Proceedings of the

4th International Cerebral Palsy Conference

Pisa, Italy, 10-13 October 2012

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Welcome to ICPC 2012

Dear Colleagues and Friends,

On behalf of the Scientific Board of the 4th International Cerebral Palsy Conference, I would like to invite you to join us at the conference, that will be hosted by the town of Pisa, Italy, on October 10-13, 2012.

The conference will be devoted to all aspects of cerebral palsy, from early diagnosis to standards of care and to new therapeutical approaches. In addition, special lectures will be dedicated to the opportunities offered by recent advances of research in Neuroscience. Contribution for understanding and treating Cerebral Palsy from animal models, genetics, stem cells, cognitive neuroscience will be discussed. The new framework provided by ICF approach, with a special attention to the quality of life, will be also taken into account.

The conference will include keynote lectures, workshops, symposia, breakfast instructional courses, oral communications and posters around the topics of the conference. Suggestions have been presented by the participants, using the format available at the conference website. The Conference will also include several spaced addressed to the parents, where the main speakers will present the main novelties of their research, with convenient time devoted to discussion. In addition to the rich programme, satellite pre and post-conference meetings will be available.

We expect hundreds of participants (medical doctors, therapists, psychologists, other professionals and students) from all over the world that will attend the conference.

Pisa, as you know, is located very close to the Tyrrhenian coast, in the middle of the beautiful Tuscany, very close to Florence, Lucca and other magnificent historic towns. The city is known for its State University, older than 600 years, and it hosts other universities and research centers with a great interest for Neuroscience. Pisa airport is one of the main Italian airports with many daily flights (often low-cost) connecting to several European and Extra-European towns. The attendants will enjoy various social events starting from the welcome ceremony and the social dinner, and the opportunity to visit the beautiful town of Pisa and its surroundings. Pre and post conference tours and short visits for the accompanying persons will be available.

The 4th International Cerebral Palsy Conference promises to be an important event from both a scientific and social perspectives. I am profoundly honoured to welcome the colleagues and the parents to ICPC Pisa 2012.

Giovanni Cioni, President, ICPC Pisa 2012 Scientific Board
The Congress Organizers gratefully acknowledge the generous support received by:

- Italian Society of Physical Medicine and Rehabilitation (SIMFER)
- International Cerebral Palsy Society (ICPS)
- Società Italiana di Neuropsichiatria dell’Infanzia e dell’Adolescenza
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- Università di Pisa
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- European Academy of Childhood Disability
- Fondazione Motrice
- Sodial
CELL-BASED THERAPY IN CEREBRAL PALSY: HYPE OR HOPE

Sayed Ali Fatemi
Kennedy Krieger Institute, Johns Hopkins University, Baltimore – USA

Advances in cell biology and cell engineering provide an opportunity for the development of novel therapeutics for neurologic disorders. Stem cell therapy for cerebral palsy (CP) has been a topic of hot debate over the last decade. Many types of stem and progenitor cells have been identified that may have a beneficial effect in neurologic diseases. These effects can be either neuroprotective in nature during the acute phase following an injury, or restorative during later disease stages. Cord blood stem cells, mesenchymal and hematopoietic stem cells are mostly thought to be neuroprotective, while neural stem cells, and glial precursor cells may have a restorative potential. The neuroprotective effect may be exerted by 1) modulation the inflammatory microenvironment following a hypoxic-ischemic or primary immune/infection mediated process, 2) release of trophic factors that will allow the activation of endogenous stem cells. The restorative approach considers remyelination or establishment of new neuronal or neuroeno-glial circuits. While many commercial full profit organizations claim to offer stem cell therapy for CP patients, there is a vast gap in knowledge in the molecular mechanisms involved, in the potential efficacy, and most importantly in the safety of these approaches. There is a great need for further preclinical research and early stage clinical safety and efficacy trials before any cell-based therapy can become a standard clinical treatment modality for CP.

CEREBRAL PALSY – IS IT IN YOUR GENES? GENETIC SUSCEPTIBILITY AND POTENTIAL TRIGGERS

Alastair MacLennan
Department of Obstetrics & Gynaecology, University of Adelaide, Adelaide, Australia

Epidemiological research suggests that less than 2% of cerebral palsy cases are solely due to acute de novo severe hypoxia in labour. In the large majority of cerebral palsy cases cerebral palsy begins in pregnancy. Research on causation is now focussing on potential genetic susceptibility to cerebral palsy and epigenetic interaction with environmental triggers.

Our initial genetic studies found several candidate genes that warranted prospective study. This study, the largest of this type, used buccal swab DNA collected from 1,741 families. The study confirmed that preterm delivery, perinatal infection and intrauterine growth restriction were major risk factors for CP. The gene-association study eliminated most of the candidate genes previously reported in other studies. Multivariate analyses suggested a genetic influence in some cases and associations with fetal (MMP-2 and TNF-α) and maternal (IL-β, TGF-β1 and TNF-α ) genes remained significant. Maternal gene-fetal gene interaction was noted for IL-10 and with maternal infection during pregnancy.

Second generation DNA sequencing technologies have accelerated genetic research. Comparative genome hybridisation arrays have discovered previously unknown, submicroscopic but genetically large structural alterations in DNA called Copy Number Variations (CNVs). Large segments of DNA may be deleted or inserted at cell division and some are pathogenic involving neurodevelopmental regions. CNVs have been associated with autism, epilepsy and intellectual disability. As cerebral palsy had not been studied for CNVs we have set up a biobank of blood-derived DNA samples from child, mother and father. In the first study of this kind, we identified in 50 families three candidate pathogenic CNVs associated with the cerebral palsy phenotype and four other cases had validated CNVs of neurological interest. In all cases the CNVs are inherited. Other factors e.g. epigenetic factors may affect penetrance through gene expression/silencing. Further studies of familial cerebral palsy are underway using exome sequencing.
NEURAL PLASTICITY AND EARLY INTERVENTION IN CP INFANTS

Andrea Guzzetta
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Mechanisms of cerebral plasticity are thought to be more powerful during development. For example, children are more fast-paced than adults in learning a new language or in achieving complex skills such as playing a musical instrument. Similarly, children lacking proper environmental inputs early in life are more prone to have abnormal development of the functions related to those inputs (the concept of critical periods).

The presence of more powerful mechanisms of neuronal plasticity during early phases of development should imply that recovery from brain damage is more effective for early lesions compared to similar lesions occurring later in life. This principle was first suggested by Paul Broca in 1865 and then more systematically explored by Margaret Kennard in the late 1930s. Since then, most of the studies carried out in different species have not denied this general principle although describing a more complex picture, which takes into consideration several other aspects beyond the timing of the insult, including the location and extent of injury (e.g., focal vs. diffuse), the clinical correlates (e.g., presence of seizures), or the genetic susceptibility of the subject.

One of the most important predictors of the efficacy of functional reorganization seems to be the distribution, diffuse versus focal, of the damage. Most strikingly, children with early unilateral left-hemisphere damage can develop normal language abilities, while lesions of similar site and extent in the adult brain would produce obvious patterns of aphasia. Even if an entire hemisphere is removed at an early stage of development (for instance, for the treatment of severe epilepsy), children can develop normal language and cognitive function. Also, children with unilateral ischemic stroke are able to develop normal cognitive functions and maintain them over time. In contrast, evidence suggests that sustaining an early generalized cerebral insult (e.g., global hypoxia or traumatic brain injury) is usually associated with slower recovery and poorer outcome, compared to what is observed in adults with similar lesions.

The time boundaries of early brain damage have never been clearly defined. This is probably due not to the absence of effort but rather to the complexity of the task. Changes in cerebral plasticity, which influences the effects of brain damage, are gradual during development, and the sensitive periods are now known to be different for the various functional subsystems. Also, the types of brain insult are extremely variable during development and affect the nervous system in ways that are directly dependent on the level of maturation at the moment they occur. For these and other reasons, the boundaries between early and late lesions are necessarily blurry.

In this presentation, I will focus on our personal experience and literature review about brain plasticity following lesions occurring before or around birth, which are more frequent and have been more extensively studied compared to later ones.
Brain plasticity as the capacity of neurons and of neural circuits in the brain to change, structurally and functionally, in response to experience. This property is fundamental for the adaptability of our behaviour, for learning and memory processes, brain development and brain repair. Experience is translated in patterns of electrical activity within neural circuits and it is the pattern of electrical activity which drives the different forms of functional and structural plasticity, through the spatially and temporally coordinated action of specific cellular and molecular factors.

During development genes and environment cooperate in building the brain, with experience guiding the final maturation of neural circuit and neural functions. Experience can shape neural circuit development because developing neural circuits are highly sensitive to experience, they exhibit high neural plasticity, particularly during “sensitive” or critical periods of early development. The developmental time course of critical period plasticity is tightly controlled by cellular and molecular factors and in particular by development of intracortical inhibition; these factors, which are likely to limit adult cortical plasticity, have attracted much interest as possible targets of interventions aimed at enhancing adult cortical plasticity and promoting brain repair.

Environmental enrichment (EE) has long been exploited to investigate the influence of the environment on brain structure and function and, more recently, plasticity. EE has been shown to accelerate the development of the visual system and to enhance visual-cortex plasticity in adulthood, promoting recovery from amblyopia. EE effects on visual system development and plasticity are mediated by endogenous molecular factors involved in visual cortical development and plasticity, and by an action on intracortical inhibition. These new findings highlight the potential of EE as a non-invasive intervention strategy to ameliorate deficits in the maturation of the nervous system and to promote recovery of normal sensory functions in pathological conditions affecting the adult brain.

WHAT KNOWN ABOUT EARLY DEVELOPMENT OF HAND FUNCTION IN CHILDREN WITH UNILATERAL CP

Brain lesion at early age leads to various degrees of functional limitation. For children with unilateral brain lesion leading to unilateral cerebral palsy (CP), decreased hand function is a major limitation. It is of major interest to understand early signs of asymmetric hand function that will lead to unilateral CP. It is also of interest to investigate the relation between, neuroradiological findings and functional outcome to be able to predict the future development of disability at early age. Likewise is the responsiveness to treatment at different age of interest and its influence on development. The aim of this talk is to present knowledge gained from intervention studies, development of hand function and neuroradiological findings. Preliminary results will be presented from a study of children below 12 month of age investigated by a new instrument Hand Assessment for Infants (HAI). The development of hand function for children, using Assisting Hand Assessment, and it relation to neurological finding will be presented. Likewise the long term impact of early intensive intervention will be reported.
EPILEPSY AND CP

Renzo Guerrini
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Epilepsy is common in children with cerebral palsy (CP) and it is estimated to affect between 15 and 60% of patients with CP (Wallace 2001), with different rates according to the type of CP. All types of seizures may occur in patients with CP. Focal motor attacks are most common in children with hemiplegia (73%) and generalized motor seizures predominate in dystonic or quadriplegic CP which represent 75% of seizure types. Children with CP are at risk of exhibiting a number of motor manifestations that are misdiagnosed as epilepsy and it is an important cause of pseudo-refractory epilepsy (Metrick et al 1991). The onset of epilepsy is usually early and the course of epilepsy in these patients is variable. Delgado et al (1996) found that only 69 of 531 patients (12.9%) with both CP and epilepsy achieved a remission of 2 years or more. In other series, a higher remission rate of 30 to 40% was observed but was sometimes only reached after many years. However, relatively benign epilepsies can be seen in children with CP, especially with hemiparesis. Some studies seem to indicate that epilepsy associated with CP considerably aggravates the total disability of patients (Vargha-Khadem et al 1992). In patients with hemiplegic cerebral palsy, the presence of epilepsy is clearly associated with more severe and increasing cognitive difficulties. In addition, behavioural problems that are common in children with CP are even more frequent if epilepsy is also present. However, epilepsy associated with cerebral palsy is not always refractory to drug treatment. Seizure control without side effects using possibly one drug in the most convenient and least expensive manner, is a reasonable target in most children with cerebral palsy. Surgical treatment of epilepsy is only indicated in a very small minority of well selected cases.

References

ORTHOPAEDIC COMPLICATIONS IN CP: ARE THEY PREVENTABLE?

Gunnar Hägglund
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During the last decades, orthopaedic surgery for ambulant children with cerebral palsy (CP), developed from repeated minor operations (“birthday-surgery”) to single event multilevel surgery where all operations to improve gait were performed at one setting at the age of 8 - 12 years. For children with lower levels of functioning the major improvements were the development of surgery for scoliosis and the recognition that hip dislocation should be prevented.

A muscle contracture may cause contractures of adjacent joints and progressive skeletal deformities if left untreated. Operative lengthening of a muscle often cause it to loose some of its strength. Most children with CP have a muscle weakness which becomes more evident as they grow older, taller and heavier. It is therefore preferable if muscle contractures can be prevented or treated non-operatively. A follow-up programme for CP, called CPUP, was initiated in Sweden in 1994. The goal was to prevent incipient contractures or hip dislocations through early detection with regular standardised monitoring and preventive treatment. In CPUP all children are assessed 1-2 times yearly. The examination includes goniometric measurement of all joints and a spinal examination. The hips are followed radiographically.
With CPUP the number of children with hip dislocation has decreased from 10% to 0.3%. The number of children with scoliosis requiring surgery and the number of children with severe contractures have also decreased. Meanwhile, the number of operations for contracture have been reduced. When a contracture starts to develop intensified non-operative treatment with proper positioning, orthoses, serial casting and/or strength exercise is undertaken.

With CPUP we have evolved from reactive orthopaedics where we treated the complications of the musculoskeletal system to preventive orthopaedics where we prevent the development of severe contractures and hip dislocations.

**SCIENCE VERSUS TECHNOLOGY IN PEDIATRIC LOCOMOTOR REHABILITATION**

**Diane Damiano**

National Institutes of Health, Bethesda, Maryland

This talk will discuss the principles underlying successful training of motor coordination in individuals with brain injuries including those with cerebral palsy. Active movement drives the process, but it must be the right type of movement in the right amount and it must be meaningful to the individual. One of the major challenges in cerebral palsy is that these individuals may be incapable of performing a movement better than they are already doing it and therefore may not be able to achieve any benefit from repeated practice. An increasing number of external devices are being developed for both upper and lower limb rehabilitation with the purpose of assisting existing movement capabilities so patients can perform the task more effectively or in some cases bypassing the abnormal control to provide motion. This talk will briefly review the effectiveness of more commonly used devices to promote lower extremity coordination in cerebral palsy and provide some novel examples of strategies we have utilized to improve intralimb and interlimb coordination in cerebral palsy. These include the use of functional electrical stimulation, elliptical training, and wearable exoskeletons all aimed to improve gait either when worn, after being worn, or both. While devices hold much promise for enhancing rehabilitation outcomes, these may alternatively limit or in some cases worsen voluntary control if allowed to provide too much assistance. Optimal strategies must challenge the individual to make incremental improvements in the target functional motor skill, while maintaining or enhancing other related capabilities (e.g. postural control and strength).
BRAIN FITNESS: TAILORING REHABILITATION FOR CHILDREN WITH CEREBRAL PALSY

Roslyn Boyd
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Neurorehabilitation needs to take account of not only physical fitness to maintain health but also brain fitness. Skilled performance requires intensive, effortful learning that requires our close attention on a daily basis. Professional musicians sustain high abilities until the end of life if they practice daily using an intensive and closely attentive learning strategy. Children with early brain injury need a white matter workout!

Evidence from randomised trials and a meta-analysis of all upper limb interventions suggests the: (i) Critical dose: 60 hours block mCIMT is sufficient to drive neuroplasticity; (ii) Optimal dose: 60 hours is enough, 120 hours is too much and 30 hours may not be enough; (iii) Specificity of training: mCIMT enhances unimanual capacity and BIMAN improves bimanual co-ordination; (iii) either model can retain improvements for up to 12 months and can (iv) translate into improvements in participation and quality of life. Questions remain regarding the density of training (group versus individual coaching) and translation of these intensive models into clinical practice.

Our recent study of executive function (attentional control; cognitive flexibility; goal setting; and information processing) in congenital hemiplegia highlighted global deficits compared to age and gender matched TDC. This highlights the need for multimodal training that combines skill training (manipulation, visuospatial, physical co-ordination with cognitive challenge). Web based rehabilitation such as Miiti® (Move it to improve it) offer intensive multimodal training with incremental challenge to remote and isolated children.

Comparison of brain structure and function provide important prognostic information for tailoring the type of rehabilitation based on the brain injury. Recent data on structural connectivity has further described the disruption of primary sensorimotor pathways and the relationship to hand function in cerebral palsy with important implications for neurorehabilitation. The “white matter workout” could be tailored to nature of the brain injury.

Acknowledgements: National Health and Medical Research Council of Australia (368300; 1003887), Career Development Fellowship and Smart State Fellowship.

References:
10) Bodimeade, H et al. 2012 Executive function in Congenital Hemiplegia. Int CP conf, Pisa

MOTOR LEARNING AND PLANNING: IMPLICATIONS FOR TREATMENT

Andrew M. Gordon
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Cerebral Palsy (CP) is a development disorder of movement and posture causing limitations in activity and deficits in motor skill as a result of non-progressive disturbances in the developing fetal or infant brain. The integrity of the motor cortex and corticospinal tract (CST) underlying dexterity is often compromised, with an aberrant organization of the motor system and the damaged side failing to establish normal connections. These abnormalities in the connectivity of the motor system result in impaired motor execution/control. The impaired motor execution...
is among the most obvious limitations in performance, and has been the focus of most rehabilitation efforts. Although less apparent, children with CP have impaired higher-level planning and motor learning deficits which can greatly impact performance. Motor learning has been shown to occur, but is considerably slower and may differ compared to typically developing children in regards to the type of practice as well as the amount and type of feedback required. Understanding these under-appreciated differences in motor planning and motor learning is essential for optimization of intensive rehabilitation approaches that rely on repeated practice of motor skills such as constraint-induced movement therapy and intensive bimanual therapy. Here the deficits in motor planning and motor learning are described, along with the implications for such rehabilitation efforts.

PERCEPTUAL AND SPATIAL MEMORY DISORDERS IN CP

Alain Berthoz
Laboratory of Physiology of Perception and Action, Collège de France – CNRS, Paris – France

Recent discoveries concerning the brain mechanisms of posture and movement control may have interesting consequences concerning the understanding and remediation of perceptual visuo-spatial, cognitive and motor deficits in children development. In this presentation I will review a number of findings around three topics.

Firstly, the top down control of locomotion and in particular the important progressive role of gaze during ontogeny in the cognitive mechanisms for the generation of locomotor trajectories. The fact that locomotion is guided by gaze has consequences for the methods of remediation and rehabilitation. In addition I will show that similar simplex principles underly the generation of hand and locomotor trajectories. Second, I shall describe new knowledge concerning the development of brain mechanisms underlying the perception of space and the cognitive strategies for navigation. I will suggest that a trans-nosographic trait across several pathologies in children (autism, schizophrenia, agoraphobia etc.) is a deficit of the capacity to manipulate spatial reference frames and perspective changes. I will describe several experimental paradigms which may be useful for the study of the development of visuo-spatial memory. A new paradigm for “the Walking will show recent results using the “magic carpet” (a walking version of the table Corsi spatial memory test) and using also a paradigm for studying executive functions: the “stroop walking test”). Thirdly, I will describe some recent work on a ventricleal origin of some scoliosis which is an example of the fundamental role of cognitive processes in motor deficits.

QUALITY OF LIFE AND PARTICIPATION OF PERSONS WITH CEREBRAL PALSY

Allan Colver
Institute of Health and Society, Newcastle University, Newcastle upon Tyne, UK

The SPARCLE project explored the participation and quality of life (subjective wellbeing) of 800 children with cerebral palsy aged 8-12 years across nine European Regions. Then the young people were visited again aged 13-17 years. Children with cerebral palsy were chosen as exemplars of disabled children because they have a range of impairments of movement, hearing and vision, intelligence and language, which have a range of severities. SPARCLE is an epidemiological study with pre-specified hypotheses, outcome measures and sampling procedures set out in published protocols.

My talk will introduce the main concepts used which concern the social model of disability and domains of the International Classification of Functioning, Disability and Health. I shall present some further results from those visits and then discuss longitudinal findings by linking results from the visits to the 8-12 year olds to results from the visits to the 13-17 year olds.

Summary of results of visits to 8-12 year olds:
- Children with cerebral palsy experience much pain
- Children with cerebral palsy are more likely to have emotional and behavioural difficulties than children in the general population
- Parents of children with cerebral palsy are more likely to experience significant stress than parents of children in the general population
- Children with cerebral palsy who can self report have the same quality of life as other children of their age in the general population
- A parent is likely to overestimate the quality of life of their child if the child experiences much pain; and underestimate it if the parent experiences much stress
- Children with cerebral palsy take part in fewer activities than other children of their age
- Some European countries provide environments which enable children with cerebral palsy to participate much more in life than children in other countries

GROWTH, NUTRITION, PHYSICAL DEVELOPMENT AND HEALTH IN CHILDREN AND YOUTH WITH CEREBRAL PALSY

Richard D. Stevenson
Department of Pediatrics, University of Virginia, USA

Children with cerebral palsy grow differently than the general population and the fundamental question is whether it matters. Growth in typical children is well described. Traditionally, children with cerebral palsy are measured in the same way as all children and compared to reference growth charts, usually developed from a population of typical children. Children with cerebral palsy often present a worrisome picture on these reference growth charts. The appropriate interpretation of this important growth data and subsequent clinical decision-making is unclear and often based on clinical experience. Limited scientific evidence exists to guide clinical decision-making. So what is a clinician to do? Dr. Stevenson’s address will review methods for assessment of growth and nutritional status, use of reference growth data, and the interpretation of clinical data. He will emphasize the relationship between growth, nutrition, physical development and health and function. In sum, Dr. Stevenson will review the current state of the science, discuss directions for further research, and suggest a contemporary state of the art.
The goal of health, social and education services for children and youth with cerebral palsy is to support their optimal development and facilitate participation in daily life. With this vision, we have a responsibility to work in partnership with families to ensure this commitment. Over the past two decades, we have gained substantive knowledge about how family-centred services can be support children and families as well as lead to improved satisfaction, adherence to therapy recommendations and decreased family stress (Rosenbaum, King, Law, King, & Evans, 1998; King, King, Rosenbaum, & Goffin, 1997; Law et al., 2003).

In this talk, we will examine how the nature of services to children with cerebral palsy and the parent-service provider relationship have changed. The use of this knowledge to develop fruitful partnerships with families is complex and does not happen automatically. Given this complexity, we must guard against a focus on service provision that applies universally and does not take into account culture, context and needs. We will explore the core concepts of family-centred service, its supports and its challenges. Family-centred service approaches recognize that the family is the constant in a child’s life. A fundamental principle is the need to identify the family as the unit of interest, and to direct considerations regarding service organization and delivery to the family as a whole. Family functioning is a fundamental environmental factor that influences child health and functioning. While awareness and knowledge of family centered service by practitioners has increased, these factors are not enough to change behaviours. Using a strengths-based model, we will examine current evidence regarding how we can support families and facilitate true partnerships in the care of their children.
ADVANCES IN ROBOTICS FOR REHABILITATION
Paolo Dario
The BioRobotics Institute, Scuola Superiore Sant'Anna

During the last decades, the effectiveness of Robotics as a tool for neuroscientific investigation has been demonstrated in many experiments, thus contributing to increase the knowledge of biological systems and, in particular, of human neuromotor performance. On the other hand, based on recent neuroscientific discoveries – particularly the mechanisms of neurogenesis and cerebral plasticity underlying motor learning and functional recovery after cerebral injury – robotic technologies are emerging as effective tools for neurorehabilitation treatments, both in children and in adults.

As a consequence, robots are increasingly used in neuroscientific research and in neurorehabilitation. In this presentation, a variety of different robotic systems will be presented and discussed according to the neuroscientific model or hypothesis that is considered, the mechatronic configuration adopted, the experiments performed in laboratory and in clinical sites, and the results obtained so far in model validation and therapy.

In particular, the cases of (i) multi/fingered robotic prostheses, (ii) mechatronic platforms for functional assessment and fall detection, (iii) end-effector robotic systems for upper and lower limbs rehabilitation, (iv) wearable robotic systems for assisted locomotion and (v) mechatronic toys for early diagnosis and therapy of children will be presented with the aim of discussing the feasibility and effectiveness of the methodological approach, and of encouraging further applications and collaboration between neuroscientists, clinical experts and researchers in biorobotics.

References
[1] Cipriani et al., Journal of Neuroengineering And Rehabilitation 2011;
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BLINDSIGHT IN CHILDREN WITH CONGENITAL AND ACQUIRED CEREBRAL LESIONS
Maria Concetta Morrone
Department of Physiology, University of Pisa, Italy

Although the primary visual cortex (V1) is a fundamental stage for visual information processing, subjects with lesions of primary visual cortex often have substantially spared visual function associated with a lack of consciousness, a condition termed blindsight (Weiskrantz et al. 1974). Although many functional aspects of blindsight have been extensively studied, the neural correlates underlying this phenomenon are as yet poorly understood and little it is known about the functional and underlying neuronal repercussions of early cortical damage in humans. We measured sensitivity to several visual tasks in children with congenital unilateral brain lesions that severely affected optic radiations, and in another group of children with similar lesions, acquired in childhood. Results show clear evidence of residual unconscious processing of position, orientation and motion of visual stimuli displayed in the scotoma of congenital lesioned children, but not in the children with acquired lesions. The blindsight is associated with a profound neuronal reorganization of the calcarine cortical BOLD responses: in children with congenital lesions the visual cortex of the spared hemisphere represents both the contra-lateral and the ipsilateral visual field. This massive reorganization of the visual system allows functional recover and the good locomotion abilities observed in these children.
About 10% of children older than 5 years in the community can present a mental disorder. Childhood chronic disorders, such as diabetes or asthma, can significantly increase the risk of mental disorders, with the emotional adjustment affected by severity of the condition and the degree of functional limitation. Children with diseases involving Central Nervous System present the highest psychopathological risk. When matched with disabled children with other disorders (i.e., musculo-skeletal), children with cerebral pathologies presented a two-fold rate of psychiatric disorders, even when IQ, social context and physical disability were controlled for. The notion that chronic cerebral disorders strongly increase the risk of psychiatric disorders in pediatric populations is supported by a classical, rigorous epidemiologic study, the Isle of Wight study (Rutter et al., 1970). Psychiatric disorders were found in 44% of children with structural brain lesions, compared with 12% in children with non-cerebral physical disorders and 7% in children without physical disorders. Clinical experience suggests that psychiatric comorbidities are usually unrecognized or untreated. The most severe difficulties are in peer relationships, which may have an impact on later social adjustment. Other co-occurring symptoms, which reduce self-control, such as drooling, urinary incontinence may increase social isolation. Particular attention should be paid to a correct management of physical pain. Anxiety disorders, such as separation anxiety, may be increased by both motor limitations and parental overprotection. Inadequate and excessive limitation in daily life may increase the risk of oppositional-defiant behaviors. Higher functioning individuals are at risk for depression, as their inability to carry out tasks and their movement disorder increase frustration, and the sense of being different from peers, which may become more severe with age. A still unmet need is to plan neuropsychiatric services with integrated diagnostic, preventive and treatment programs for both neurological and psychiatric disorders.
WORKSHOPS AND SYMPOSIA

WEDNESDAY, 10\textsuperscript{TH} OCTOBER, 2012

15.55 - 16.55 PARALLEL SESSION 1

WORKSHOP 1

METHODICAL STEPS IN TASK ORIENTED THERAPY FOR CHILDREN WITH CEREBRAL PALSY

Rameckers E.A.A.\textsuperscript{1}, Van Den Dikkenberg N.\textsuperscript{2}

\textsuperscript{1}University of Maastricht, Adelante Rehabilitation Centre, The Netherlands. Avansplus, University for professionals, Breda, The Netherlands
\textsuperscript{2}Amsterdam Rehabilitation Research Center | Reade, The Netherlands.

Aim:
Participants are familiar with the methodology of constructing an intervention based on the principles of task oriented therapy.

Content 1:
Task oriented therapy in children with Cerebral Palsy (CP) is based on the idea that behaviour arises from the dynamic interaction between Task, Child and Environment. Motor behaviour is analysed in this perspective and treatment is focused on the most problematic and essential part of the task performed by a specific child and in a specific environment. Defining the needs of the child, formulating the goals, performing the task-analysis and defining the specific goals for the child are the frame for an individualized task oriented approach, in which the task and/or the environment can be adapted. In task oriented therapy the principles of motor learning and training are used and these principles are translated into methodical therapy steps. These methodical therapy steps can be divided into 3 categories, namely Loading (based on training principles), Changing (of the task and/or environment) and Connecting (combining tasks) (LCC). The task oriented approach based on the needs and the goals of the child, the task analysis and the methodical steps will guide the therapy to elicit the optimal motor behaviour of a specific task in a specific environment.

Purpose:
The first goal is to share experiences of professionals with the focus on the treatment principles. The main part of the workshop focuses on the specific methodical steps (LCC) during the therapy.

Content 2:

Van Vulpen L.F.
Amsterdam Rehabilitation Research Centre | Reade, The Netherlands.
Reade, Centre for Rehabilitation and Rheumatology, Amsterdam, The Netherlands.

In task oriented therapy the principles of motor learning and training are used and these principles are translated into methodical therapy steps. In the second session the focus will be on the category Loading (based on training principles). Based on a case study the Loading will be explained and tools for the task analysis and therapy steps will be discussed in this part of the workshop. The task oriented approach based on the needs and the goals of the child, the task analysis and the methodical steps will guide the therapy to elicit the optimal motor behaviour of a specific task in a specific environment.
Purpose:
The second goal is to share experiences of professionals with the focus on the Loading during task oriented therapy.

Content 3:

Snijders B., Scheijmans C.
Rehabilitation Centre, Revant, Breda, The Netherlands.
Rehabilitation Centre, Blixembosch, The Netherlands.

In task oriented therapy the principles of motor learning and training are used and these principles are translated into methodical therapy steps.
In the third session the focus will be on the category Changing (of the task and/or environment).
Based on a case study the Changing of task and environment will be presented and discussed and tools for the task analysis and therapy steps will be discussed in this part of the workshop.
Purpose:
The third goal is to share experiences of professionals with the focus on the Changing of task and/or environment during task oriented therapy.

Content 4

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In task oriented therapy the principles of motor learning and training are used and these principles are translated into methodical therapy steps.
In the third session the focus will be on the category Connecting (combining Tasks).
These most complex step will be demonstrated an discussed using a case study.
The tools for the task analysis and therapy steps will be discussed in this part of the workshop.
The task oriented approach based on the needs and the goals of the child, the task analysis and the methodical steps will guide the therapy to elicit the optimal motor behaviour of a specific task in a specific environment.
Purpose:
The fifth goal is to share experiences of professionals with the focus on the Connecting of tasks as an very important step for automisation of a task.
EVIDENCE BASED REHABILITATION: USE OF EFFECTIVE KNOWLEDGE TRANSLATION STRATEGIES TO ENHANCE EVIDENCE

Novak I., Morgan C.
Cerebral Palsy Alliance Research Institute

Aim:
The workshop aims are to: (1) Outline the knowledge translation evidence base via a systematic review; (2) Present randomised controlled trial findings of a novel knowledge translation program designed to enhance professionals use of cerebral palsy evidence. (3) Provide delegates with opportunities to identify barriers to evidence use in their own workplace and determine strategies for promoting change.

OUTLINE THE KNOWLEDGE TRANSLATION EVIDENCE BASE VIA A SYSTEMATIC REVIEW

Novak I.
Cerebral Palsy Alliance. Contribution: Chairing; Present Systematic Review and Randomised Controlled Trial findings (aim 1-2).

Implementation of research evidence into clinical practice can take as long as 10-20 years. The cerebral palsy evidence base is rapidly advancing due to an exponential increase in published evidence about effective interventions, outcome measures, classification tools and the natural history of the condition. Now more than ever, is there a need for managers, senior clinicians and researchers to know how to bridge the research to practice gap using effective knowledge translation strategies. The objectives of this workshop are to: (a) Outline the current knowledge translation evidence base for bridging the gap between what is known and what is done by providing a summary of the knowledge translation literature via a systematic review. Knowledge translation and client-centered evidence, and will be presented using a combination of learning formats including videos, case studies and clinical decision-making algorithms; (b) Present the outcomes of implementation including data collected in a randomised controlled trial by Lanie Campbell, evaluating the effectiveness of the knowledge translation strategy to change practitioner behaviour. Large improvements in professionals EBP behaviour were observed when compared to the controlled-comparison group (Effect size 6.92 [95%CI 1.80-12.05], p=0.009); and

PRESENT RANDOMISED CONTROLLED TRIAL FINDINGS OF A NOVEL KNOWLEDGE TRANSLATION PROGRAM DESIGNED TO ENHANCE PROFESSIONAL USE OF CEREBRAL PALSY EVIDENCE

Novak I.
Cerebral Palsy Alliance

Contribution: Coordinate small group interactive workshop activities (aim 3).

ABSTRACT: (c) Describe a unique service provision model devised and implemented at Cerebral Palsy Alliance based on knowledge translation evidence and informed by Grahams knowledge to action framework. The model draws upon the latest knowledge
PROVIDE DELEGATES WITH OPPORTUNITIES TO REFLECT ON THEIR OWN SERVICE PROVISION MODELS, IDENTIFY BARRIERS TO EVIDENCE USE AND DETERMINE FACILITATORS FOR PROMOTING CHANGE

Morgan C.
Cerebral Palsy Alliance

Author Contribution: (4) To provide delegates with opportunities to reflect on their own service provision models, identify barriers to evidence use and determine facilitators for promoting change. Small-group interactive activities will be used to facilitate identification of barriers to evidence uptake within participants service delivery models and promote exploration of facilitators for fostering evidence use.

WORKSHOP 3

THE F-WORDS IN CHILDHOOD DISABILITY: WHY IS IT SO HARD TO DO IN THE REAL WORLD?

Camden C., Rosenbaum P.
CanChild Centre for Childhood Disability Research, McMaster University, Hamilton, Canada

Aim:
(i) To present the background, parental perspectives and service delivery implications of the “F-words” (function, family, fitness, fun, friends, future); (ii) To identify suggestions for further implementing the “F-words” in the services we delivered to children with CP.

BACKGROUND AND RATIONALE FOR USING THE "F-WORDS" IN THE SERVICES WE DELIVER TO CHILDREN WITH CP AND THEIR FAMILIES.

Gorter J.W
CanChild Centre for Childhood Disability Research, McMaster University, Hamilton, Canada.

Contribution.
In the field of childhood disability traditional biomedical concepts are being incorporated into - but expanded considerably by - new ways of formulating ideas about children, child development, social-ecological forces in the lives of children with chronic conditions and their families, and ‘points of entry’ for professionals to be helpful. In this contribution I will present a set of ideas, grounded in the World Health Organization’s International Classification of Functioning, Disability and Health (the ICF), into a series of what we have called ‘F-words’ in child neurodisability - function, family, fitness, fun, friends and future. It is hoped this will be an appealing way for people to incorporate these concepts into every aspect of clinical service, research and advocacy regarding disabled children and their families. For each "F-word", the underlying scientific background and rationale will be presented, and examples will be given to illustrate how it applies to children with cerebral palsy.
PARENTAL PERSPECTIVES ON THE "F-WORDS"

Kay D.
mother of a seven years old boy with cerebral palsy, Wigan, United Kingdom.

Family-centred care is recognised as the best approach in paediatric rehabilitation. Service providers should work with families to help them make informed decisions about the services and supports children with cerebral palsy and families receive. For this reason, it is important to know parents' opinions about the "F words". In this contribution, I will present my son and briefly describe the services he has received. I will share with the workshop participants my general thoughts, as well as those of other parents with children with cerebral palsy, about the "F-words". Moreover, for each word, I will give examples of services that have been offered to my son and my family, and of services that I would have liked to have received. I will provide some suggestions to foster the implementation of the "F-words" and overcome potential barriers, such as what appear to be outdated professional beliefs and limited resources. I will conclude by discussing how to involve parents to transform and improve services delivered to children with cerebral palsy.

PUTTING "F-WORDS" INTO PRACTICE

Kolehmainen N.
Health Services Research Unit, University of Aberdeen, United Kingdom, and CanChild Centre for Childhood Disability Research, McMaster University.

Service providers - e.g. occupational therapists and physiotherapists - acknowledge the importance of the "F-words" and family-centred practice. Yet it is widely documented that they find it very difficult to put "F-words" into practice. Since 2005, we have worked with therapists and parents to systematically develop an implementation strategy to support therapists to put "F-words" into practice. To date, we have done so by using the latest evidence and theory; and have shown that the strategy is feasible to deliver in a range of contexts and has potential to change practice. In this contribution I will: (1) describe the evidence about the main problems underpinning therapists' difficulties in putting "F-words" into practice; (2) describe the ways in which the strategy addresses these difficulties; and (3) propose for discussion some key open questions that remain.

SERVICE DELIVERY IMPLICATIONS OF THE "F-WORDS" AND WHY IS IT SO HARD TO DO IN THE REAL WORLD.

Camden C.
CanChild, McMaster University, Hamilton, Canada.

Based on previous contributions, clinical experiences and literature review, a gap appears to exist between the ideal service organization, grounded in the "F-words", and the current service delivery models for children with cerebral palsy. One of the possible reasons for this gap is that "F-words" expand our conception of rehabilitation services beyond interventions aimed at 'fixing' to include opportunities for participation in a broad range of activities (e.g. community-based group leisure activities to improve fitness and peer-interactions). These 'extras' often seem to come on top of traditional, hands-on interventions aiming at improving a child's function, with no extra resources provided. In this contribution, I will discuss financial- and organizational-related factors, as well as other factors that influence our ability to implement optimal service delivery models for children with cerebral palsy. Workshop participants' contributions will be fostered to identify suggestions for further implementing the "F-words" in the services we delivered to children with cerebral palsy. Among other ideas, we will discuss how to support rehabilitation programs taking decisions concerning resource allocation and the offer of services. We will also discuss: (i) the development of an offer of services where for each rehabilitation goal the most efficient service delivery method is selected; (ii) the identification of families' goals and the negotiation of priorities for services with them; (iii) the need for teaming with community partners; and (iv) researchers' role and the need to adapt knowledge transfer activities to foster optimal delivery of services for children with cerebral palsy.
MOLECULAR MECHANISMS OF MOTOR SKILL LEARNING

Forssberg H.
Neuropaediatrics & Stockholm Brain Institute, Karolinska Institutet, Stockholm, Sweden

During the last decades there has been a growing interest in exploring the activity-dependent plasticity of the brain in order to develop new intervention programmes for children with motor and cognitive disorders, e.g., constrained induced therapy for children with unilateral cerebral palsy or working memory training for children with attention deficits. Neuroimaging studies in humans have demonstrated both training associated alterations in brain activity (fMRI) and changes in dopamine D1 receptors (D1R; using PET). However, to understand the molecular mechanisms underlying learning induced plasticity, there is a need to study animal models.

In this lecture I will summarize recent findings on motor learning induced plasticity. The motor system involves circuits in the frontal-striatal-cerebellar network and differs thus distinctly from the well-studied memory systems in the hippocampus and related nuclei. Studies in rodents have demonstrated that training in a forelimb skilled reaching task leads to rapid turnover and selective stabilization of "spines" on the dendrites of efferent pyramidal neurons in motor cortex. The dopamine system innervating the motor cortex seems to be necessary for learning fine motor skills, e.g., shown by elimination of dopaminergic terminals, application of D1R and D2R antagonists in motor cortex, and in animal models with genetic variations in the dopamine system. A better understanding of the mechanisms underlying motor learning may help us to develop cognitive (motor) enhancing drugs that can be used in combination with training.

ANIMAL MODELS FOR ASPHYXIA AND NEUROPROTECTION

Elisa Landucci¹, Luca Filippi², Renzo Guerrini² & Domenico E. Pellegrini-Giampietro¹
¹Department of Preclinical and Clinical Pharmacology, University of Florence and ²Neonatal Intensive Care Unit, “A. Meyer” University Children’s Hospital, Florence, Italy

Models of neuroprotection used in our laboratory include the use of rats exposed to transient or permanent middle cerebral artery occlusion, gerbils exposed to common carotid artery occlusion for 5 min and, as a model of hypoxic-ischemic encephalopathy (HIE), rat pups (7 days) subjected to permanent left common carotid artery occlusion followed by 120 min of hypoxia. We have also developed in vitro models, such as primary cultures of rat mixed cortical cells or cultured rat organotypic hippocampal slices exposed to a variety of insults ranging from excitotoxins to oxygen and glucose deprivation (OGD). We have recently used these models to assess the neuroprotective efficacy of hypothermia combined with memantine, a putative ideal non-competitive NMDA receptor blocker, and with topiramate, an inhibitor of glutamate receptors (including kainate and AMPA). For the in vitro experiments, we used rat organotypic hippocampal slices exposed to OGD or to kainic acid. When present in the incubation medium, memantine (1-100 µM) and topiramate (0.1-10 µM) significantly attenuated CA1 damage induced by 30 min OGD. Our results show an additive neuroprotective effect of memantine and topiramate in association with hypothermia (32 or 35 °C). Hypothermia (32°C), but not memantine or topiramate alone or in combination, also attenuated the CA3 injury induced by kainate (5 µM for 24 h) in hippocampal slices. For the in vivo
experiments, we used our model of HIE. Seventy-two hours after exposure to hypoxia, we observed a
diffuse left brain injury and TTC-stained sections were obtained from HIE induction to asses brain infarcts.
In this model memantine, topiramate, hypothermia alone resulted neuroprotective and we observed a
reduction of extent of infarct volume following HIE. This preliminary finding supports the idea that
topiramate, memantite and hypothermia alone or in combination may become a potential therapeutic
intervention in HIE treatment.

A RAT MODEL OF PERINATAL STROKE AND HEMIPLEGIA

M.Gennaro 1, L. Gherardini 2, N. Berardi 3, G. Cioni 1 and T.Pizzorusso 1
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4) PhD Course of Basic and Developmental Neuroscience, University of Pisa.

Unilateral brain injury occurring during this time may interfere with the innate development of architecture,
connectivity and mapping of functions and trigger modifications in structure and wiring that may impinge
on quality of life in relation to transition to adulthood. The primary aim of this work was to evaluate the effects of the focal lesion on the functional outcome of the contralesional forelimb 7 days after surgery and into adulthood. Further, we investigated the beneficial effect of s both an early behavioural treatment (“Staircase” task) and a pharmacological treatment with the neuro-protective and pro-plastic molecule, the 7,8 dihydroxyflavone, a specific Tyrosine kinase receptor (TrkB) agonist, on the acute and long lasting motor outcome in treated versus control animals.

We used a new model of early focal ischemic stroke in rat, obtained using unilateral focal microinjections of
vasoconstrictor Endothelin-1 in the zone of the forelimb motor cortex, performed during axonal pruning and
remodelling at postnatal age 21. Acute and long lasting behavioural changes were evaluated using a battery
of motor tests. Behavioural treatment by staircase was administered one week after lesion and the beneficial effects were measured in young and adult rats. To test the effect of the BDNF receptor agonist, rats at P21 received 5mg/Kg of 7,8-dihydroxyflavone daily for one week, starting the day after ischemic injury, assessing the reaching behaviour at the end of the pharmacological treatment.

We found that, in juvenile rats, the focal lesion selectively elicits a mild motor impairment in the forelimb
contralateral to the lesion, still evident at adult age (P60). Moreover the early lesion could interfere with the normal development of motor behaviour of the healthy limb, reverberating on adult motor behaviour. We found that early post lesion behavioural training with the staircase improves motor function in young and old animals. Moreover, administration of BDNF receptor agonist, which might mediate neuronal survival, differentiation, synaptic plasticity, and neurogenesis, improve functional outcome in young animals that also possibly correlated to improved learning abilities.

SYMPOSIUM 2

PARTICIPATION BASED PHYSICAL AND OCCUPATIONAL THERAPY FOR
CHILDREN WITH PHYSICAL DISABILITIES

Palisano R.1, Chiarello L. 1, Novak I. 2
1Drexel University, Philadelphia, PA, USA
2Cerebral Palsy Alliance, Sydney, Australia

Aim:
1) Present a framework for optimal participation of children with physical disabilities, 2) Propose and appraise a model for physical therapy and occupational therapy intervention, and 3) Engage participants in discussion of application to practice through a case study.

OPTIMAL PARTICIPATION OF CHILDREN WITH PHYSICAL DISABILITIES

**Palisano R.**
Drexel University, Philadelphia, PA, USA

Optimizing home and community participation of children with physical disabilities is critical to their full participation as adults in social roles, post-secondary education, employment, and independent living. Children with physical disabilities participate in fewer leisure activities that occur more at home, spend more time on quiet activities, and are involved in fewer social and physical activities compared with children without disabilities. Participation is defined in the International Classification of Functioning, Disability, and Health (WHO, 2002) as involvement in life situations. Although the definition is simple, participation is complex, multi-dimensional, and personally determined.

Optimal participation refers to the meaning that is associated with and derived from physical, social, and self-engagement in activities and life situations. We have conceptualized optimal participation of children with physical disabilities as a dynamic interaction of determinants (attributes of the child, family and environment) and dimensions (physical, social and self engagement) of participation. Determinants encompass attributes of the child, family, and environment that are directly related to the goal for participation. This includes strengths and what needs to occur to achieve the goal. Within the context of a specific activity physical engagement is the child’s involvement in the activity - what the child is actually doing. Social engagement encompasses interpersonal interactions that occur during the activity, and self-engagement refers to the child’s enjoyment in the moment and self-understanding such as learning new things and developing self-determination.

We propose that participation emerges from child and family interests and priorities, and it is optimized by real life experiences in natural environments that foster the child’s playfulness, learning, skill development, and self-determination. The framework for optimal participation guides the assessment and intervention plan for participation-based therapy.

MODEL FOR PARTICIPATION-BASED THERAPY

**Novak I.**
Cerebral Palsy Alliance, Sydney, Australia

Based on research and our framework for optimal participation, we have developed a model for participation-based physical and occupational therapy that is innovative in focus and the manner in which services are provided. Interventions emphasize real world experiences that build on child, family, and environmental strengths and interests. The outcomes are achievement of child and family identified goals for home and community participation. Our overriding assumptions are that optimal participation by children with physical disabilities is an important outcome of rehabilitation and that childhood is a sensitive period for: a) development of self-determination and b) empowerment of families with knowledge and skills to advocate for the full inclusion of their children into society.

Participation-based therapy is goal-oriented, family-centered, and ecological. Short-term interventions are initiated when goals for home and community participation are realistic and achievable. The therapist is a consultant, collaborating with the child, family, and community providers. The therapist shares information, educates, and instructs in ways that build child, family, and community capacity. The principles of participation-based therapy are implemented through a five-step process:

1. Develop a Collaborative Relationship with the Family and Child
2. Determine Mutually Agreed Upon Goals for Home and Community Participation
3. Assess Child, Family, and Environment Strengths and What Needs to Change
4. Develop and Implement the Intervention Plan
5. Evaluate Processes and Outcomes with the Child and Family
Therapist, family, and others develop and implement strategies and procedures for providing children real life experiences to promote their self-determination and desired participation. We believe the model has utility for: 1) collaboration and forming partnerships with families and community providers, 2) establishment of goals for home and community participation, 3) development of intervention plans, and 4) evidence-informed interventions.

APPLICATION OF PARTICIPATION-BASED THERAPY FOR A CHILD WITH CEREBRAL PALSY

Chiarello L.
Drexel University, Philadelphia, PA, USA

An expert physical therapist collaborated with Jason, a 12-year old boy with cerebral palsy, his family, and his church youth group to implement the participation-based therapy model. The therapist established a collaborative relationship with the child and mother by listening to their interests, having thoughtful conversations with them, and offering realistic choices for the family to make final decisions. The family identified a goal of actively participating in the church youth group. The Canadian Occupational Performance measure was used to document extent of physical and social participation and satisfaction with participation. Goal attainment scaling was used to document extent that the goal was achieved. The therapist conducted an ecological assessment to identify child, family, and environmental strengths as well as what needed to occur for the child to actively participate in the church youth group. The therapist’s roles in implementation of the plan for Jason’s participation in the youth group included communication, coordination, sharing information, demonstration, and instruction. Collectively, these roles are related to advocacy. The intervention built on child, family, and environment strengths and was provided in a manner that promoted Jason’s self-determination through his initiating conversation and engaging in activities with the other youth. Jason achieved higher physical and social participation in the youth group, exceeded the anticipated level of goal attainment, and the family was highly satisfied. Qualitative evaluation indicated that the mother became more empowered to advocate for her child. Participants in the symposia will interact to identify how the model can be applied in their practice to promote the participation of children with physical disabilities in home and community life.
TREATMENT OF CHILDREN WITH CVI
Atkinson J. (UK), Fazzi E., (Italy) Hyyarinen L., (Finland)

EARLY IDENTIFICATION AND TREATMENT OF CVI
Atkinson J., Braddick O.
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CVI is a common visual correlate of wide-ranging cerebral problems, with visual deficits being difficult to dissociate from visuocognitive, visuomotor, and attentional disorders. Deficits usually involve the dorsal cortical stream, a network of interrelated brain areas, underlying the control and planning of actions such as reaching and grasping, motion processing, navigation, spatial memory and attention, including executive function. We have modelled development of these dorsal stream networks, in comparison to ventral stream networks (for face and object recognition). Dorsal are more vulnerable than ventral stream systems in developmental disorders. This cluster of problems, ‘dorsal stream vulnerability / DSV’, is found in both acquired (eg perinatal brain insult, preterm birth, hemiplegia, congenital cataract,) and genetic disorders (Williams syndrome, fragile-X, autism, dyslexia) and includes many children with cerebral palsy and CVI. We have assessed DSV linked to CVI using ABCDEFV functional vision battery; brain imaging in event-related potentials; Fixation/Shifts attention test which predicts cognitive outcome; visuomotor/spatial tests and the Early Childhood Attention Battery (ECAB) including use in an ongoing dietary intervention trial for infants with CP.


SPECTRUM OF CVI IN CHILDREN WITH CP

Fazzi E.
University of Brescia, Italy

Visual problems are a main clinical feature of cerebral palsy (CP). The spectrum of visual problems in children with CP is extremely broad and includes both peripheral problems, such as strabismus, refraction disorders and retinopathies, and cerebral visual impairment (CVI), which is a problem of central origin. The literature shows that 60 to 75% of children with CP also present CVI. Cerebral visual impairment is defined as a deficit of visual function caused by damage to, or malfunctioning of, the retinogeniculate visual pathways (optic radiations, occipital cortex, visual associative areas) in the
absence of any major ocular disease. This involvement of the retrogeniculate visual pathways is common in CP given
The clinical manifestations of CVI are extremely heterogeneous, a finding that, judging by the main contributions of authors in this field, appears to be related to involvement of different aspects of visual function, corresponding to different visual system structures.
Ocular involvement in CVI manifests itself through refractive errors and fundus oculi abnormalities. Geniculostriate visual pathway involvement manifests itself through reduced visual acuity, visual field and contrast sensitivity, and abnormal stereopsis and optokinetic nystagmus.
Impairment of the oculomotor system is also very typical and is shown by abnormalities of functions such as fixation, smooth pursuit and saccadic movements; strabismus and abnormal ocular movements are also frequently described.
Visual associative areas may also be involved and this involvement is reflected in disorders of visual perception and integration, the so-called visual-cognitive disorders, which are often identified when the child reaches school age. These disorders should be looked for even when visual functions such as visual acuity and visual field are normal or only mildly impaired (so-called higher-functioning CVI).
CVI is prevalently a clinical diagnosis based on the presence of the above signs and symptoms. Neuroradiological and electrophysiological investigations can support the diagnosis. In the literature, there are few studies exploring visual dysfunction associated with CP and the new classification of CP brings out the fact that the perceptual disorder, and thus also the visual component, is, together with the motor disorder, an integral part of the clinical picture of CP and not an associated symptom.
In conclusion each form of CP is characterized by a typical neuro-ophthalmological profile, it is very useful to evaluate CP children from a neuro-ophthalmological point of view also for giving new perspectives for a more tailored rehabilitative intervention in CP.

EARLY INTERVENTION STRATEGIES

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University of Helsinki, Faculty of Behavioural Sciences

Infants born with motor problems that later lead to cerebral palsy often spend several weeks to months in the hospital where early intervention for visual development can be started. The play therapy must be very gentle and slow to avoid increase in blood pressure.
If the infant has been prematurely born, retinas are regularly examined. Also refractive errors should be measured. If there is marked hyperopia, infant’s visual functioning should be observed when he is well awake to follow the development of the use of vision.
Like in the care of all infants, the development of eye contact should be observed and recorded. If is not normal, infant’s accommodation and refraction need to be measured and near correction should be prescribed without delay. Activation of the use of vision can be built in the early intervention for motor functions.
Delay in beginning of active interaction and social smile should lead to well-planned training of visual communication using tactile and auditory information to support vision. For this the infant’s vision should be assessed for fixation, convergence, accommodation, visual field, and awareness and use of hands together with the infant’s physiotherapist who can use the findings in therapy.
Vision functions as an effective activator of motor functions; tactile exploration with hands and mouth gives confirmation to the visual forms and surface quality. Vision is used for awareness of body parts and development of body image.
If amblyopia is starting to develop, activation of the use of the amblyopic eye is included in physiotherapy by using visually stimulating toys in physiotherapy. The power of strong visual stimulation can be such that an infant with no head control suddenly is able to keep head up. One of the strongest visual stimuli is a picture of smiling face.
SYMPOSIUM 4

SKELETAL MUSCLE AND THE DEVELOPMENT OF DEFORMITY IN CHILDREN WITH CEREBRAL PALSY

Gough M. Shortland A.
Guy's Hospital, London, UK

Aim:
This symposium aims to provide an understanding of normal skeletal muscle function and growth, to consider how this may be altered in children with cerebral palsy, and to consider the implications for intervention.

INSIDE THE CELL: MUSCLE FUNCTION AND PLASTICITY

Gough M.
Guy's Hospital, London, UK

Skeletal muscle contraction occurs through the interaction of two proteins, actin and myosin. These proteins form filaments which overlap in the sarcomere, the basic functional unit of the muscle cell. In the presence of calcium, actin binds to myosin and the resulting configurational change in myosin results in a relative change in the position of the actin and myosin filaments. A range of structural proteins are needed to facilitate and to stabilise this interaction, including nebulin and titin. Other proteins form supportive structures called costameres which transmit the force generated through the cell membrane and provide support for the neuromuscular junctions. Energy is needed within the cell for actin/myosin interaction, for rapid storage of calcium in the sarcoplasmic reticulum after contraction, and for protein synthesis and degradation. This energy is provided predominantly by intracellular organelles called mitochondria. Skeletal muscle is a highly adaptable tissue, and is able to respond to altered demand by changes in the expression of proteins within the cell leading to adaptation in structure and energy utilisation. The genes expressed allow changes in muscle contraction speed, in mitochondrial number, and in muscle size. The most important influence on gene expression appears to be the combination of mechanical forces and ionic changes in the muscle cell that occur during contraction. Other influences include the energy substrates available and the presence of local hormones and growth factors. Different signalling pathways allow a balance between active muscle protein synthesis and active protein degradation which in turn determines the size and function of the muscle cell. Innervation, growth factors and nutrition promote protein synthesis, while denervation, immobilisation, systemic inflammation and starvation result in active protein degradation and muscle atrophy.

FROM THE CELL TO THE TENDON: MUSCULOTENDINOUS UNIT MORPHOLOGY AND INNERVATION

Shortland A.
Guy's Hospital, London, UK

The force generated within the sarcomere needs to be transmitted through the muscle and tendon if the muscle is to produce motion. Costameres link the sarcomeres to the basal lamina, which is in turn linked to a continuous 3D network of connective tissue surrounding fibres, fascicles and whole muscles which is connected to internal and external tendons and to the surrounding fascia. The basic functional unit of muscle is the motor unit: this is composed of an α-motorneurone and the fibres it innervates. In general, each muscle fibre is innervated by only one α-motorneurone. Muscles are composed of multiple motor units distributed over large volumes of the muscle. The combination of a
mechanically-robust connective tissue framework and a distributed MU network allows the smooth transmission of lateral and axial forces. Most muscles are pennate, with muscle fibres arranged at an angle to the tendon. This leads to a small loss of force for an individual fibre but this is offset by the increased force available due to the greater number of fibres which can be accommodated. The force produced by a muscle is related to the physiological cross-sectional area. The speed of contraction and range of contraction are influenced by fibre length, with longer fibres (with more sarcomeres in series) having a faster rate of contraction and greater range, and shorter muscles (with more sarcomeres in parallel) producing more force over a shorter range. The action of a muscle is modified by the mechanical properties of the adjoining tendon. The interaction of tendon and muscle in the lower limbs appears to improve the energetics of walking and prevent damage from eccentric contractions.

SKELETAL MUSCLE DEVELOPMENT AND GROWTH

Gough M.
Guy’s Hospital, London, UK

Muscle development begins in the embryo with migration of myoblasts into the limb buds to form primary myotubes. These are innervated from 9 weeks post-conception onwards. Isolated limb movements can be seen from 10 weeks, after which further waves of myoblast migration occur. Each muscle fibre is initially innervated by a number of α-motorneurones: with subsequent development the number of α-motorneurones innervating each fibre decreases to a single α-motorneurone. This appears to be influenced by maturation of neuronal networks in the spinal cord which are in turn influenced by ingrowth of the corticospinal tract, which in humans reaches the cervical spinal cord at around 29 weeks postconception. There is a gradual increase in the percentage of slow fibres in muscle from around 34 postconception weeks which continues after birth. The change in muscle fibre properties appears to represent transformation of muscle fibre phenotype rather than the ingrowth of new fibres and is associated with the maturation of muscle innervation and of the neuromuscular junctions. The change in muscle fibre properties is associated with disappearance of immature myosin and its replacement by mature myosin, and increased efficiency of mitochondria. It is accompanied by development of the muscle connective tissue network, although the development of contractile tissue may initially be given priority.

Muscle fibre growth involves an interaction between a number of factors including innervation, nutrition, and local and systemic growth factors and is sensitive to changes in these factors, and to nutritional impairment, sepsis and inflammation, particularly in the perinatal and early postnatal period. Muscle fibres grow in length and in diameter: because of the pennate nature of muscle, muscle fibre hypertrophy, or growth in diameter, appears to be the main factor influencing growth in length of the muscle belly.

ALTERED MUSCLE GROWTH AND ADAPTATION IN CHILDREN WITH CEREBRAL PALSY

Shortland A.
Guy’s Hospital, London, UK

Given the intimate relationship between neurological input and muscle morphology, it is not surprising that altered muscle development is seen in children with cerebral palsy. Previous studies in children with cerebral palsy have noted marked fibre-size variability and predominance of either fast or slow fibres: this may reflect the heterogeneous functional level of the cases described and the heterogeneity of the muscles assessed. A recent systematic review of studies in this area noted that the most consistent morphological and structural change evident was reduced muscle size. As well as being small, these muscles may have a greater component of connective tissue or fat. Changes in muscle gene activation and expression in cerebral palsy have been described that may affect muscle cell force development and metabolic capacity. It is possible that these findings represent the outcome of a combination of impaired muscle growth and adaptive changes to chronic overload. There may be an initial reduction in muscle growth consequent to
impaired nutrition as a result of prematurity, but the predominant cause of impaired muscle growth is likely to be the impaired development of muscle innervation postnatally. The development of tonic activation in particular appears necessary to promote the development of slow muscle fibres which are essential to the subsequent development of posture and ambulation. In ambulant children, the increasing demands placed on small muscles with growth (particularly in the form of eccentric loading) may lead to injury and a reparative response with an increase in connective tissue, atrophy of some muscle fibres and overuse hypertrophy of others, and the replacement of muscle fibres with fat or connective tissue. In nonambulant children muscle fibre growth may be limited by altered innervation and impaired nutrition.

IMPLICATIONS FOR INTERVENTION

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Nonoperative intervention to muscle in children with cerebral palsy mainly involves stretch, immobilisation, and denervation which are applied with the aim of preventing or correcting fixed deformity and of promoting muscle fibre growth through stretch and through a reduction in spasticity. Although widely used, evidence to support the use of these options remains limited. Strengthening has been used to increase muscle volume, but its effect on function may be limited. Operative intervention involves the alteration of musculotendinous unit length or skeletal lever-arm function. This may be effective but recurrence of deformity may occur. A shift from the concept of development of muscle deformity because of reduced stretch related to spasticity to the concept of deformity resulting from impaired muscle growth and adaptation would shift the focus of intervention to finding ways to make skeletal muscles grow and function more effectively. It would suggest caution in the use of sustained stretch or immobilisation, both of which may promote muscle atrophy. It would also suggest caution in the use of botulinum toxin: evidence of its effect on human muscle is lacking and the available animal evidence would suggest that the response of growing muscle to denervation is not favourable. The improvement of oxidative metabolic capacity by strengthening may be a more functional goal than improvement in muscle volume. Surgery has the capacity to reduce the eccentric demands on muscle by improving musculotendinous unit length and in this way enhance development and growth of muscle fibres rather than connective tissue, but this may not be achieved if postoperative immobilisation is prolonged.

Skeletal muscle in children with cerebral palsy remains plastic: the challenge we face is to use this adaptability to enhance muscle growth and function and in this way limit the development of deformity.
MANAGEMENT OF SPASTICITY IN CHILDREN AND YOUNG PEOPLE WITH NON-PROGRESSIVE BRAIN DISORDERS

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Aim:
To present how the NICE clinical guideline on the management of spasticity was developed and discuss the key messages for interventions, service delivery, gaps in the evidence base and how to ensure that we have a service that is child-centred and meets their needs.

NATIONAL INSTITUTE FOR HEALTH AND CLINICAL EXCELLENCE: GUIDELINE ON MANAGEMENT OF SPASTICITY IN CHILDREN AND YOUNG PEOPLE - CLINICAL RECOMMENDATIONS

The NICE clinical guideline on management of spasticity in children and young people will be published in June 2012. The guideline development group consists of clinicians and therapists from different backgrounds, parent representatives, and a technical team who together collect and review the evidence for interventions. The evidence is assessed using the GRADE system. The group set key questions in principles of care, physical therapy, orthoses, oral drugs, Botulinum Toxin-type A therapy, Intrathecal Baclofen Therapy, orthopaedic surgery, and Selective Dorsal Rhizotomy and then developed recommendations based on the best available published evidence, or, in the absence of evidence, a consensus view based on their own clinical experience. The evidence is limited for many of the interventions which are currently used to manage spasticity as ‘standard practice’ in many health services. Evidence of complications and cost effectiveness is also similarly lacking. In England and Wales, there is inequality in access to different services on geographical basis. This contribution will discuss how the evidence in the guideline was gathered and graded, and will present the important clinical recommendations.

NATIONAL INSTITUTE FOR HEALTH AND CLINICAL EXCELLENCE: GUIDELINE ON MANAGEMENT OF SPASTICITY IN CHILDREN AND YOUNG PEOPLE - RESEARCH RECOMMENDATIONS

The NICE clinical guideline on the management of spasticity contains research recommendations in addition to clinical recommendations. The guideline development group identified gaps in the evidence in all the groups of interventions. The group concluded that five key research questions in particular require a high degree of priority. These concern inhibitor of functional ability, postural management, botulinum toxin type-A therapy, intrathecal baclofen therapy and selective dorsal rhizotomy. The group developed outline research proposals for these questions. A further 21 research questions were identified which covered the other interventions considered in the guideline.
This contribution will discuss how providing answers to these research questions will guide services and therapies to better meet the needs of the individual children and to use health service resources in a more efficient and cost-effective manner.

NATIONAL INSTITUTE FOR HEALTH AND CLINICAL EXCELLENCE: GUIDELINE ON MANAGEMENT OF SPASTICITY IN CHILDREN AND YOUNG PEOPLE - EDUCATION AND INFORMATION TOOLS

NICE produces documents for health professionals and the public on the clinical guidelines and educational tools to help disseminate the key information contained within the guideline. This contribution will present these tools and documents and discuss how they can be used to help develop services for children and young people with spasticity.
NEW TOOLS FOR EARLY ASSESSMENT OF PERCEPTUAL MOTOR FUNCTION IN INFANTS AT RISK FOR CP
Von Hofsten C. (Sweden), Krumlinde-Sundholm L (Sweden), Cecchi F. (Italy)

DEVELOPMENT OF A NEW ASSESSMENT TOOL TO STUDY BILATERAL HAND FUNCTION IN INFANTS WITH UNILATERAL CEREBRAL PALSY: THE HAI (HAND ASSESSMENT FOR INFANTS)

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Background: Asymmetric hand/use is commonly the first clinical signs of unilateral cerebral palsy (CP), however, there is currently no assessment available which can detect and quantify, i.e. measure, hand function in infants 3-10 months old. Aim: The aim of this study was to describe the development of the Hand Assessment for Infants (HAI), and report its psychometric properties.

Methods and subjects: Test items were developed from literature review and from systematic observations of goal/directed hand/arm actions of infants. The items describe both unilateral and bilateral actions assessed on frequency and quality, and scored for both hands separately. Internal scale validity was evaluated by Rasch measurement model analysis of 68 assessments of infants with clinical signs of unilateral cerebral palsy.

Results and discussions: After stepwise exclusion of items showing misfit to the Rasch model assertions, 19 items describing object related hand actions scored on a 3-point rating scale was found to form a unidimensional construct. The HAI outcome is presented both for each hand separately, showing magnitude of asymmetry, as well as by a measure of bimanual hand use. Age norms will be made available based on 400 typically developing infants.

Conclusion: The HAI showed to be a promising tool which can be used to quantify measures of hand function in children with signs of unilateral CP with good separation, making it possible to detect and measure asymmetries, follow development over time and evaluate effects of early intervention on hand function.

DESIGN AND DEVELOPMENT OF A BIOMECHATRONIC GYM FOR THE STUDY OF UNILATERAL AND BIMANUAL REACHING AND GRASPING IN INFANCY

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Prehension skills are fundamental to perform many routine tasks. They consist of various aspects, such as reaching, grasping, manipulation, unimanual and bimanual actions and grading of grip force.
The use of specific instrumented tools for measuring those skills could be useful for helping the diagnosis and consequently the therapy of developmental disorders. In the last years, engineering has brought support in this field in terms of devices and instruments for quantitative analysis of neuro-motor development, in an emerging field named Neurodevelopmental Engineering.

We proposed a mechatronic platform as a tool to measure infants’ movement during the acts of reaching and grasping. The proposed platform is a “baby gym” composed by a set of instrumented toys equipped with a variety of sensors designed for the assessment/stimulation of upper limb of infants between 4 and 9 months of life [1].

We longitudinally investigated, from the first weeks of life, the development of palmar grasp both for assessment of unimanual/bimanual grasping actions in centrally and laterally placed objects and for measurement of exerted power grip force.

These longitudinal trials showed a good level of acceptance and involvement by infants of the entire system. The results demonstrated a significant increase in unimanual power grip force between the 18th and 30th week followed by a flat period until the 41st week; we also ascertained an early tendency to play bimanually with centrally and laterally placed objects with a subsequent increase in all ages of unimanual successful power grasping both for central task and midline crossing [2].

The proposed platform represents a valid tool for continuous and quantitative measuring infants’ manual function, without being distressful for the infant and consequently could be suitable for early intervention training during the first year of life.


**MEASUREMENTS OF FUNCTIONAL GAZE**

Claes von Hofsten\(^1\), Kerstin Rosander\(^1\), Giovanni Cioni\(^2\), Giuseppina Sgandurra\(^2\), Elena Beani\(^2\), Martina Orlando\(^2\), Michele Coluccini\(^2\) & Bo Strömberg\(^1\)

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*Research supported by La Fondation Motrice (Paris) and Sodiaal (PACE Project)*

The early development of eye-head control forms a base for postural control, which in turn is crucial for actions. When the infant properly controls and regulates its posture, gaze can be directed to a specific goal or used to explore the environment as a whole. In typically developing infants the situation of tracking a moving object is a challenge. It is managed by coordinated eye-and head movements that together anticipate the moving object smoothly. Such coordination functions at 3 months of age in typically developing children. Another challenge is to compensate one’s own head movements with compensating eye movements (VOR). This functions well in very young (1 month) infants. We are in the progress of examining and measuring eye-head coordination in these two situations in infants at risk for developing cerebral palsy. In a first stage we have constructed a special infant chair and are prepared to measure smooth pursuit and VOR. In the next stage we will use this setup to study a number of infants at risk for cerebral palsy. Eye and head movements are measured with equipment that gives data for both eyes and head separately (SmartEye). The trunk of the infants, the chair, and the visual target are recorded by an optoelectronic system (BTS, Italy) using passive markers. Both instruments are synchronized by means of dedicated hardware and software. This apparatus has not been used earlier with infants. Results from a similar study of very preterm infants (Strand-Brodd et al., 2011) indicate that eye-head coordination is less coordinated in 4-month-old infants that later in development were diagnosed with cerebral palsy.
CARE OF CP - A GLOBAL PERSPECTIVE
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A GLOBAL PERSPECTIVE ON MANAGEMENT OF CEREBRAL PALSY - Introduction
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Cerebral Palsy (CP) is a common cause of neurodisability in children all around the world. In the scientific literature there is paucity of information regarding this condition from the developing world with most data skewed towards studies done in the Western hemisphere. While it is difficult to get insight into the epidemiology surrounding this condition in other parts of the world, a number of “environmental risk factors” have been associated with CP, e.g., hypoxia, infections, preterm birth, brain infarcts and haemorrhage. The panorama of pathology may therefore alter depending on e.g., maternal and perinatal care, and the epidemiology of infections prevailing in the various countries. In addition, the view of the “disabled child” varies in different cultures and therefore their inclusion in society will probably also differ between countries. This, along with the economic level will certainly have an impact on the health service provision and management of these children. Finally, the existing traditional differences in the view on brain function and the pathophysiology underlying the motor disorder may also lead to different therapeutic approaches on how to treat CP.

In this workshop child neurologists from three different parts of the world, e.g., Sub-Saharan Africa, Eastern Europe and Asia, will share their experiences regarding the situation of CP in these different aspects.

CARE OF CP IN NON-WESTERN COUNTRIES - CEREBRAL PALSY AND CHILDHOOD DISABILITY IN RUSSIA
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Since 2000, the birth rate in Russia is on the rise, mainly due to the North Caucasus and the Far East region (Chechen Republic 29.1 per 100 000, Tyva 26.1 per 100 000, Altai 20.3 per 100 000, Ingushetia 18.7 per 100 000, Dagestan 8.5 per 100 000). The mean fertility rate in 2009 in Russia was 1.5 children per woman of reproductive age.

The birth rate is inevitably linked with an increase in children's neurological disability, including through the cohort of premature infants. According to the State Statistics Service, the percentage of babies born prematurely in the last 5 years in Russia rose from 6% to 9%, which is associated with an increase of children's neurological disability, most often presented cerebral palsy. To date, the most problematic regions in cerebral palsy prevalence are: the Republic of Mari El (528.6 per 100 000), Kalmykia (507.2 per 100 000), Kemerovo (506.9 per 100 000), with an average for Russia 333.8 per 100 000.

Of course, a large percentage of diagnoses might be the result of selective social policy, most friendly with cerebral palsy patients, as well as - overdiagnostics, when under the guise of cerebral palsy occur unrecognized hereditary diseases, especially common due to the closely related marriages in the Caucasus region. At the same time, the analysis of statistical data established that the incidence of cerebral palsy among children in regions correlates with low supply medical and nursing staff in them. If the average number of medical doctors in Russia 50.1 per 10 000 population, in the Republic of Mari El - 33.5 per 10 000 in Dagestan - 38.3 per 10 000, in the Kemerovo region - 47.7 per 10 000.
This situation demonstrates the demand to optimize the differential diagnostics of cerebral palsy, to equalize social benefits for neurological disabled children and to increase skilled health workers in areas with a high incidence of cerebral palsy.

**CARE OF CHILDREN WITH CEREBRAL PALSY IN CHINA**

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The epidemiological survey in 2001 shows the incidence of cerebral palsy (CP) in China is 1.92‰. Every year more than 40,000 new CP cases are born in China. Currently 80% of CP children live in poor areas. GMFCS has been used in recent years in many medical centers, but national epidemiological data are not available. Preterm birth (Low gestational age and very low birth weight) has been an increasing risk factor of CP. There are few information about the prognosis of CP, life expectancy, and nutrition status. Definition of 2006 has been recommended to Chinese professionals. Prechtl's assessment of general movements has been introduced in China since 2004. GMFM has been used in clinical assessment in China. Combination of western rehabilitation treatment and traditional Chinese medicine is widely being used in China. Registration for Children with CP has been carried out by using ScpChild first edition since 2008. Chained Rehabilitation Model (Medical center-Community-Family) for Children with Cerebral Palsy is an effective, convenient and economical practice in China.


**CARE OF CP IN AFRICA**

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Cerebral palsy (CP) is more prevalent in more deprived socio-economic populations. In Uganda, despite the lack of reliable information, the prevalence of CP is believed to be high in view of the high maternal and infant mortality rates. The Swedish classification by Hagberg is used in diagnosis. The spastic quadriplegic (bilateral spastic) type dominates in presentation. Underweight is the more common form of malnutrition with cognitive impairment followed by epilepsy as the frequent co morbidities. The majority of children are in the class IV for both the Bimanual Fine Motor Function and Gross Motor Function Classification Systems. Interactions of multiple risk factors have been attributed as contributory to development of CP. The perinatal causes and complications of cerebral infections especially cerebral malaria and meningoencephalitides are however the most frequent underlying risk factors. Social stigma issues’ surrounding many of the CP children has isolated them from society. This often stems from the community and caregivers lack of knowledge regarding the possible causes of the condition (widespread belief that CP is due to witchcraft or a curse); lack of understanding of what the child is capable of and the overall prognosis. In addition, there is a marked shortage of technical personnel such as Occupational therapists, Orthopaedic Technological Assistants, Physiotherapists or Specialist doctors. This scenario implies that there are a limited number of CP children having access to these services. The presentation of the children with CP, available interventions in their care, their participation in society and transition into adulthood will be discussed.
Movement disorders represent a common cause of disability in children with neurological impairment and can be divided into two broad groups: i) dyskinesias (dystonia-athetosis, chorea-ballism, tics, myoclonus and tremor) and ii) hypokinetic-rigid syndromes (parkinsonism). The recognition of the pattern of movement disorders and the possibility to grade their severity are relevant for the clinician in order to plan rehabilitative and pharmacological interventions, to monitor the results of treatment, and to predict later outcome. Several instruments and rating scales are currently used to assess movement disorders; however, they have been mainly designed for adult patients and are limited to the assessment of a single type of disorder. A scale specifically designed for movement disorders in paediatric populations is crucial and for this reason a new scale for children and adolescents called Movement Disorder Childhood Rating Scale was designed and developed in two different forms on the basis of patient’s age, MD/CRS 0-3 and MD/CRS 4-18. Both versions are subdivided in two parts: Part I for Global assessment (motor function, oral/verbal function, self-care and attention/alertness) and Part II for MD intensity (evaluation of movement abnormality at rest and during specific tasks). Reliability, construct validity and consistency of the scales are tested in 101 subjects: MD/CRS 4-18: 61 patients [Ped Neurol 2008] and MD/CRS 0-3: 40 [Ped Neurol 2009]. We tested, also, 68 patients during one year of specific treatment in order to verify the scale responsiveness and its possibility to represent an outcome measure during trials. The MD/CRS was developed to address the perceived limitations of existing rating scales and the results of our study seem to fulfil the statistical requirements for its application in the quantitative assessment of movement disorders in childhood and demonstrate the sensibility of the scale and its capability to quantify clinical modifications during drug treatment.

NEW GENETIC FORMS

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While in a relevant number of children suffering from dyskinetic cerebral palsy (CP) anamnestic risk factors and/or neuroimaging alterations are not contributory to the diagnosis, several genetic and genetic-metabolic conditions present with movement disorders mimicking CP. Moreover in some of these disorders the occurrence of risks factors (such as prematurity, threatened abortion, etc) as well as the pattern of white matter (WM) involvement (i.e. periventricular or basal ganglia lesions) may mislead to the diagnosis of CP. Several metabolic conditions have been recognised in the last few years as cause of early onset movement disorders, such as parkinsonism, dystonia, chorea, myoclonus and tremor. They embrace: defects of biogenic amines and other neurotransmitter (GABA and glycine) metabolism and transport (DAT), disturbs of fuel supply to the brain (such us the defect of Glut1) and intracellular ATP transport (creatine metabolism disorders), mitochondrial encephalopathies, organic acidemias (for example propionic and methylmalonic acidemia) and some lysosome disorders specifically affecting basal ganglia (NCLs, Gaucher disease, metachromatic leucodystrophy, Niemann-Pick disease type C, etc.). Finally, some early onset degenerative
disorders, which selectively destroy motor neurons and/or pathways, should be considered. They may be difficult to diagnose owing to their extreme slow progression, which in some cases follows a specific pattern (as for example in infantile-onset ascending hereditary spastic paralysis).

The availability of specific, sometimes etiologic, treatment for some of the metabolic diseases together with the knowledge of their genetic origin, make mandatory an early detection. An algorithm for the diagnostic work-up of subjects presenting with an early onset dyskinesias will be discussed.

DEEP BRAIN STIMULATION FOR DYSTONIA-DYSKINESIA IN CHILDREN

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Childhood dystonia-dyskinesia of primary, secondary and herodegenerative origin exerts a profound adverse influence on growth, development, education, activity and social participation. Early clinical management strategies are needed to alter the progressive natural history of maladaptive motor development and to avert the consequences of long-standing dystonia-dyskinesia: disability, dysarthria, dysphagia, deformity and, rarely, sudden dystonic death.

The role of neuromodulation of dystonia-dyskinesia with deep brain stimulation (DBS) will be explored with a view to demonstrating what all dystonias (irrespective of aetiology) share in common as well as the characteristics which may contribute to the most favourable outcome following DBS.

Clinical examples of dystonia-dyskinesia will be used to illustrate the potential for DBS to improve motor function, well-being and independence. The impact of dystonia-dyskinesia duration and secondary musculoskeletal deformities will also be explored.

The importance of an experienced multidisciplinary team within and experienced clinical network to screen and manage children undergoing DBS will be emphasised. This clinical process includes appropriate goal-setting based on functional priorities established prior to DBS surgery within the International Classification of Functioning, Disability, and Health Framework (ICF) which allows identification of priorities relating to activity and participation.


WORKSHOP 6

**POSTURAL MANAGEMENT AND MINIMAL INVASIVE SURGERY TO PREVENT HIP DISLOCATION IN CHILDREN WITH CP**

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**AIM:**
Aim of this workshop is to focus attention on musculoskeletal disorders in CP as indicated by the last classification of cerebral palsy. During the workshop will be proposed a protocol for monitoring and early intervention, including the construction of custom orthoses, in agreement with the consensus statement of 2006.

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**THE PREVENTION OF HIP DISLOCATION IN CHILDREN WITH CP. THE ROLE OF POSTURAL MANAGEMENT**

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**OBJECTIVES:** To determine the effect of a siège moulé postural management on the progression of hip displacement in children with CP. Background: Musculo-skeletal disorders play a key role on future development of adaptive functions in children with CP. Lateral migration of the femoral head increases on average 7.7% per year and may progress to hip dislocation. Methods: A prospective comparative study was conducted. 70 patients with bilateral CP were included into the study and evaluated by clinical examination and radiological measurements (Migration Percentage). 36 children were treated (treatment group-TG) with neurodevelopmental treatment (NDT) and postural management 4/5 hours a day, and 34 children (CG) were treated with NDT alone. Statistical analyses: Crude analyses for continuous variables were performed using Wilcoxon matched-pairs signed-ranks test for analyses within TG over time and Wilcoxon rank-sum test for unpaired comparisons between treatment groups. Categorical variables were analyzed using McNemar chi-squared test (for paired and unpaired comparisons). MP was analyzed either as a continuous variable or categorized into normal (MP<21), at risk (21-33), or subluxated (>33). Results: At baseline the TG and CG were similar for all clinical relevant characteristics except for average MP that was significantly higher in TG (28.9) compared to the CG (19.1) (p=0.004). There was substantially no change of MP over time in the TG, while the CG showed a significant worsening at year 1 (average MP=30.2; p<0.0001) and further important MP increase at year 2 (average MP=39.3; p<0.0001). From the multiple GEE model, we found a strong negative statistical interaction between treatment and time (p<0.0001). Conclusion: The study supports the evidence that conservative management of hip deformity and preservation of muscle length and balance may prevent or reduce femoral head migration.

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**THE SIÈGE MOULÉ: EVALUATION CRITERIA AND CUSTOM SEAT SETTING UP**

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The siège moulé is a custom made seat developed from child body shape by a computer model imaging reconstruction (Cad-Cam system) with the purpose of maintaining the femoral head centralized within the
acetabulum, giving a comfortable seat position, supporting potential head and trunk weakness, allowing a free manipulation to the child. This system guarantees a better reproduction of the child’s shape.

The evaluation includes 6 steps:

a. Child’s neuro-motor skills examination scale. This scale (0-4) measures the postural-motor function, related to the child’s age. The score 0 suggest a normal function and 4 a severe impairment.

b. Migration Percentage by Reimers of the hip radiograms.

c. Angle of femoral antversion (FA) by greater trocanter palpation.

d. Hip muscles lengths measurement (adductors, hip flexors, knee flexors) after relaxing (inhibition) manipulations to distinguish tightness from retraction.

e. Hip centering by hip diagram (HD), developed by Lespargot. The hip cover diagram is a simple physical examination, necessary to define standing and seating safe positions, without risk of the excetration of the femoral head. Palpation of the femur head in different points of hip ROM gives the examiner the femoral head centering in acetabulum indications. The diagram shows the degree of lower limbs abduction and flexion/extension requested to realize a safe child sitting position.

f. Back and lower limbs perceptual sensibility evaluation, the determine the child consciousness level related to his body position in the space.

The sièges moulés employment for 5 h/day during upper extremities activities is combined with strengthening and stretching in a global rehabilitation program that needs to be acceptable for the child and family and easily integrated into their lifestyles.

MULTILEVEL MINIMALLY-INVASIVE APPROACH (MMA) FOR PREVENTION OF HIP DISORDERS IN CP

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SCIENTIFIC BACKGROUND: Hip disorders are common in patients with CP. The hip is normal at birth, a combination of muscle imbalance and bony deformity leads to progressive dysplasia. The MMA approach restores muscle balance, mechanical stress up on the hip joint and prevent femoral head migration and bone deformities.

Treatment consists of:

M.M.A.1: RI≤20%: multilevel injection of botulinum toxin in case of muscular hyperactivity without morphological alterations of the couple muscle-tendon (contractures)

M.M.A.2: RI≥20%: multilevel aponeurectomies in case of muscular hyperactivity with morphological alterations of the couple muscle-tendon (retraction)

M.M.A.3: MMA2 associated to early bone surgery (proximal femoral temporary epiphysiorisis to achieve a progressive correction of valgus deformity).

METHODS: Retrospective study, conducted from 2004 to 2010, in patients with CP. There were 300 patient subdivision for MMA1 (n°=132; mean age 9.06), MMA2 (n°= 131; mean age 11.06) MMA3 (n°= 37; mean age 9.7). The management were based on Reimer index and acetabular index. Patients were evaluated after eight months postoperatively and after one year.

RESULT: 15 male switched from MMA1 to MM2 (three patient repeated the treatment twice MMA1 and one repeated twice MMA2); 7 female switched from MMA1 to MM2 (four patients repeated the treatment twice MMA1 and two patients repeated twice MMA2); 1 female switch from MMA1 to MMA3; 2 male switch from MMA2 to MMA3. Only 4 male patient and 2 female after treatment MMA needed further major surgery.

CONCLUSION: The results show the possible prevention of subluxation. They also show that the earlier will be the approach, the better the results. This approach avoids major reconstructive surgery, and promotes a better quality of life.
SPATIAL MEMORY & LOCOMOTION IN CHILDREN
Berthoz A (France), Guariglia C. (Italy), Belmonti V. (Italy), Kemoun G.(France)

SPATIAL MEMORY AND PATH PLANNING FOR LOCOMOTION ARE SPECIFICALLY AFFECTED IN CHILDREN WITH CONGENITAL BRAIN LESIONS
Belmonti V, Brovedani P, Capuzzo Y, Susino C, Cioni G, Berthoz A

BACKGROUND Spatial memory and visual spatial abilities are frequently affected in children with spastic Cerebral Palsy (CP) (Gonzalez-Monge et al. 2009; Pueyo et al. 2009). A classical test for spatial memory is the Corsi Block-tapping Test (CBT) There is no means, to our knowledge, of clinically assessing spatial memory for locomotion, which on the other hand is the object of much recent research (Bullens et al. 2010, Berthoz 1997)

OBJECTIVES To apply a newly validated test for spatial memory and path planning for locomotion, the Walking Corsi Test (Piccardi et al., 2008), to children with CP, and to check if congenital brain lesions affect memory in the locomotor space differently than in the manipulation space.

METHODS The Walking Corsi Test (WCT), a locomotor version of the CBT, has been adapted to children with motor disorders. Inclusion criteria: spastic CP, independent walking, IQ>50, age>4 yrs. All subjects have undergone the WCT, the CBT, and tests for general intelligence. Control group of 92 typically developing children.

RESULTS Data on 18 CP subjects (7 with bilateral, 11 unilateral) are available. Both WCT and CBT scores are related to mental age in the whole sample (R²>0.5, p<0.001). At the CBT, but NOT at the WCT, children with unilateral CP tend to perform better than those with bilateral CP of the same mental age. CBT scores are more strongly related to non-verbal than to verbal IQ, while WCT seems to be related to both. In the control group, a linear regression of both tests with age was found, and typical errors have been analyzed.

DISCUSSION Spatial memory and path planning for locomotion seem to be differentiated in the manipulation and in the locomotion spaces. Typical errors in children seem to indicate less ability to use allocentric spatial encoding.

IS SPATIAL MEMORY DURING LOCOMOTION DIFFERENT FROM OTHER TYPES OF SPATIAL MEMORIES?
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Spatial memory during locomotion refers not only to the subjects’ ability to memorize their own movements in space but also to their ability to memorize the environment in which they are moving binding these two types of information in order to build up complex representations of the space. I will present results of different studies demonstrating that systems processing spatial memory during locomotion (that is memory in navigational space) differ from systems processing spatial memory in peripersonal (or reaching) space. Indeed, data show that working memory in navigational space develops with later and with different developmental rate than memory in reaching space. Also, subjects affected by selective acquired or developmental Topographical Disorientation may show impairments in navigational memory but not in reaching memory.
Results of fMRI studies on normal subjects and of behavioral studies on brain damaged subjects will be presented demonstrating that neural basis of spatial memory in navigational space differ from that of spatial memory in reaching space.

**HOW SPECIFIC ARE COGNITIVE FUNCTIONING DEFICITS IN VISUOSPATIAL SHORT TERM MEMORY IN “MILD COGNITIVE IMPAIRMENT” PATIENTS?**

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Several studies have shown an impaired capacity of visuo-spatial working memory in Alzheimer Disease (AD) compared to healthy subjects. Some authors have suggested that visuospatial deficits might constitute an early predictor of AD and that cognitive decline may be better predicted by deficits diffused in linguistic and visuospatial domains. We present here a clinical study using a functional approach based on the problem solving constraint notion applied to Corsi test. We wish to determine whether a locomotor version of the Corsi test causes a decrease in subjects' performance compared to the table version, to show whether the spatial navigation task is more discriminant in the early detection of cognitive disorders, to show whether the errors reflect the implementation of special strategies in solving the Corsi test and to see if some are specific to cognitive disorders. This new approach by analyzing functional performance (strategy) in the Corsi task could be a good marker to differentiate the various subgroups of MCI and to identify dysexecutive individuals. We also think that we could use this paradigm in the study of different behavioral profiles during the child development in visuo-spatial task.

IDENTIFYING CLINICALLY RELEVANT RESEARCH QUESTIONS

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Aim:
To discuss the possibilities to improve the clinical relevance of cerebral palsy research

THE USE OF THE EUNETHTA CORE MODEL TO IDENTIFY CLINICALLY RELEVANT RESEARCH QUESTIONS

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Randomized controlled studies are recognised as the gold standard for evaluating the effectiveness of interventions. However, they cannot give us answers to questions like why an intervention worked, why a theoretically sound new intervention method didn’t work or what is needed for it to work. Qualitative studies can give us answers on some of the “why’s” but a more systematic approach is needed to identify the intervention, content and perspective relevant research questions.

The European Union (EU) has funded a multinational EUnetHTA project that aims to facilitate the efficient use of resources available for any health technology assessment for health decision making within Europe. The EUnetHTA collaboration has so far produced three core models to identify transferable and important, clinically relevant issues that need to be answered when deciding on the implementation of a specific intervention, diagnostic method or screening programme. The core models are divided into nine domains that are all of equal importance: 1. Health problem and current use of the technology, 2. Description and technical characteristics of technology, 3. Safety, 4. Clinical effectiveness, 5. Costs and economic evaluation, 6. Ethical aspects, 7. Organisational aspects, 8. Social aspects and 9. Legal aspects.

The EunetHTA core model goes beyond the traditional question on effectiveness and emphasizes that patient perspective, organizational and ethical aspects are equally important to be evaluated. What works in one country may not be transferable to another country due differences in financing, organization of health care system or cultural differences. The EunetHTA core models can be helpful when planning rehabilitation research that is clinically relevant and also transferable to other countries. This is explained with some clinically relevant research areas.

PARTNERSHIPS BETWEEN FAMILIES, SERVICE PROVIDERS AND RESEARCHERS TO IDENTIFY RESEARCH QUESTIONS

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The Peninsula Cerebra Research Unit (PenCRU) carries out a broad programme of applied research that aims to improve the health and wellbeing of disabled children and their families. Fundamental to the ethos of the unit is the meaningful involvement of families affected by childhood disability in all aspects of our research and related activities. This includes setting our research agenda and deciding how to carry out specific research projects. In addition we work in partnership with local and national agencies providing health, social and educational services for children. We believe that promoting partnerships between
families, service providers and researchers is vital to improving the lives of people affected by childhood disability. Each of these groups develops different insights into how interventions and understanding of the predicaments faced by children and families might be addressed to promote health and wellbeing. Examples of research ideas suggested by different groups will be presented, as well as methods for engaging and empowering families as partners in research. Finally, a new initiative for a research priority setting partnership with families and clinicians, utilising the method promoted by the James Lind Alliance, will be discussed.

BACK TO THE ROOTS - THE FOUNDATION OF CLINICALLY RELEVANT RESEARCH

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According to a Finnish health service report published in 2005 over 220 different outcome measures were used for clinical assessments in children and adolescents with CP. Another survey on national practice identified a fourfold difference in the intensity of physiotherapy for the same child with diplegia. These observations have provided evidence that prior conducting any bench-marking comparisons or inter-vention studies the national practice has to be unified.

A multiprofessional working process was established in 2008 in two neuropediatric units of university hospitals (Turku and Helsinki) and one outpatient clinic (Turku) in order to find reliable, valid and clinically fea-sible set of outcome measures for children and adolescents with CP. All the professional groups selected the most valid outcome measures in their field of expertise. The selection was based on the available evidence, expert opinion and ICF framework. At the second phase the selected measures were used in clinical assessments of 269 children and adolescents with CP (Jan to June 2009 and 2010). After the clinical utility of the results was analysed, the multiprofessional team agreed on the set of the recommended outcome measures.

The multiprofessional working model outlined here has greatly facilitated the process of developing national consensus recommendations of care practices. Two other university hospitals (Kuopio and Oulu) and three state-owned special schools for children with CP have already started to change their practice according to the suggested recommendations. The active and equal involvement of all the multiprofessional team members has been valued as a key factor in order to change the prevailing practice and reach commitment to the consensus recommendations.

WORKSHOP 9

SALIVA CONTROL: MULTIDISCIPLINARY MANAGEMENT AND RESEARCH FINDINGS

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Aim:
1. Describe the assessment process and the interventions that are recommended.
2. Present the results of research into the effectiveness of medication, an intraoral appliance, botulinum toxin injections and saliva control surgery.

This workshop will be useful for clinicians who wish to learn about the benefits and disadvantages of various treatments.
BEHAVIOURAL APPROACHES, MEDICATIONS AND APPLIANCES

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Drooling impedes socialization, interpersonal relationships, and integration into school and community life and may limit employment options in adults. A Melbourne saliva control clinic has adopted a hierarchical approach to the treatment of drooling, from the least to the most invasive. The assessment of the child with saliva control problems will be discussed with the role played by each multidisciplinary team member. Medication is one of the most frequently used treatments yet evidence about effectiveness and the rate of adverse effects is limited. A review of the various medications will be presented along with results of a preliminary study of the use of medication in a cohort of children attending the saliva control clinic. Little research is available regarding the use of appliances. The effectiveness of one type of intra-oral appliance, the ISMAR, in improving drooling and eating skills was studied in a group of children with cerebral palsy, to determine which factors might indicate a good candidate for this type of therapeutic approach. Eighteen children aged between 4 and 11 years were selected. Measures of drooling and feeding skills were made at baseline, at the completion of a 6-month control phase, and at two more 6-monthly time points after the ISMAR was fitted. Children varied greatly in both the length of time taken to tolerate wearing the ISMAR and time the appliance was worn. Only six children completed the full study. For these children, drooling severity scores and eating and drinking skills improved significantly over the treatment period compared to the control phase. The ISMAR remains a valid option that warrants further study but may only be useful for a small group of children with cerebral palsy given the time consuming and invasive nature of this treatment option.

ASSESSMENT TOOLS, EVALUATION OF BOTULINUM TOXIN

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Assessment tools, evaluation of Botulinum toxin Research is essential to determine how best to assess drooling problems and to evaluate the various treatments. A major problem for research in this area is the lack of valid and reliable measures of saliva control. In formulating the requirements for a new scale, the Dri Scale, a questionnaire was designed that could either be self administered by carers or allow an interviewer to record the carer’s answers. Items for the new scale were devised using information gained during clinical consultations and the expert opinion of speech pathologists. Much of the previous research had been focused on questions about the frequency and severity of drooling and the number of bib or clothing changes needed each day, so these questions were incorporated into the item pool. The clinimetric properties of the new scale will be presented.

Botulinum toxin is increasingly used for management of saliva control. A randomised trial was undertaken involving 48 participants with 24 randomised to the treatment group and receiving 25 units of Botulinum toxin into each parotid and submandibular gland. Those randomised to the control group received no treatment. The degree and impact of drooling was assessed at monthly intervals up to 6 months and then at one year post injection. Maximal response was at one month with a highly significant difference in the mean scores between the two groups which remained significant at six months. Four children failed to respond and four children had a mediocre response. In a more recent study, the secondary effects of injection in 26 children were studied. Over four weeks, improvement was seen for the entire group with respect to drooling (p<0.001), eating (p=0.05), speech (p=0.04), and sleep (p=0.01) but not saliva management. A minority of families reported worsening of eating skills.
**DENTAL MANAGEMENT**

Desai M.
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Poor oral hygiene can contribute to saliva control problems and a dentist is an important member of the saliva control team. Regular dental visits are essential with preventive advice about cleaning, use of mouth rinses, placement of dental sealants, use of topical fluoride and tooth mousse. “Tooth friendly” food and drinks are also important.

Prior to invasive treatments such as Botulinum toxin and saliva control surgery, it is essential to ensure that there is no dental caries and that gingival health and oral hygiene is satisfactory. Saliva control surgery is associated with an increased risk of dental caries occurring particularly in the lower central incisors.

Knowledge of this problem has resulted in initiation of dental surveillance for all young people having saliva control surgery, which has effectively prevented the development of caries in children now undergoing this procedure.

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**WORKSHOP 10**

**EXPERIENCES ON NEW TECHNOLOGIES IN PEDIATRIC REHABILITATION**

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**Aim:**
The workshop will update participants on the possible role of robotics and new technologies in pediatric rehabilitation. Theoretical basis and some clinical experiences will be presented.

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**NEW TECHNOLOGIES IN PEDIATRIC REHABILITATION**

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In the past 50 years several rehabilitation strategies have been used to increase functional recovery in children, to improve their autonomy and quality of life. Great progresses have been achieved due to a multidisciplinary clinical and rehabilitative approach towards children’s problems, developing new materials and making of orthosis, administration of medicines for spasticity treatment and functional surgery. Nevertheless, if we analyse the motor outcome of these children in the last decades we realize there has been no significant change. For example, the proportion of nonwalking in children with Cerebral Palsy (CP) is stable over 20 years and across centers, despite the changes that have occurred in neonatal care across Europe. In the last years new high technological devices became available for rehabilitative evaluations, and for use in substitution of abilities lost and no more amendable. This is the case of robotic exoskeletons worn during gait, which are being tested in adults with paraplegia from spinal cord injury. These devices are also potentially usable in children and adults with CP from brain damage. Today exoskeletons are available only for adults, while Robotic Mediated Therapy (RMT) devices for the recovery of motor disability of upper and lower limbs and of walking can be used on children. RMT is a new rehabilitative opportunity. The video-game approach increases the treatment motivation in children and it seems to be able to activate neuroplasticity essential for recovery. Moreover, RMT delivers a highly reproducible motor learning experience, quantitatively monitors and adapts itself to the child’s progress, and ensures consistency in planning a therapy program. Integration of RMT with regular PT treatment may further enhance its effectiveness.
NOVEL ROBOTIC SYSTEM FOR MULTIAXIAL DYNAMIC POSTUROGRAPHY

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Human upright balance control involves in the terrestrial gravitational field: the gathering of information from visual, vestibular, proprioceptive systems, and exteroceptors; and the consequent execution of appropriate and coordinate postural responses which evoke and control coordinated activities of the musculoskeletal system. Measures of postural steadiness, addressed as posturography, are utilized to assess balance control deterioration with age, trauma and disease. It is generally held view that the maintenance of the upright stance during the imposition of an experimentally induced external perturbation represents, in comparison with static condition, a more complex equilibrium task to be managed by the Central Nervous System (CNS). It was also exploited the usefulness of dynamic posturography in rehabilitative treatments to reduce balance deficits.

The main limitation inherent to all of the studies conducted on dynamic posturography is their reliance on postural responses elicited via uniaxial perturbations, while real-life situations, for which perturbations are intended to mimic, typically act along multiple directions. In that perspective we decided to develop in-house a custom parallel robot capable to continuously change the rotating direction and to be set at different values of perturbation frequency.

In this study we used quantitative assessment of upper body kinematics using dynamic posturography in healthy adults. Our working hypothesis was that the presence of the visual information, when continuous 3D support/surface motion are applied, would induce, similarly to the uniaxial perturbation, a greater upper-body stabilization than that occurring when the vision is deprived. We also hypothesized that the selection of two perturbation frequencies of the continuous 3D support-surface motion could drive the subject to elicit different compensation strategies of the upper-body.

ROBOTIC-ASSISTED GAIT TRAINING IN CHILDREN AFFECTED BY CEREBRAL PALSY

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The objective was to evaluate if robotic-assisted gait training (RAGT) in children with Cerebral Palsy (CP) could improve gross motor abilities and gait.

Driven Gait Orthosis (DGO) consists of a treadmill, a dynamic unloading system and two light-weight robotic actuators allowing to perform a physiological gait pattern with a velocity ranging from 1 to 3.2 Km/h.

There is increasing evidence that intensive functional training is effective in improving the motor abilities of children with CP. Based on the motor learning concept, RAGT offers a specific gait rehabilitation by a greater amount of stepping practice increasing speed and longer walking distance during therapy sessions.

32 ambulatory children with Bilateral Spastic CP were assigned to three 10/week training groups. 9 children had 20 sessions of RAGT and 20 sessions of TOP (RAGT+TOP), 13 children had 40 sessions only of RAGT and 10 children had 40 sessions only of TOP. The GMFM, 6-Minute Walk Test and 3DGait Analysis were assessed prior to, at the end of, and 3 months after the end of the treatment.

After the training and during the follow up, all the groups showed significant improvement in GMFM. Children of RAGT and RAGT+TOP group increased their walked distance more than children of TOP group. After the treatment, GGI derived from 3DGait was unchanged for RAGT+TOP and RAGT group, whereas children of TOP group showed a worsening in gait pattern.

Our data suggested that RAGT is safe, feasible to implement and well-accepted by children. RAGT seemed to be generally as effective as intensive traditional physiotherapy, with an additional slightly positive effect on gait endurance and maintenance of gait pattern. The DGO device had a positive impact on children’s and family’s daily life.
ASSESSMENT AND MANAGEMENT OF PAIN IN CHILDREN AND YOUTH WITH CEREBRAL PALSY

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Aim:
Chronic pain in children and youth with CP significantly impacts on child participation in activities and quality of life. This course will guide the clinician to more accurately identify children and youth with CP who experience pain and develop a differential diagnosis for pain to prioritize investigations and management.

Course Summary: Attendees will be introduced to the body of research evaluating the prevalence of pain in children and youth and the negative impact of pain on activity, participation, and overall quality of life. Common risk factors and causes of pain will be presented and include clinical patterns of pain presentation. Discussion will focus on overcoming the challenge of developing a differential diagnosis for pain in this population given the heterogeneity of potential causes of pain. Attendees will be introduced to multiple evidence-based pain assessment tools available for use in this population based on a systematic review of the literature. Finally, intervention options will be discussed for the management of pain with a particular focus on musculoskeletal pain. Workshop attendees will then participate in case discussions centered on children/youth with CP who present with pain focusing on assessment, differential diagnosis and management strategies.

Target Audience: Health Professionals caring for individuals with cerebral palsy

Objectives: At the conclusion of this course the participant will:
1. understand the need to clinically inquire/assess for pain in children with cerebral palsy
2. have a working knowledge of tools for identifying pain in this population
3. understand and be able to identify potential causes or risk factors associated with pain for the development of a thorough differential diagnosis
4. have working knowledge of pain management strategies for children and youth with cerebral palsy

Format:
• Prevalence of pain in children and youth with CP; Risk factors for pain and differential diagnosis (D Fehlings)
• Pain assessment tools for children and youth with CP (derived from a systematic review) (D Fehlings)
• Intervention options for management of pain (D Fehlings)
• Discussion of MSK pain in CP (U Narayanan)
• Case Discussions (U Narayanan, D Fehlings)

THE FUTURE OF REHABILITATION? USE OF WEB BASED REHABILITATION FOR PERSONS WITH CEREBRAL PALSY

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Aim:
To summarize the latest evidence on new virtual reality technologies used as therapy for persons with Cerebral Palsy, to explore future technologies in this rapidly expanding area, and use Mitii as an example of a successful web delivered program.

“INTRODUCING THE FUTURE OF REHABILITATION”

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The Queensland Cerebral Palsy and Rehabilitation Research Centre (QCPRRC), in Australia, have partnered with the Helene Elsass Center in Denmark, to explore eBRAIN: a new frontier of rehabilitation, which is virtual reality and novel web-based training. This session will present the research teams at these two centers and summarize workshop themes.

“CURRENT EVIDENCE FOR VIRTUAL REALITY AND WEB BASED INTERACTIVE TRAINING”

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Virtual reality as an intervention for children with cerebral palsy is relatively new and research is rapidly evolving. So far the emphasis has been on establishing its feasibility as a therapeutic modality for rehabilitation. Systematic reviews of evidence have found emerging evidence supporting the ability of these technologies to improve motor capacity, visual-perception, participation, and neuroplasticity; though methodological quality and small subject numbers limit the conclusiveness of these results. In addition to more rehabilitation specific benefits, virtual reality systems which utilize whole body movements may have the potential to increase physical activity levels.

Our systematic review of evidence determined the ability of virtual reality interventions to increase physical activity capacity and performance in children and youth with cerebral palsy. Four studies of limited methodological quality were identified. The studies included predominantly commercially available active video games or rehabilitation specific virtual reality systems, which are limited by cost (ranging from EUR160 to EUR10,500) and their ability to be individualized to clients particular needs. Mitii (Move it to improve it) has the potential to overcome these limitations. Mitii is a web-based interactive training delivered using the internet using a home computer and simple low-cost equipment, and is individualized by a team of virtual trainers. Virtual reality systems delivered using the internet, have the ability to remotely deliver interventions at a similar or greater intensity to one-on-one therapies. This session will summarize the current evidence for virtual reality and web based interactive training for children and adolescents with cerebral palsy.

“MITII: MOVE IT TO IMPROVE IT - BACKGROUND AND APPLICATIONS”

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Move it to improve it or Mitii was developed, and piloted to provide proof of concept that individualized and supervised interactive home-based training delivered through the internet may provide an efficient way of maintaining intensive training of children with cerebral palsy over prolonged periods. The therapeutic construct is multimodal training, including bimanual coordination, motor planning, visuospatial training, physical activity and cognitive training. Pilot testing in 9 children concluded that it is feasible to deliver interactive training of children with cerebral palsy at home through the internet and thereby ensure more intensive and longer lasting training than what is normally offered to this group. Since pilot testing, 60 children and adolescents with CP in Denmark have undertaken Mitii training, and a study is currently underway in Australia where 98 children and adolescents with CP will participate in a randomized controlled trial of Mitii training. This session will include the background of the development of Mitii, results from testing in children and adolescents with CP, present case studies, and explore potential applications of this novel web-based training.

“MITII: MOVE IT TO IMPROVE IT - PRACTICAL WORKSHOP”

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This practical session will allow participants to try Mitii firsthand.

“FUTURE DIRECTIONS FOR NEURO-REHABILITATION”

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This final session will present future technologies and research projects being completed at the Helene Elsass Center and QCPRRC, and explore what health technologies we are likely to see for the rehabilitation of persons with cerebral palsy in the near future.

WORKSHOP 13

COGNITIVE FUNCTIONING AMONG CHILDREN WITH CEREBRAL PALSY: THE STRENGTHS AND DIFFICULTIES

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Aim: Cognitive functioning among children with CP will be presented in relation to a number of background variables and especially to the level of motor impairment. Deficits in executive functions among youth with CP will be analyzed. Fluctuation of cognitive functioning as a result of environmental support will be discussed.
COGNITIVE AND COMMUNICATIVE PROFILES OF ICELANDIC PRESCHOOL CHILDREN WITH CEREBRAL PALSY

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Background: Intellectual assessments of children with CP are challenging as physical impairment can hamper them from responding to standardised tests. However, erroneous presumptions about their abilities may prevent children from receiving adequate educational opportunities.

Aim: A. To explore the cognitive profile of children with CP. B. To evaluate speech and expressive language skills of children with CP.

Subjects and Methods: Cross-sectional observational study based on data obtained through clinical assessments of a whole population of children with CP. Mean age 5 years 5 months, SD 6 months.

A. The cognitive profile of 127 children was assessed using either the Wechsler Preschool and Primary Scale of Intelligence (WPPSI) (IQ) or various developmental scales (DQ).

B. Speech and expressive language skills of 152 children were studied. Children were classified as verbal or nonverbal communicators and speech was classified as normal, mild or severe dysarthria.

Results and Discussion: A. 42% of the group had IQ/DQ scores within the normal range whereas 40% had scores below 70. Children with diplegia and quadriplegia had significantly lower performance IQ than verbal IQ. A third of the group could not be assessed by WPPSI but 20% of these children had DQ within the average range. B. Most children (72%) expressed sentences, two-thirds had normal speech or mild dysarthria whereas 16% were non-verbal. A quarter of children with severe dysarthria had normal or borderline cognition. The results of the two studies will be discussed and we’ll emphasize that detailed assessments can unfold skills which may affect children’s educational planning.

PREDICTING COGNITIVE FUNCTIONING IN CHILDREN WITH SPASTIC CEREBRAL PALSY

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Background: Among children with cerebral palsy (CP), the severity of motor impairment seems to be associated with the level of general cognitive functioning, showing negative association between the level of Gross Motor Function Classification Scale (GMFCS) and the cognitive level. However, it is not known whether the association between the motor impairment and cognition is restricted to general IQ/DQ only or also to specific aspects of the cognitive profile and educational achievement.

Aim: To describe the cognitive profile among children with spastic CP in all levels of motor impairment (GMFCS level 1-5) and to investigate whether the GMFCS level is associated with the cognitive profile and academic achievement.

Subjects and Methods: An extended battery, fully adapted to the motor limitations of the participants, was administered to children with spastic CP (N = 105; 66 %, male), and aged 4-16.5 years (M = 8.9; SD = 2.9). The scores were computed according to six indexes: IQ, Verbal Abilities, Visual Abilities, Verbal Memory, Attention and Executive Functions, Reading, and Arithmetic. The motor impairment of the participants was classified according to the GMFCS level.
EXECUTIVE FUNCTIONS IN YOUTH WITH SPASTIC CEREBRAL PALSY

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Background:
In general, patients with cerebral palsy score significantly lower on a wide variety of executive function tests compared to peer control groups. However, a significant statistical difference in performance between a patient group and a control group does not per se imply clinical relevance.

Aim:
To examine EF skills of individuals with cerebral palsy.

Subjects and Methods:
Nineteen patients with mild to moderate spastic CP (age range from 7 to 17 years) participated. Their GMFCS and MACS scores ranged between 1 and 3. The majority of the patients had an IQ > 80. Brain MRI data during the first year of life or later were used to determine the lesion site. The EF was assessed by the Conner’s Continuous Performance Test (CPT) which has norms for focused attention, vigilance, and impulsivity. Test parameters are converted to T scores. Mild criterion (2 atypical T scores) and stringent criterion (4 atypical T scores) were used. Additionally, the Inhibition subtest from NEPSY-II with standardized scores was used.

Results and Discussion:
According to the CPT, between 35% and 53% of the participants had EF deficits within the clinical range. According to the NEPSY, 45% of the participants showed inhibition deficits within the clinical range. Consequently, standardized tests validate laboratory findings that a significant number of children with CP indeed have executive function deficits. However, CPT scores correlated with gender, lesion site and birth weight, not the NEPSY scores. It seems that the CPT and the NEPSY results differ in many respects, and the outcomes may lead to different interpretations when using them in the clinical setting.

COGNITIVE FUNCTIONING OF CHILDREN WITH SPASTIC CP VARIES WITH ENVIRONMENTAL SUPPORT OF CHILD PARTICIPATION

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Background: Visual and attentional impairments are common among children with spastic CP. The cognitive impairments affect the ability of the child to participate in social activities and learn relevant skills. The dialectic processes between intrinsic and extrinsic factors affect and develop each other, calling for analyses of how the interaction between the child and his/hers social conditions for learning and cognitive development at one point in time has the potential to impact on the developmental trajectory of the child.

Aim: to investigate how attention and visual functioning of a child with severe spastic CP and CVI arise from the dialectical relationship between the child and the support in 1) school 2) the home environment.

Subject and Methods: The case of an 11-year-old boy with severe CP and CVI was selected for this study. A huge disparity was observed between the parents’ and the professionals’ perceptions of his present abilities and proximal developmental possibilities. Video observations from school and home were analysed at three levels of increasing complexity: 1. coding of observable behaviors; 2. coding of activity patterns; 3. interpretations of developmental incongruence and congruence.

Results and Discussion: Analyses revealed that the boy’s use of his visual ability and his impairment in attention depended on how the adults respond to him and on the organization and quality of the social interaction. The visual perception of the child with CVI is a highly variable cognitive function that fluctuates not only due to environmental properties such as lighting but also as part of the content and structuring of activities with other children and adults as participants. The two settings create different
levels of functioning. The influence of developmental impairments and biological deficits, as well as particular patterns of interaction and social conditions on cognitive functioning will be discussed.

SKILL LEARNING AMONG CHILDREN WITH SPASTIC CP

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Background: Skill learning (SL) indicates the ability to learn incidentally, as a result of repeated exposure and practice. SL seems to play an important role in cognitive development. Surprisingly, relatively little is known about the effects of developmental disorders on SL.

Aim: To examine: (1) differences between children with spastic CP and normally developed controls in SL; (2) the effect of age on SL in children with CP and in controls.

Methods and Subjects: Twenty-five children with spastic CP and 25 matched healthy controls, aged 9-19 years. All children performed three SL tasks in two separate sessions: (1) the Serial Reaction Time (SRT) task in which learning is studied via a repeated sequence of finger movements; (2) a non-motor SRT task, in which participants respond only to one location of the repeated sequence, thus decreasing the amount of motor effort in the acquisition of the skill, and (3) a Probabilistic Classification Learning (PCL) task in which cue-outcome associations are learned gradually over many trials.

Results and Discussion: In the SRT task a marginal improvement in performance was found in both groups. Yet, the children with CP were significantly slower than controls. In addition, introduction of a random sequence caused a decline only in the control group, indicating that the improvement in the CP group was a result of general decrease in reaction time only. In the non-motor version of the SRT task only the CP group improved in reaction time, possibly due to a floor effect in the control group. In both SRT tasks no age effect was found. In the PCL task, a significant improvement in performance between younger and older children was found for controls, but not for the CP group. To conclude, skill learning among children with CP is qualitatively and quantitatively different than that of their peer controls. Understanding the unique aspects of SL in children with CP might help planning efficient interventions.
IT IS MY LIFE. PROMOTING AUTONOMY IN ADULT LIFE FOR YOUNG PEOPLE WITH CHILDHOOD ONSET DISABILITY.

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Aim:
In their transition to adulthood, young people with CP may experience problems to regulate their own lives and take responsibility for their health. In this symposium we share expertise from the Netherlands and Canada on interventions to promote the autonomy of youth with disabilities.

YOUNG ADULT TEAMS: INTERVENTIONS TO EMPOWER YOUNG PEOPLE WITH DISABILITIES

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Young people with CP without severe intellectual impairment show a delayed transition to adulthood for housing, work and sexual experience. In this process, many of them experience problems in self-care, productivity and leisure activities. This stresses the importance of focusing transition programs for youth and young adults with disabilities (including CP) on autonomy and participation. A key element for young people with a disability is to learn how to self-manage life. Using this element, Dutch rehabilitation centers developed a series of interventions for several life areas.
In this presentation, we share our experience with a modular transition program of outpatient rehabilitation clinics for young adults. We will discuss an intervention aiming to improve work participation of young adults with disabilities and introduce the Rotterdam Transition Profile as a practical tool for goal setting and monitoring transition to adulthood in clinician-youth interaction. Interaction with participants of the workshop is encouraged by giving practical examples and discussing the preliminary effectiveness and feasibility of the program.

TEEN TRANSITION TEAMS: HELPING YOUTH WITH CP AND FAMILIES TO PREPARE FOR ADULT LIFE

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Many teenagers with CP currently are limited in their participation in everyday life, and in adulthood; they do not catch up with their healthy peers. In late adolescence, young people usually, but not always, are able to regulate their own lives. It is also a time when adult behaviours become established and therefore represents a window of opportunity to promote healthy behaviour. For youth with disabilities (including CP), it is therefore of utmost importance to provide support through developmentally appropriate life experiences and regular opportunities.
In this presentation I will focus on the importance of preparation phase in the process of transition to adulthood. Case (video) examples of youth with CP from a specialized teen-transition clinic will be shared.
to illustrate the topics relevant to the preparation for adult life and how these are discussed. The application of the self-report version of the Rotterdam Transition Profile will be demonstrated. Also, results from a pilot study evaluating the use, perceived utility and impact on self-determination of a novel transition intervention will be presented. The novelty of our approach lies within the way we deliver services to youth and young adults, because it shifts the paradigm from ‘doctor knows best’ towards an empowered young person who enters the adult world knowing what is important and how to deal with the system. The intervention includes two components: a downloadable Youth KIT© that promotes information-gathering and health self-management, and an internet-based Transition Coordinator (TRACE) with whom youth can interact online. It is hoped that this presentation will allow a new paradigm of patient-driven transition navigation that will enhance self-determination and continuity of care.

INTERVENTION ACTIVE LIFESTYLE AND SPORTS PARTICIPATION: TOWARDS HEALTHY ADULT BEHAVIOUR

Van den Berg-Emons H.J.G. 1, Slaman J. 1
1MoveFit research group, Erasmus University Medical Center, Rotterdam, the Netherlands.

People with CP, both children and adults, are known to have inactive lifestyles and impaired physical fitness. Since this may impact health, daily functioning, participation, and quality of life, it is important to promote an active lifestyle and improve fitness in people with CP. During adolescence and young adulthood, people start to develop their own lifestyle. This seems to be a critical period since studies in the general population showed declines in physical activity and increases in body fat at this age. Therefore, to improve and maintain health during adulthood, treatment in adolescents and young adults with CP should also focus on activity and fitness.

In this presentation we discuss the intervention ‘Active Lifestyle and Sports Participation’, which is offered in outpatient rehabilitation clinics for young adults. The intervention aims to improve levels of physical activity and fitness. The main approach consists of personalized tailored counselling sessions with a physical activity counsellor. Other components of the intervention are sports participation and fitness training.

The background and content of the intervention will be presented. Interaction with participants of the workshop is encouraged by sharing our experiences with the intervention in adolescents and young adults with CP.

FITNESS AND PHYSICAL ACTIVITY STIMULATION IN THE TREATMENT OF CHILDREN WITH CEREBRAL PALSY

Balemans A.C.J. 1, Van Wely L. 1
1Department of Rehabilitation Medicine, EMGO Institute for Health and Care Research, Research Institute MOVE, VU University Medical Center, Amsterdam, the Netherlands

Aim:
Emphasizing the role of fitness, fitness testing, and physical activity stimulation in clinical decision-making for children with cerebral palsy.
THE ROLE OF FITNESS IN THE REHABILITATION TREATMENT OF CHILDREN WITH CEREBRAL PALSY

Balemans A.C.J.
Department of Rehabilitation Medicine, EMGO+ Institute for Health and Care Research, Research Institute MOVE, VU University Medical Center, Amsterdam, the Netherlands

Children with cerebral palsy suffer from motor impairments that interfere with performing daily activities, which might result in a reduced level of physical activity. In addition, physical fitness in terms of aerobic and anaerobic fitness is lower than in typically developing children. Adequate levels of physical fitness are related to general health, exercise tolerance, and prevention of the development of secondary conditions. The activity limitations and reduced level of fitness may induce a vicious cycle of deconditioning, which might in the end result in worsening of the motor problems, despite the fact that cerebral palsy is a non-progressive disorder. Both the motor impairments and inactivity affect the level of physical fitness. Furthermore, the impairments associated with cerebral palsy result in a higher energy cost of walking. In combination with the decreased physical fitness this can cause a higher physical strain of activities inducing an early onset of fatigue. Both aspects (reduced fitness and higher energy cost) require different treatment strategies. The aerobic and anaerobic fitness and physical strain should objectively be assessed in order to set up tailored therapeutic interventions. In this contribution we will discuss the role of fitness and fitness testing in the treatment of children with cerebral palsy.

Topics to discuss:
- The importance of physical fitness
- Assessment of fitness
- Implications of fitness test results for medical and paramedical treatment

PHYSICAL ACTIVITY STIMULATION FOR CHILDREN WITH CEREBRAL PALSY BY MOTIVATIONAL INTERVIEWING

Van Wely L.
Department of Rehabilitation Medicine, EMGO+ Institute for Health and Care Research, Research Institute MOVE, VU University Medical Center, Amsterdam, the Netherlands

Regular physical activity is essential to stay healthy for everyone, but especially for individuals with motor problems interfering with daily activities, such as children with cerebral palsy. To stimulate physical activity of children with cerebral palsy one should consider that the level of the motor problems, as indicated by the Gross Motor Function Classification System, the physical fitness levels, and the perceived barriers to increase physical activity vary among children with cerebral palsy. It is therefore important that the possible causes for reduced physical activity are individually assessed, in order to individually tailor medical and paramedical interventions. Physical activity stimulation should strive for a multi-factorial approach, by for example incorporating a fitness training program and counseling towards a more active lifestyle. In this contribution we will indicate how the interview technique “motivational interviewing” can be used to elicit a change in physical activity behavior and lifestyle in children with cerebral palsy.

Topics to discuss:
- Integrating the current level of physical fitness in tailoring physical activity stimulation
- Using the technique “motivational interviewing” in physical activity stimulation
CLINICAL EXAMPLES OF IMPLEMENTING FITNESS ASSESSMENT IN THE REHABILITATION TREATMENT OF CHILDREN WITH CEREBRAL PALSY

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1Department of Rehabilitation Medicine, EMGO+ Institute for Health and Care Research, Research Institute MOVE, VU University Medical Center, Amsterdam, the Netherlands

The VU university medical center has performed an implementation project, in which we integrated fitness testing as an additional tool within the process of clinical decision-making. In this contribution we will discuss clinical examples of the role of the assessment of aerobic and anaerobic fitness, and physical strain in the rehabilitation treatment of children with cerebral palsy.

Topic to discuss:
- Clinical examples by means of case-studies

SYMPOSIUM 8

REORGANIZATION OF MOTOR AND PERCEPTUAL FUNCTIONS AND CLINICAL CORRELATES

Eyre J., (UK), Krageloh-Mann I (Germany), Pannek K. (Australia)

REORGANISATION OF SENSORIMOTOR SYSTEM AND CLINICAL CORRELATES – fMRI

Krägeloh-Mann I.
University Children’s Hospital, Department for Pediatric Neurology, Tübingen, Germany

Functional magnetic resonance imaging (fMRI) can be used to assess cortical activation following motor activation or sensory stimulation tasks in children with sensorimotor impairment following early brain lesions. For the assessment of reorganisation within the sensorimotor system a multimodal approach is necessary, however. Especially TMS (transcranial magnetic stimulation) and SEP (sensory evoked potentials) are complementary methods. Here the specific role of fMRI in elucidating the characteristics of organisation and reorganisation in the sensorimotor system with respect to early, unilateral lesions will be highlighted and discussed with respect to TMS and SEP/MEG results.

In smaller lesions, not disrupting the motor tracts, an enlarged motor network involves also the healthy hemisphere (1). In larger lesions, disrupting the motor tracts, abnormal fast conducting corticospinal projections from the healthy hemisphere exert the primary motor control. Such ipsilateral projections are physiological in the neonate and can apparently be maintained under pathological conditions (2, 3). However, their functional role seems to decrease already during late gestation (4).

In contrast, interhemispheric reorganisation seems not to be possible in the sensory system. Thus, in larger unilateral lesions, where the healthy hemisphere has taken over primary motor control, primary sensory representation still remains in the lesioned hemisphere (5,6). Thus, there is a dissociation between primary motor and primary sensory representation. We have evidence for axonal deviations but not substantial intrahemispheric reorganisation of the cortical representation (6, 7). Sensory deficits and also connectivity are dependent on the fact, whether the primary or secondary sensory cortex are lesioned (8, 9).

References:
5. Guzzetta A et al.(2007) J Clin Neurophysiol,
7. Staudt M et al. (2006) Neurology
8. Jünger et al. (2012) Cerebral Cortex
USE OF ADVANCED DWI TECHNIQUES

Pannek K.
The University of Queensland, Brisbane, Australia

Diffusion MRI is a non-invasive technique for the assessment of white matter microstructure. The diffusion of water molecules in the brain provides indirect information about the degree of organisation, myelination and fibre density. Anisotropy of diffusion indicates the orientation of white matter bundles, and allows delineation of white matter pathways with the help of tractography. The use of diffusion MRI for the study of cerebral palsy has increased over the recent years, with the majority of studies assessing the cortico-spinal tract (see [1] for review). It is, however, increasingly recognised that other ascending, descending, commissural and association pathways may also be affected by cerebral palsy. Advances in diffusion MRI have improved the accuracy of tractography by enabling the resolution of crossing fibres within the brain. The network of structural connections in the brain can be assessed with the connectome framework, which helps identify connections commonly affected by cerebral palsy. More recently, techniques that allow statistical analysis of white matter properties even in the presence of crossing fibres have been developed. These techniques will allow more accurate assessment of structural brain changes in cerebral palsy, and the effect of therapy. Application of these techniques to infants at risk of developing cerebral palsy will improve early detection.

References:

CLINICAL CORRELATES OF ADVANCED ELECTROPHYSIOLOGICAL TECHNIQUES

Eyre J.
Institute of Neuroscience, Newcastle University, UK

NOT RECEIVED


**GENERAL GUIDELINES FOR GMS ASSESSMENT AND DYSKINETIC CP**

**Einspieler C.**
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Prechtl’s assessment of spontaneous general movements (GMs) has shown its merit for the prenatal and postnatal evaluation of the integrity of the nervous system. It is a reliable and valid tool for distinguishing between infants who are at significant risk of developing neurological deficits and infants who are not. Central are the age-specific “fidgety movements” – small movements of the neck, trunk and limbs in all directions and of variable acceleration. Various work groups have emphasised the significance of fidgety GMs for an early prediction of the neurological outcome: Infants develop normally if fidgety GMs are present and normal (specificity 82% to 99%), even if their brain ultrasound findings indicate a disposition to later neurological deficits. Conversely, if fidgety movements are absent, infants develop neurological deficits (sensitivity of 95% to 100%). Fidgety movements are absent in all eventual subtypes of cerebral palsy. In addition, infants who develop dyskinetic cerebral palsy, move their arms circularly and spread the fingers.

**FOCAL LESIONS, HEMIPLEGIA AND GMS**

**Guzzetta A.**
Department of Developmental Neuroscience, Infant Neurology Section, Stella Maris Scientific Institute, Pisa

New evidence suggests that spontaneous hand and digit movements of infants from birth to 5 months are various and abundant, including segmental wrist movements, fistig, pre-precision grips (sideways contacts between thumb pad and the side of other fingers), precision grips (contacts between thumb pad and other digit pads). The emergence and early development of these complex hand movements has been posed in relation to the maturation and function of the cortico-spinal tract, on the basis of recent electrophysiological and anatomical studies suggesting that in humans direct connections of the pyramidal tract to motor neurons are established before birth. Should this be true, development of hand movements would be impaired from the first weeks of life in infants with unilateral brain damage and later hemiplegia.

We review here the data available regarding GMs and segmental hand movements in infants with asymmetric brain damage. They show how in preterm and term infants with unilateral brain damage, asymmetries of segmental distal movements of the upper limb at 3 months post-term age are related to later development of hemiplegia. More specifically, at least in term infants with arterial stroke, we have studied the number per-minute of different types of hand movements (i.e. segmental wrist movements, isolated finger movements and global hand movements) and compared it with neuromotor outcome at 2 years. It is of interest that the relative reduction of wrist movements and isolated finger movements (but not that of glogal hand movements) was associated with the development of hemiplegia. In conclusion, our findings show that, at 3 months of age, infants with neonatal stroke may present with a relative impoverishment of the contralesional upper limb in terms of distal movements, which is always predictive of later hemiplegia.
Nevertheless, the degree of impoverishment or asymmetry was not correlated with the severity of motor impairment, suggesting that other factors play a significant role in the prediction of functional outcome at this age. These findings need to be replicated on larger cohorts and possibly with more precise tools. Having a strong and reliable early predictor of hemiplegia would be of pivotal importance in all the intervention studies in order to ascertain whether the found effects are related to intervention-dependent functional reorganization or are just reflecting the natural history of the disorder.

QUALITY OF REPERTOIRE OF GMS AND SEVERITY OF CP

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Background and aim: The quality of fidgety movements (FMs), assessed between 9 and 16 weeks after term, is a reliable and valid predictor of cerebral palsy (CP): most infants (96%) with normal FMs have a normal neurological outcome, while most infants (95%) in whom FMs are absent during this particular period develop CP. However, the absence of FMs does not predict the level of self mobility in the children who develop CP. The motor repertoire at this period does not only consist of FMs but of other movement and postural patterns as well. Our aim was to determine whether these aspects of the early motor repertoire might have predictive value for the severity of the functional limitations of CP at school age.

Methods: Video-recordings were made at 11-17 weeks after term in 37 preterm infants (20 male/17 female) who later developed CP. The early motor repertoire was assessed by obtaining a motor optimality score. At 6-12 years, children were classified according to the Gross Motor Function Classification System (GMFCS).

Results: Of 37 children (gestational ages: 29.1 weeks [SD 1.9], birth-weights 1273g [SD 324]) nine had unilateral and 28 had bilateral spastic CP. Twelve children had GMFCS-level I, three level II, ten level III, four level IV and eight had level V. The absence of the age/adequate motor repertoire, a cramped motor repertoire, an abnormal kicking pattern, and a non-flat posture were associated with lower levels of self-mobility (Chi²-for-trend-test, p<0.05). Predictive for a low level of self-mobility was a cramped motor repertoire/ non-flat posture (PPV 100%, NPV 54%). Predictive for a high level of self-mobility was a non-crumped repertoire/ flat posture (PPV 80%, NPV 74%).

Conclusion: Several aspects of the motor repertoire at 11-17 weeks post term predicts the degree of functional limitations in children with CP at school age.

PREDICTION OF CP: MRI FINDINGS AND GMS

Fabrizio Ferrari, Isotta Guidotti, Elena Coccolini, Rossella Frassoldati, Natasia Bertoncelli, Luca Ori, Paola Zagni, Licia Lugli
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In recent years, neonatal brain magnetic resonance imaging (MRI) has been used to study the effects of perinatal and postnatal brain damage in full term and preterm infants and to predict the motor and cognitive outcome. Ischemic lesions due to perinatal asphyxia and cerebral infarction predominate in full term, whereas intraventricular–para ventricular haemorrhages (IVH) and periventricular leukomalacia (PVL) are the most common lesions in the preterm infants. In full-term infants perinatal asphyxia due to an acute severe global hypoxic-ischemic event affects the basal ganglia and thalam; an abnormal signal intensity (SI) is usually observed in the posterior limb of internal capsule. Cortex of the central sulcus and the adjacent sub cortical white matter (WM) and the brainstem are involved in the severe cases. The motor correlate is a spastic or dystonic cerebral palsy. When the predominant lesion involves WM and cortex but spares the basal ganglia, thalami and the posterior limb of
the internal capsule (a pattern likely resulting from prolonged partial hypoxia-ischemia), the motor outcome is often good, but there may be significant cognitive and behavioral impairments proportional to the extent of the WM and cortical injury. As far as infarction is concerned only the concomitant involvement of hemisphere, internal capsule and basal ganglia infarction is associated with hemiplegia. In preterm infants two types of lesions prelude nearly invariably to CP. Extensive cystic WM damage lead to later spastic diplegia in case of bilateral PVL or to spastic hemiplegia in case of unilateral PVL. Intraventricular hemorrhage grade 3, if associated with unilateral intraparenchymal involvement (i.e. IVH grade 3 plus) may lead to hemiplegia.

Early neuroimaging does not obviate the need for bedside clinical assessment. Brain imaging is not always available, images may be difficult to interpret, and not all infants follow a well-defined clinical course predictable from their imaging findings. Moreover the neurologic examination can provide information on the severity of the functional motor impairment and distinguish the infants who will walk from those who will only sit or not even acquire the sitting posture. In addition, documenting early signs of neurologic dysfunction and introducing appropriate therapies are important.

Prechtl’s assessment of general movements (GMs) is based on observation of the infant without physical examination and it as proved a to be a reliable and sensitive method in the neonatal period and early infancy for predicting normal and abnormal motor outcomes, particularly CP. Only few studies have dealt with the comparison of the predictive value of GMs versus MR scans until now.

In full-term infants affected by neonatal cerebral infarction Guzzetta et al detected movement asymmetries as early as 3 to 6 weeks post-term age that were predictive of later hemiplegia (Guzzetta et al 2003, Guzzetta et al 2010). In term infants with HIE the site and severity of brain lesions seen on early MR were highly correlated with GMs. Central gray matter damage leads to cramped/synchronized GMs and poor outcome. Early MRI scans and GMs were found to be complementary tool for predicting motor outcome (Ferrari et al 2011).

In preterm infants, Spittle and coworkers found that at 1 and 3 months abnormal GMs were strongly correlated to MR WM abnormalities. White matter abnormal SI and 3 months GMs strongly predicted CP.

SYMPOSIUM 11

MIRROR NEURON SYSTEM AND CP
Fogassi L., Biagi L., Sgandurra G., Ferrari A. (Italy)

MIRROR NEURON SYSTEM AND ITS ROLE IN MOTOR DEVELOPMENT AND MOTOR REORGANIZATION
Fogassi L.
Department of Neuroscience and RTM (Italian Institute of Technology), Parma

Mirror neurons in the monkey are visuomotor neurons that activate both when the monkey observes and executes a motor act (e.g. grasping). They have been suggested to constitute the neural basis of our automatic capacity of understanding others’ actions. In fact it has been demonstrated that a mirror system does exist also in humans, mostly involving, as in monkeys, the frontal and the parietal cortex. In recent years, among others, two very relevant issues concerning the mirror system have been empirically addressed, namely the development of the mirror system and its plasticity in monkeys and humans (both children and adults). Although we are still far from tracing final conclusions from the studies related to these two issues, two aspects can be pointed out. First, behavioural and neural data suggest the presence of a mirror system since the early stages of human newborn life. Furthermore, recent data confirm the presence of a mirror mechanism also in newborn monkeys. Second, studies investigating the role of plasticity, as revealed during action observation, show that the activity of the mirror system is strictly linked to motor
plasticity and can be used for motor learning. These aspects are very promising for an action observation-based rehabilitation.

RESULTS OF A RANDOMIZED CONTROL TRIAL OF ACTION-OBSERVATION THERAPY IN CP

Ferrari A.
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Imitation is a suitable learning modality, utilizable especially for the recovery of manipulation. Mirror neuron system sustains the ability in imitating, implementing both goals comprehension and motion-employed strategies. In Hemiplegic Cerebral Palsy (HCP) action observation training can improve unimanual and bimanual upper limb function, as demonstrated by recent research carried out by Buccino et al. (DM&CN) and by Sgandurra et al. (submitted), with favourable outcomes regarding increased spontaneous activity and personal autonomy. It is important that the complexity of proposed therapeutic models are matched to current and potential capabilities of the HCP child. Therefore it is necessary to divide HCP children according to adopted strategy in uni and bimanual manipulation activity, and then build therapeutic programs appropriate for obtaining the maximal possible improvement of manipulation function achievable for each child. Because it is very important to maintain the attention and the participation of the child, the proposed activities have to be interesting, useful for developmental needs, specific for each personal environment, as well as being as fun as possible.

EVIDENCE OF MIRROR NEURON ACTIVITY IN BRAIN DAMAGED CHILDREN

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Department Dev Neuroscience, IRCCS Fondazione Stella Maris, Pisa, Italy

A series of neuroimaging studies in fMRI, carried out in adults, report strong activations of mirror neuron system (MNS) during a task of imitation learning [1-3] and in the course of rehabilitation treatment of motor functions after stroke [4,5]. This increased activation of MNS is also observed in stroke patients showing a motor improvement following intensive training based on action observation [6], suggesting that the activation of MNS constitutes a powerful mechanism for recovery of motor deficits after stroke. At our knowledge there are no studies in children, neither in healthy nor in brain damaged children. We aimed to study the representation of MNS in paediatric subjects and its (re)-organization in children with hemiplegic cerebral palsy (HCP). We enrolled 3 distinct groups of 12 subjects: healthy children, children with HCP and healthy adults. We provided the same fMRI paradigm done with adults in our previous work [7] based mainly on the observation of complex object-manipulation tasks as compared to simple tasks executed with the left and the right hand. We demonstrated that there are some developmental differences in the organization of MNS between children and adults. The circuit network of the healthy children is more bilateral than the adults group so that the lateralization index of the system is age-dependent. Moreover, children with HCP present difference in the (re)-organization of this system respect to the age-matched control group. These preliminary findings seem very interesting and indicate that our paradigm might be useful to explore the mirror neuron function and the response to therapy in subjects with brain damage and motor disorder.

SUPPORTING OUTCOMES OF YOUNG CHILDREN WITH CP: IMPLICATIONS FROM THE MOVE & PLAY STUDY

Chiarello L., Westcott McCoy S., Palisano R.
1 Drexel University, 2 University of Washington.

Aims: The aims of this symposium are to 1) share the key findings of the Move and PLAY multisite study on the determinants of gross motor abilities, self-care, participation, and playfulness of young children with cerebral palsy, and 2) discuss the implications for clinical practice.

THE MOVE & PLAY STUDY: RESEARCH AIMS, CONCEPTUAL MODEL, AND METHODS

Chiarello L.
Drexel University, Philadelphia, PA, USA.

Move & PLAY was a prospective longitudinal cohort study involving 429 young children with cerebral palsy (CP) and their families who live in Canada and the United States. The aims were to identify child, family, and service determinants that together explain 1) gross motor abilities, 2) self-care, 3) amount and enjoyment of participation, and 4) playfulness of children, 18-60 months of age, with CP. Our overriding assumption is that early childhood is a sensitive period for development and empowerment of families with knowledge and skills to advocate for their children. We believe that knowledge of determinants of gross motor abilities, self-care, participation, and playfulness has implications for collaboration among families and service providers to identify determinants that are amenable to change and for shared decision making regarding goals and intervention planning. At Time 1, therapist assessors who met criteria for reliability measured balance, distribution of involvement, quality of movement, spasticity, muscle strength, range of motion, gross motor function, and observed the parent/child during play. Parents provided information about their children’s endurance, health conditions, adaptive behavior, self-care, and participation. At Time 2 (6 months), parents were interviewed about their family life and services they and their children received. At Time 3 (12 months), parents provided information on self-care and participation and therapists assessed gross motor function. The model for each outcome was tested using structural equation modeling. The following determinants were included in the models: child (primary and secondary impairments in body functions and structures, associated health conditions, adaptive behavior), family (relationships, social integration, expectations) and environment (intensity of rehabilitation services, family centered services, community programs, services meeting needs). The symposium includes key findings and a case scenario to illustrate practice implications.

DETERMINANTS OF MOTOR FUNCTION OF YOUNG CHILDREN WITH CEREBRAL PALSY

Westcott McCoy S.
University of Washington, Seattle, WA.

Motor abilities were measured using the Gross Motor Function Measure-66, Basal and Ceiling method. Fit statistics indicated a good fit between observed data and structural models. The models explained 58% of the variance in Time 3 motor function for children with higher motor function (Gross Motor Function Classification System level, [GMFCS], levels I and II) and 75% of variance for children with lower motor function (GMFCS levels III, IV, and V). For children in all GMFCS levels, primary impairments in body functions and structures (balance, quality of movement, spasticity, distribution of involvement) and
secondary impairments (strength, range of motion, and endurance) had direct effects on motor abilities. Primary impairments also had an indirect effect through secondary impairments. Balance contributed most to explaining the variance in motor abilities. For children in levels I and II, involvement in community recreational programs also had a direct effect on motor abilities. For children in levels III, IV, and V, adaptive behavior also had a direct effect on motor abilities. To apply the results to practice, considerations should be made regarding whether significant determinants are amenable to change by therapeutic intervention or not amenable but valuable for realistic goal setting. Our results suggest that efforts to support the acquisition of motor abilities by young children with cerebral palsy might include optimization of postural control and prevention of secondary impairments through activity-based interventions. Participation in community recreational programs may promote activity-based practice for children, especially those in levels I and II. Supporting adaptive behavior by encouraging the child’s self-awareness, adaptability, motivation, persistence, and interactions with people in real life situations may also assist to optimize motor abilities for children in levels III, IV and V.

DETERMINANTS OF SELF-CARE OF YOUNG CHILDREN WITH CEREBRAL PALSY

Westcott McCoy S.
University of Washington, Seattle, WA.

Self-care abilities were measured with the Child Engagement in Daily Life questionnaire, a new measure developed by the investigators and completed by parents. Fit statistics indicated a good fit between observed data and structural models. The model explained 65% of the variance in Time 3 participation in self-care for children with higher motor function (Gross Motor Function Classification System level, GMFCS, levels I and II) and 75% for children with lower motor function (GMFCS levels III, IV, and V). For children in levels I and II, gross motor ability, health conditions, adaptive behavior, and the extent services met child’s needs had a direct effect on self-care. For children in levels III, IV, and V, gross motor ability, body functions and structure, health conditions, adaptive behavior, family ecology, and family-centeredness of services had a direct effect on self-care. Determinants of self-care are complex and multi-factorial. Child and service factors contribute to explaining participation in young children with cerebral palsy across all motor abilities; whereas, family ecology only contributes to explaining self-care ability for children in levels III-V. Gross motor ability has the greatest contribution to self-care across all levels of the GMFCS and is, therefore, a logical focus for intervention, as are efforts to promote postural control (especially for children in levels III-V), and prevent secondary impairments. In addition, supporting children’s health and adaptive behavior may optimize children’s participation in self-care. For children in levels III-V, supporting families may also promote higher self-care performance. The results can be used to assist with realistic goal setting and intervention planning to optimize self-care of young children with cerebral palsy.

DETERMINANTS OF PARTICIPATION AND PLAYFULNESS OF YOUNG CHILDREN WITH CEREBRAL PALSY

Chiarello L.
Drexel University, Philadelphia, PA, USA.

Participation was measured with the Child Engagement in Daily Life questionnaire and playfulness with the Test for Playfulness. Fit statistics indicated a good fit between observed data and structural models. For children with higher motor function (Gross Motor Function Classification System, [GMFCS], levels I and II), the models explained the following total variance in Time 3 outcomes: 35% for amount of participation, 28% for enjoyment of participation, and 22% for playfulness. For children with lower motor function, GMFCS levels III, IV, and V, the models explained the following total amounts of variance in outcomes: 40% for amount of participation, 38% for enjoyment of participation, and 44% for playfulness. Adaptive behavior, family ecology, and number of community programs had a direct effect on amount of participation for children in both groups but gross motor ability only had a direct effect on amount of
participation for children in levels III-V. Adaptive behavior had a direct effect on enjoyment of participation for children in both groups; whereas extent services met children’s needs had a direct effect for children in levels I-II and family ecology had a direct effect for children in levels III-V. Gross motor ability had a direct effect on playfulness for children in both groups; whereas health conditions had a direct effect for children in levels I-II and adaptive behavior had a direct effect for children in levels III-V. The models accounted for a higher amount of variance in the outcomes for children with lower motor function. To impact participation and playfulness, practitioners are encouraged to broaden the focus of services to include not only development of motor abilities but also comprehensive interventions to support children’s adaptive behavior and family ecology.

SUMMARY & CONSIDERATIONS FOR CLINICAL PRACTICE

Palisano R.
Drexel University, Philadelphia, PA, USA

The models explained the most variance in gross motor abilities (58% for children in GMFCS levels I and II, 75% for children in GMFCS levels III, IV and V) and self-care (65% and 75%). A lesser amount of variance was explained for amount of participation (35% and 40%), enjoyment of participation (28% and 38%), and playfulness (22% and 44%). For all outcomes, the amount of explained variance was higher for children with mobility limitations (levels III-V) compared with children who walk (levels I-II). Body functions and structures explained the most variance in gross motor abilities. Body functions and structures also influenced self-care and playfulness (children in levels III-V) through gross motor abilities. Adaptive behavior, family ecology, and community programs were the largest determinants of participation. Adaptive behavior was a determinant of gross motor function, self-care, amount of participation, and playfulness (children in levels III-V). Health problems influenced self-care and playfulness for children who walk (levels I-II). Considerations for making decisions on interventions to improve gross motor abilities and self-care include whether impairments in body functions and structures are amendable to change and, if not, whether to adapt tasks, use assistive technology, modify the environment or some combination. The findings for participation are encouraging since adaptive behavior and environmental factors are potentially amendable to change. The findings that adaptive behavior was a determinant of gross motor abilities, self-care, and participation suggests that fostering children’s self-awareness, motivation, persistence, problem-solving, and interactions with people in real-life situations are important to optimize outcomes. Participants in the symposia will interact to identify how the findings can inform their practice to support outcomes for young children with cerebral palsy.
Trainingskurse

Donnerstag, 11. Oktober 2012
08.00 – 09.00

Trainingskurs 1

Wie man den Einsatz der Hand für Kinder unter 12 Monaten im Risiko für ein unilateralen CP erläutert

Eliasson A.N., Sjöstrand L.
Karolinska Institutet Stockholm

Ziel: Es geht um die Präsentation und Diskussion eines Modells für die sehr frühe Entwicklung der Bewegungsfähigkeit der oberen Extremität basierend auf einer modifizierten Form der Constraint/Induced Movement Therapy in Kindern, die ein unilateralen CP (CP) entwickeln könnten.


Kursformat:
- Ein Einführung in die theoretischen Konzepte hinter dem sehr frühen Trainingmodell.
- Guided by video examples, demonstrate and discuss the practical experience of implementing very early upper limb skills training.
- Discuss considerations for choice the toys to promote development of hand function in very young children.

Trainingskurs 2

Management der Hüfte im CP: Ein umfassendes Vorgehen

Narayanan U.1, Fehlings D.2
1The Hospital for Sick Children, Bloorview Research Institute, University of Toronto
2Holland Bloorview Kids Rehabilitation Hospital, Bloorview Research Institute, University of Toronto

Ziele: Definieren der Epidemiologie und natürliche Geschichte von Hüftproblemen im CP, und eine systematische evidenzbasierte Überprüfung der Rolle des Screening und frühen Eingriffen; sowie die vergleichende Effektivität von nicht-operativen, prophylaktischen und reaktiven chirurgischen Vorgehensweisen, sowie chirurgische Rekonstruktive versus Sanierung Verfahren.
Target Audience: Orthopaedic Surgeons, Physiotherapists, Developmental Pediatricians, Pediatric Physiatrists (Rehabilitation Medicine); and other health care professionals involved in the care of the musculoskeletal health of children with cerebral palsy.

Summary: This workshop will provide a comprehensive evidence based review of the management of hip in children with cerebral palsy. Population based studies provide estimates about the scope of the problem (epidemiology) and identify who is at risk for progressive hip instability. An understanding of the pathophysiological mechanisms of hip instability and the natural history provides a rationale for screening or surveillance that allows for early intervention. Using case examples, the workshop will examine the evidence of the effectiveness (or not) of early interventions, including physiotherapy, spasticity management (botulinum toxin or phenol), bracing, and soft tissue procedures; and discuss the prevailing controversies about the comparative effectiveness of early prophylactic versus early reactive approaches to surgical reconstruction and contrast these with that of late salvage procedures. The workshop will also discuss how best to measure outcomes of hip interventions using the ICF model with an emphasis on more meaningful patient/parent reported outcomes in addition to conventional radiographic measures.

Objectives & Course Format:
1. Epidemiology, pathophysiology of hip instability in CP: Who is at risk and when? (5 min)
2. Natural History & the Goals of Prevention & Treatment of Hip Instability (5 min)
4. Role & effectiveness of Non-operative Interventions (5 min)
5. Role of Surgery for hip instability (with case examples) (20 min)
   a. Early Prophylactic versus Reactive approaches
   b. Reconstructive Surgery: When and what to do?
   c. Salvage surgery: When and what to do?
6. Do our interventions work? Measuring outcomes of hip interventions (10 min)
7. Discussion: Questions & Answers (10 min)

TRAINING COURSE 3

CLASSIFICATION OF MOTOR SPEECH DISORDERS IN CHILDREN: DESCRIPTIVE ANALYSIS IN PERCEPTUAL ASSESSMENT

Brady T., Ní Murchú D.
Central Remedial Clinic, Waterford, Rep. of Ireland

Aim: To provide a framework for assessment and differential diagnosis of motor speech difficulties in children using a speech process theoretical model. To identify the primary contributing factor(s) to a dysarthric presentation to inform treatment.

Course Content: This course will provide a summary of the definitions and theory underpinning motor speech and the difficulty of applying an adult/acquired based system to a developmental population. It aims to outline a top-down descriptive method derived from the speech process theoretical model but placed in the greater context of the interplay between speech and other cognitive and sensory domains. This course will look at the challenges and pitfalls of attempting to assess in isolation a motor skill (speech) which is known to occur within a complex language-sensory-motor framework.

Course Format:
1. Definitions given
2. Theoretical overview of speech production
3. Developmental issues
4. Relationship between motor speech and other domains
5. Proposed form of description of presenting speech difficulty based on theoretical overview supported by video
6. Discussion time
"Cerebral" refers to the brain and “palsy” to muscle weakness/poor control. Cerebral palsy itself is not progressive (i.e. brain damage does not get worse); however, secondary conditions, such as muscle spasticity, can develop which may get better over time, get worse, or remain the same. The physical challenges of people with Cerebral Palsy intensify with age, frequently resulting in increased spasticity, fatigue, and the loss of strength and mobility (CPA, 1994).

Cerebral palsy People with Lack of postural stability and independent mobility predisposes to:

- Tissue adaptation leading to established contracture and deformity.
- Tissue damage including pressure ulcers.
- Infections - respiratory and urinary.
- Osteoporosis.
- Constipation.
- Reduced functional mobility.
- Increased effort of care.

Aims therefore are:

- Maximise functional ability & independence.
- Minimise secondary complications.
- Minimise effort of care.

Majority of the people with Cerebral palsy never born with a physical deformity, it’s happening throughout their life cycle. A programme to 'manage' the physical condition as a whole is very essential.

Postural Management

A postural management programme is a planned approach encompassing all activities and interventions which impact on an individual’s posture and function. Programmes are tailored specifically for each person and may include special seating, night-time support, standing supports, active exercise, orthotics, surgical interventions, and individual therapy sessions (Gerricke 2006). The earlier the intervention, the better - but it is never too late to start protecting and restoring someone’s body shape.

24-hour Postural Management is a programme which is applied throughout the day to encompass all activities and interventions which impacts on an individual's posture and function. The physiotherapeutic approach is evolving from a position of treating the impairments to one of managing the physical condition.

Benefits of 24 HR Postural Management, Positioning and treatment in lying, sitting and standing is designed to:

- Improve functional ability, encourage normal movement patterns.
- Maintain proper skeletal alignment.
- Reduce the progression of deformity.
- Reduce fatigue.
- Enhance autonomic nervous system functions.

With postural management care we can aim of reducing secondary complications associated with the impairment while at the same time facilitating remaining functional ability and therefore we can get-up-and-go to improve overall quality of life of a person with Cerebral palsy.
DYSKINETIC CP: PATHOLOGICAL SIGNS AND CLINICAL EVALUATION OF DYSTONIA AND CHOREOATHETOSIS IN CP

Monbalin E., Ortibus E., Feys H.
1Katholieke Universiteit Leuven, Department of Rehabilitation Sciences, Leuven, Belgium
2University Hospital Leuven, Department of Paediatrics, Leuven, Belgium

Aim: This training course aims to improve insights in the second largest Cerebral Palsy group namely Dyskinetic CP.
Course Summary: In the past two decades, interest in cerebral palsy (CP) has increased remarkably. However, compared with the spastic CP type, the assessment and treatment of patients with dyskinetic CP are still underreported. This lack of research is understandable in view of the complexity of dystonia and choreoathetosis in dyskinetic CP, rendering it difficult to measure. According to the Surveillance of Cerebral Palsy in Europe (SCPE), dyskinetic CP is characterized by involuntary, uncontrolled, recurring, occasionally stereotyped movements in which the primitive reflex patterns predominate and muscle tone varies.* Dyskinetic CP is further subdivided into dystonia and choreoathetosis. The SCPE described dystonia in CP as dominated by abnormal postures that may give the impression of hypokinesia and muscle tone that is fluctuating (but with easily elicitable tone increase). Characteristics are involuntary movements, distorted voluntary movements, and abnormal postures due to sustained muscle contractions. Choreoathetosis in CP is dominated by hyperkinesia and tone fluctuation (but mainly decreased). Chorea refers to rapid, involuntary, jerky, often fragmented movements. Athetosis means slower, constantly changing, writhing or contorting movements. These clinical characteristics are of major importance to differentiate dystonia and choreoathetosis in dyskinetic CP.
This course is subdivided in four parts. First, definition and classification of CP will be presented with special attention for the discrimination between dystonia and choreoathetosis. Secondly, pathological signs will be reviewed in accordance with the International Classification of Functioning, Health and Disability model (ICF), specifically within the ICF body function and structure. The third part will focus on clinical assessment, with special attention for the newly developed Dyskinesia Impairment Scale.** In the fourth part, the possibility will be given to evaluate dystonia and choreoathetosis in an interactive way with the audience using videos of clinical cases.


Course outline:
10min: part 1_Definition and Classification
15min: part 2_Pathological Signs
15min: part 3_Evaluation
10min: part 4_Clinical cases
10min: questions
WEB BASED HOME REHABILITATION GAMING SYSTEM FOR BALANCE TRAINING

Kachmar O., Kozyavkin V., Markelov V., Kachmar B., Melnychuk V.
International Clinic of Rehabilitation, Truskavets, Ukraine

Aim of the Course: To acquaint and teach participants to use the Home Rehabilitation Gaming System designed for movement training under distant supervision by a therapist and available for free use at http://game.reha.lviv.ua.

Course Summary: Recovery and acquisition of motor skills depends on neuroplasticity that is driven by repetition, intensity, motivation and task oriented training. Recent experimental evidence suggests that virtual reality technologies have great potential in neurological rehabilitation of patients with movement disorders.

Presented at the training course Home Rehabilitation Gaming System was developed for motor training of patients with movement disorders by combining exercises with computer games. System does not need expensive special equipment and could be used at home under distant supervision by a therapist.

The system could be used for training different movements with several types of motion controllers (Nintendo Wii remote, Nintendo WiiFit balance board, motion sensor Kinect, custom made rehabilitation gaming devices).

At the course we will demonstrate its use for patients with balance disorders. A personal computer with Internet connection and commercially available low cost balancing board Nintendo WiiFit is required for training. The board has pressure sensors defining the position and displacement of patient’s center of pressure. The patient is standing or sitting on the balance board and while performing balance training exercises he/she at the same time is controlling movements of computer game character.

Currently six special games each with 5 levels of difficulty have been developed. Before the training sessions each game is calibrated according to the patient’s possible range of movements. Balance training is performed in following positions: a) standing on a board with the left - right shift of body weight, b) standing with forward - backward shift of weight, c) standing with support, d) sitting on the board, e), standing, one foot in front of another, e) on the knees.

Physical therapist evaluates the patient and develops training program for him, indicating recommended games, training positions, frequency and duration of sessions.

After setting up home computer, patient logs in to the System at webpage, selects the recommended games and starts training session. Information about duration and time of the gaming sessions and game score is stored in the system and is available to the therapist.

Course Format: Participants will: a) get acquainted with rehabilitation system, b) try different gaming exercises, c) learn to set-up computer, d) discussion.
FRIDAY, 12TH OCTOBER, 2012
08.00 – 09.00

TRAINING COURSE 7

TREATMENT PLANNING TARGETING FUNCTIONAL HAND USE FOR CHILDREN WITH UNILATERAL CP 8 MTHS -12 Y OF AGE

Krumlinde-Sundholm L.¹, Hoare B.², Greaves S.³
¹Karolinska Institutet, Stockholm, Sweden
²Monash Children’s, Southern Health, Melbourne, Australia
³Royal Children’s Hospital, Melbourne, Australia

AIM: To discuss the concept of functional hand use in children with unilateral cerebral palsy (CP) and demonstrate the planning and delivery of targeted treatment programs to improve hand use based on individual responses on the Assisting Hand Assessment (AHA) and the Mini-AHA.

When performing a task that requires the use of two hands, each hand adopts a different, but complimentary role. For children with unilateral upper limb impairment, the well-functioning hand will always be the preferred hand for performance of fine manipulation and skilful actions. The kind of actions that are functional to perform with the affected hand and degree of efficiency is dependant upon the severity of impairment. One important feature in the development of the AHA and the Mini-AHA has been the Rasch measurement model derived test-item difficulty hierarchy that reflects steps of increasing ability of assisting hand function. This hierarchy can facilitate the targeting of components of bimanual hand function treatment adjusted to the individual child’s ability level. The bimanual ability profile created by the AHA and Mini-AHA outcome scores can be used as a tool for designing individualised treatment programs for children with unilateral CP aged 8 months to 12 years.

CONTENT OF THE WORKSHOP:
- Test development of the AHA and Mini-AHA and construct measured by these assessment tools
- Definition and demonstration of functional hand use in children with unilateral cerebral palsy aged 8 months to 12 years.
- Analysis and interpretation of AHA and Mini-AHA scores.
- Clinical utility of the item difficulty hierarchies for program planning using different treatment approaches such as:
  - Botulinum toxin injections
  - Constraint induced movement therapy
  - Bimanual training
  - Task/goal oriented approaches
- Practicing treatment planning from video footages
- Video footage of case studies will be used to illustrate objectives outlined above.

This workshop will be interactive and encourage discussions.

TRAINING COURSE 8

ORTHOPEDIC SURGERY FOR ADOLESCENTS AND ADULTS WITH CEREBRAL PALSY

Shrader M.W¹, Chambers H.²
¹Phoenix Children's Hospital, Phoenix, AZ, USA
²Rady Children's Hospital, San Diego, CA, USA
COURSE LEVEL: Advanced

AIMS OF THE COURSE:
1. To understand some details of orthopedic surgical procedures that are performed on adolescents and adults with cerebral palsy.
2. To develop an appreciation for the complex issues requiring medical management of adolescents and adults with CP undergoing surgery, including preoperative assessment, hospital management, and management of postoperative complications.

SUMMARY: This course will present an overview of typical orthopedic surgical procedures that adolescents and adults with cerebral palsy (CP) may need. Specifically, the course will present the unique aspects of caring for adolescents and adults with CP undergoing orthopedic surgery, including preoperative assessment, medical co-management, and postoperative rehabilitation. This course will provide an introductory level discussion of orthopedic surgical procedures that adolescents and adults with CP may undergo. Surgery of the foot, knee, hip, and spine will be briefly discussed, including indications, patient selection, consent issues, surgical techniques, and postoperative care, including a discussion of the unique rehabilitation requirements for adults with CP. A discussion of the issues regarding medical co-management of this patient population will also be presented. Specifically, the course will focus on preoperative assessment, where to do the surgery (children’s hospital vs adult hospital), ICU issues, management of complex medical issues, such as nutritional issues and seizure disorders, and postoperative complications.

COURSE FORMAT:  
Introduction, Overview of Course Objectives, Consent Issues: Hank Chambers, M.D. (5 minutes)  
Hip and Spine Surgery (including postoperative rehabilitation): M. Wade Shrader, M.D. (15 minutes)  
Foot and Knee Surgery (including postoperative rehabilitation): Hank Chambers, M.D. (15 minutes)  
Perioperative and Medical Management: M. Wade Shrader, M.D. (15 minutes)  
Question & Answer session: All speakers (10 minutes)

TRAINING COURSE 9

POSITIONING AND EYE-GAZE FOR SUCCESSFUL COMMUNICATION WITH CHILDREN WITH COMPLEX COMMUNICATION NEEDS

Ni Mhurchú D, Brady T.  
Central Remedial Clinic, Waterford, Rep. of Ireland

COURSE LEVEL: Basic

AIM: To provide a better understanding of the role of eye-gaze in communication and expand on the link between positioning and success in communication. To increase awareness of the range and subtlety of communications by children with cerebral palsy.  

SUMMARY OF CONTENTS: Clients with complex communication difficulties draw on a range of modes of communication to interact with others and get their message across, both in isolation and in combination. With severe motoric impairment, these modes can not only be subtle but also adversely affected by poor positioning. Eye-gaze in particular is the most utilised, yet frequently missed mode for clients with severe physical disability. All modes of communication benefit from optimum positioning. This presentation aims to examine a range of communication modes including body orientation, facial expression, eye-gaze, gesture, vocalisation as well as speech, and how clients use these meaningfully and with intention. Eye-gaze, as a frequently used mode, will be explored in greater detail. This will include function for learning, and also for communication. Eye-gaze in communication will be considered at its simplest level, moving through to more complex use for language learning and communication with light-tech and high-tech systems. Optimum eye-gaze will be discussed in the context of the team and joint working with specialist seating colleagues, in order to achieve the balance between stability and function through whole-body positioning.

COURSE FORMAT:
1. Definitions/Discussion of Communication including different modes, purpose and function, with particular emphasis on eye-gaze (with video)
2. Consideration of development of language and cognition for children with physical disability and the need to be aware and responsive to communicative attempts.
3. Further definitions of non-speech communication, aided and unaided (with video)
4. Relationship of eye-gaze to whole-body positioning and motor function
5. Discussion time.

TRAINING COURSE 10

INFLUENCE OF REDUCED LOWER EXTREMITY MOTOR CONTROL IN CHILDREN WITH SPASTIC CEREBRAL PALSY

Fowler E.¹, Oppenheim W.¹, Rose J.²
¹University of California, Los Angeles, USA
²Stanford University, Palo Alto, California, USA

COURSE LEVEL: Advanced

AIM OF THE COURSE: The purpose of this course is to describe the assessment and clinical implications of reduced lower extremity selective motor control in patients with spastic cerebral palsy.

SUMMARY: Voluntary isolated movement requires activation of the corticospinal tracts, which are commonly damaged in patients with spastic cerebral palsy. Children with cerebral palsy who lack the selective motor control necessary for the development of skilled movements may retain primitive movement patterns to varying degrees. Selective motor control is assessed clinically as the ability to perform isolated joint movements upon request, without using mass flexor/extensor patterns and without undesired movement at other joints, such as mirroring. It may also be quantified using gait kinematics and electrophysiological assessment. In this tutorial, the neurophysiological implications of reduced selective motor control will be discussed and the neuroanatomy of the brain and spinal cord reviewed to better understand possible relations between the initial brain injury, subsequent loss of descending excitatory and inhibitory motor signals, and selective motor control deficits. Clinical assessment and grading using "Selective Control of the Lower Extremity" (SCALE) will be demonstrated and the relationship between SCALE scores and joint coupling during gait will be evaluated using relative phase analyses. The value of selective motor control assessment for predicting terminal knee extension following hamstring lengthening surgery will be illustrated using gait analysis data. EMG findings of obligatory co-activation between synergist muscles for children with spastic CP will be compared to those of children with idiopathic toe walking, and typically developing children.


COURSE FORMAT:
• Introduction
• Overview of SCALE administration and grading using videos
• Gait Assessment
• Orthopedic surgery outcomes
• EMG assessment
• Discussion
SLEEP PROBLEMS IN THE CHILD WITH NEURODEVELOPMENTAL DISORDERS

Milo-Manson G.
Holland Bloorview Kids Rehabilitation Hospital, Toronto, Ontario Canada

AIM: To improve the clinician’s understanding of sleep problems in children/youth with disabilities. To provide information on how best to counsel families and when to refer for a formal sleep study.

CONTENT 1: Pediatric sleep problems are common and appear to occur more frequently in children with special needs. Although the range is quite variable one study documented an 80% occurrence of sleep problems in children with developmental disabilities. This presentation will focus on the following areas:

1) a review of the literature
2) a discussion of how much sleep is enough
3) developmental issues in sleep
4) what are common pediatric sleep problems
5) what is the physiology of sleep problems
6) what are sleep associations
7) principles of behavior management of sleep problems
8) medication use in sleep problems

Lastly, what is our role as professionals and how can we best assist families in managing their own child’s sleep issues?

CONTENT 2:

Pediatric sleep problems are common and appear to occur more frequently in children with special needs. Although the range is quite variable one study documented an 80% occurrence of sleep problems in children with developmental disabilities. This presentation will focus on the following areas:

1) a review of the literature
2) a discussion of how much sleep is enough
3) developmental issues in sleep
4) what are common pediatric sleep problems
5) what is the physiology of sleep problems
6) what are sleep associations
7) principles of behavior management of sleep problems
8) medication use in sleep problems

Lastly, what is our role as professionals and how can we best assist families in managing their own child’s sleep issues?

CONTENT 3:

Pediatric sleep problems are common and appear to occur more frequently in children with special needs. Although the range is quite variable one study documented an 80% occurrence of sleep problems in children with developmental disabilities. This presentation will focus on the following areas:

1) a review of the literature
2) a discussion of how much sleep is enough
3) developmental issues in sleep
4) what are common pediatric sleep problems
5) what is the physiology of sleep problems
6) what are sleep associations
7) principles of behavior management of sleep problems
8) medication use in sleep problems

Lastly, what is our role as professionals and how can we best assist families in managing their own child’s sleep issues?
AIM: Explore the concepts of patient priorities, quality of life and health related quality of life outcomes in children with severe chronic disabilities, using the Caregiver Priorities and Child Health Index of Life with Disabilities (CPCHILD©) Questionnaire as a working example.

CONTENT 1:
SUMMARY: The impact and effectiveness of health care interventions are more meaningfully assessed using patient reported outcome measures such as quality of life. This workshop will use the ICF model to explore the concepts of quality of life (QOL) and health related quality of life (HRQL) within a framework of patient priorities. We will discuss the challenges involved in conceptualizing these constructs for children with severe disabilities, using the example of the CPCHILD Questionnaire. Participants will become familiar with the conceptual underpinnings and the validation of this instrument to serve as a primary outcome measure of effectiveness of various interventions used to treat children with severe disabilities. The course will be used as an opportunity for interested participants to enroll in a collaborative international multicentre longitudinal cohort study to evaluate the effectiveness of different interventions for children with severe cerebral palsy (GMFCS IV & V).

TARGET AUDIENCE: Health care professionals across all clinical and non-clinical disciplines involved in the care of, or clinical research with, children with chronic disabilities.

OBJECTIVES OF CONTRIBUTION 1:
1. Introduce a new framework of patient priorities to define the concepts of quality of life (QOL) and health related quality of life (HRQL); and the ICF model.
2. Discuss the challenges inherent to the measurement of QOL/HRQL and its domains, in children with severe disabilities.

WORKSHOP SCHEDULE:
1. The ICF model; Definitions of QOL vs HRQL; Framework of Priorities (10 minutes)
2. Challenges of measuring these constructs in children with chronic disabilities (5 minutes)

CONTENT 2:

OBJECTIVES OF CONTRIBUTION 2:
1. Demonstrate how QOL/HRQL outcomes instruments are constructed, using the development and validation of the CPCHILD as an example.
2. Discuss the application, scoring and interpretation of the CPCHILD Questionnaire, including evidence of responsiveness to different interventions

WORKSHOP SCHEDULE:
1. The CPCHILD Questionnaire: Purpose; Development & Validation (30 minutes)
2. Applications of the CPCHILD to evaluate different interventions (20 minutes)

CONTENT 3:

OBJECTIVES OF CONTRIBUTION 3:
1. Introduce a proposed multicentre longitudinal cohort study to evaluate different interventions for children with severe CP. The opportunity will be used to invite participation in the proposed international multi-centre prospective cohort study of severe CP with specific emphasis on a. Natural History; and the following treatment cohorts: a. Intrathecal baclofen; b. Botulinum toxin injections; c. Seizure management; d. GI interventions; e. Hip Interventions; f. Spine surgery

WORKSHOP SCHEDULE:
1. Introducing the SCOPE Project (10 minutes)
2. Discussions: Questions & Answers (15 minutes)
FUTURE LINES OF RESEARCH IN CONSTRAINT-INDUCED MOVEMENT THERAPY FOR CHILDREN: WHAT IS THE NEXT STEP?

1Karolinska Institutet Stockholm - 2Sweden, Victorian Rehab Service- 3Australia, Columbia University - New York – USA, 4Helsinki University - Finland.

Course Level: Advanced
Aim: To clarify and discuss what is currently known about Constraint-induced movement therapy (CIMT) in children with unilateral CP, aiming to address current gaps in knowledge and highlight areas for future research, with a particular focus on the design and consistent reporting of studies.
Course Summary: This course will report outcomes from a European consensus meeting held in Sweden January 2012. Over the past decade, interest in CIMT for children with unilateral cerebral palsy (CP) has increased dramatically. Research has seen publications expand from a few single case studies to over 70 different studies. However, unlike areas of medical research that follow a progressive staging of studies to build on existing knowledge, the development of CIMT literature consists of a diversity of small trials that do not necessarily build on each other. The variation within the CIMT concept and its modifications, as well as the different study designs, make it extremely difficult to draw conclusions about what constitutes the key ingredients of CIMT and the effects of various models. Or which children benefit most from CIMT. What restraint should be used? How much therapy should be offered each day and for how many days? In order to understand current literature and inform the development of consensus guidelines for future research, a comprehensive literature search was conducted. Guided by the EUnetHTA framework, outcomes from the literature review were synthesised and following consensus agreement, a list of questions for each EUnetHTA domain were formulated. Specific domains were then prioritized to guide future lines of research. The outcome of this process and clinically relevant research questions will be further explored and discussed during this course.
Course format:
- Overview of published literature with a focus on evidence of CIMT in children with unilateral CP.
- Description of the structure and outcomes from a European consensus meeting in January 2012
- Report and discuss key ingredients in models of CIMT.
- Report and discuss variation on outcome measure selection and reporting.
- Report and discuss variation in study design and composition comparison/control groups.

A SEQUENCED REHABILITATION FOLLOWING SINGLE EVENT MULTILEVEL SURGERY FOR CEREBRAL PALSY

Sharan D.
RECOUP Neuromusculoskeletal Rehabilitation Centre – Bangalore – India.

COURSE LEVEL: Advanced
AIM OF THE COURSE: This course will discuss an evidence based, intensive and sequenced multidisciplinary rehabilitation protocol following Single Event Multilevel Surgery (SEMLS) for cerebral palsy (CP). This workshop will update attendees in assessment methods in the post-surgical period and outline the importance and sequence of a specific rehabilitation protocol that they can incorporate into their
clinical practice.

COURSE SUMMARY: Even though SEMLS has grown in popularity over the past decade, post-surgical rehabilitation remains challenging and a relatively unexplored area and few training opportunities for rehabilitation professionals exist. The eventual functional outcome following SEMLS is closely dependent on the quality of the postoperative rehabilitation. In this unique course, the authors will share their experience of using a rehabilitation protocol developed by them to successfully rehabilitate over 1000 patients with CP following SEMLS.

COURSE OBJECTIVES:

1. To understand the different stages of post-surgical rehabilitation, including the criteria for transitioning from one stage to the next.
2. To know more about the manual therapy (soft tissue and articular mobilization techniques) used in post-surgical rehabilitation.
3. To understand the benefits and methods of functional strength and balance training in post-surgical rehabilitation.
4. To familiarise participants with common complications encountered during the rehabilitation and strategies for preventing them.

Occupational and Physical Therapists, Physiatrists, Orthopedic Surgeons, Rehabilitation Nurses and other pediatric rehabilitation professionals these professionals will be benefited by this particular training course.

COURSE FORMAT:

Speaker 1: Deepak Sharan (15 minutes): Introduction to post-surgical rehabilitation: stages of rehabilitation, common complications encountered during the rehabilitation and preventive strategies, precautions in special groups (low bone mineral density, dysplastic hip, severe cerebral palsy - GMFCS IV and V), assessment at each stage and criteria for transitioning from one stage to the next.

Speaker 2: Ajeesh P S (10 minutes): Manual therapy (soft tissue and articular mobilization techniques) used in post-surgical rehabilitation.

Speaker 3: Deepak Sharan (15 minutes): Role of Ancillary therapies such as Hippotherapy, Virtual Reality Based Therapy, Whole Body Vibration Therapy, Yoga, etc.

Speaker 4: Ajeesh P S (15 minutes): Role of advanced strengthening techniques such as Body Weight Supported Treadmill Training, Core Strengthening, Functional Electrical Stimulation, EMG Biofeedback and Aquatic Therapy.

Open Discussion (5 minutes): Q&A.
II. Sends and receives with familiar and unfamiliar partners but may need extra time
III. Sends and receives with familiar partners effectively, but not with unfamiliar partners
IV. Inconsistently sends and/or receives even with familiar partners
V. Seldom effectively sends and receives even with familiar partners

The CFCS requires a rater to know how the individual with CP communicates with both unfamiliar and familiar communication partners in different environments in order to establish shared understandings.

Current status of CFCS validity and reliability studies will be presented. Professionals and researchers will received guided practice in making the CFCS classifications through the use of videos and discussion.

The CFCS’ 5 levels can be combined with with Gross Motor Function Classification System (GMFCS) and the Manual Ability Classification System (MACS) to created functional profiles. As with the GMFCS and the MACS, the CFCS does not explain the reasons why a person’s performance falls within a particular classification level. Building on the conceptual foundation of the ICF, functional patterns may be due to differing aspects of the person and contextual factors including speech intelligibility, hearing sensitivity, language skills, AAC competencies, and familiarity of conversational partners and their communication skills.

Course Time table:
- 5 minutes - Introduction, background of the need for a communication classification
- 10 minutes—Explanation of the development of the CFCS
- 25 minutes—Watch video samples of children with cerebral palsy and classify communication performance using the CFCS
- 10 min -Discuss clinical and research uses of the CFCS
- 10 min - Questions and Answers/Final Discussion

TRAINING COURSE 16

TRAINING POSTURAL CONTROL IN CHILDREN WITH CP

Stortini M.1, Pasquale A.1, Rosellini R.2, Giannarelli P.1
1‘Bambino Gesù’ Children’s Hospital - Scientific Institute - Rome IT, 2Orthopedic Technical Institute ITOP Palestrina - Rome IT.

Course level: Advanced

Purpose: to introduce an assessment and intervention approach for babies and young children with cerebral palsy that focuses on treatment strategies for improving postural control inside the global rehabilitative approach

Target audience: Developmental Psychiatrists, Neurologists, Therapists

Summary: Postural difficulties are reported to occur in most serious neurological impairment. The course introduces participants to the importance of postural control for the achievement of every day activities. Many children have problems regarding walking and reaching/grasping because of their insufficient repertoire regarding postural balance; maintenance of stability is a critical factor in all movements. The instructors will include information about the theoretical frameworks influencing the context strategy as well as the assessment and intervention methods developed to train postural control. We present an oscillating platform bearing on a central pin with reference to variable elastic fields: an instrument that allows to apply controlled sways and imbalances to the child posture. Intensive practice is carried out in standing or sitting posture accordingly the level of child’s impairment, training reactive or proactive balance.

Course format: Introduction to postural control and its theoretical frameworks, New materials and methods enclosed in the rehabilitative treatment, Presentation of video material on Case-studies to demonstrate the patient selection principles, treatment decisions and outcomes, Discussion.
LIFESPAN EXPECTATIONS FOR INDIVIDUALS WITH CEREBRAL PALSY

Tan S. S., Dallmeijer A. J., Ketelaar M.

1Erasmus MC University Medical Centre - department of Rehabilitation Medicine – Rotterdam - the Netherlands, 2VU University Medical Centre - department of Rehabilitation Medicine – Amsterdam - the Netherlands, 3Rudolf Magnus Institute of Neuroscience and Centre of Excellence for Rehabilitation Medicine - University Medical Centre Utrecht and Rehabilitation Centre De Hoogstraat – Utrecht - the Netherlands.

Course level: Basic
Aim of the course: To encourage the use of growth curves for the gross motor function, activities and social participation of individuals with cerebral palsy (CP). The audience will learn that growth curves are a unique tool to support individuals with CP, their families and professionals in setting realistic long-term expectations and optimizing the choice of interventions at an early age.

A comprehensive summary about the contents of the Course: Because growth curves empirically model the evolution of an outcome variable over time, their use in clinical practice has gained attention in many developed countries. Growth curves are an established instrument to monitor and predict the length and weight of new-borns and are increasingly used for prevention and treatment in other areas of evidence based practice. In the treatment of individuals with CP, however, growth curves are, as yet, only used for gross motor function. As they are a unique tool to optimizing the choice of interventions at an early age, this training course encourages the use of growth curves for gross motor function, as well as for activities and social participation of individuals with CP.

The Dutch PERRIN+ study is the first longitudinal study covering toddlers, children, adolescents and young adults with CP aged 1-24 years. As part of this study, growth curves were developed for the gross motor function, activities and social participation. These growth curves were stratified by age and GMFCS-levels and adjusted for cognitive impairment. In this training course, we will firstly describe the development and implementation of the growth curves for gross motor function into rehabilitation practice. Secondly, we will present the growth curves for activities and social participation which have not yet been implemented in current practice. By means of interactive discussion with the audience, we will determine aspects to improve the growth curves for activities and social participation and explore the necessary steps for implementation into practice. The audience will learn (1) to recognize the value of growth curves in the context of lifespan expectations for the treatment of CP, (2) to identify key issues involved in improving growth curves and (3) to reflect on necessary steps to implement growth curves into rehabilitation practice.

Course timetable giving the order and timing for their contributions:
1. Introduction (SST; 5 min)
2. Gross motor function (DWS; 15 min)
3. Activities and social participation (RCV; 15 min)
4. Interactive discussion (SST; 15 min)

DYSPHAGIA/FEEDING DISORDERS IN CHILDREN WITH NEUROLOGICAL DISABILITIES: ASSESSMENT AND MANAGEMENT

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Aim:
To revisit the theoretical and practical aspects of the development of oral motor skills and swallowing.

Rehabilitation Program dysphagia,-How to structure an individual rehabilitation project. (multidisciplinary team) -Postural control.

Content_1:
Feeding disorders and swallowing disorders are very common in infant and children with developmental disabilities and neurological damage. These Children have an oral motor dysfunction, risk of aspiration, prolonged feeding times and malnutrition with attendant physical compromise.

Interdisciplinary team approaches allow for coordinated global assessment and management decisions.

The workshop start with a theoretical part about general overview, clinical evaluation of feeding disorders. It will conclude with Instrumental Management presentation for evaluation of dysphagia and feeding disorders (Fiberoptic Endoscopic Evaluation and Videofluoroscopic swallowing study -(VFSSs))

Content_2:
Rehabilitation Program:
Consist in practical session about rehabilitative treatment:
- Oral motor therapy
- Sensory motor therapy
- Oral stimulation exercise
- Weaning from feeding tube
- Meal time therapy

Content_3:
Correct postural alignment is important in the normal feeding/swallowing process. In the child with neurological disabilities, the alignment and stability of the oral structures for feeding/swallowing may be compromised by abnormal muscle tone and movement patterns. Effective oral functioning for feeding begins with attaining better head stability to improve jaw control. Head control is influenced by trunk alignment, which depends upon the stability of the pelvic area.

While there is evidence that alignment reduces extensor tone and improves feeding, further research is needed to determine whether this population's high risk for aspiration can be reduced by alignment.
ORAL PRESENTATIONS
WEDNESDAY, 10TH OCTOBER, 2012
15.55 – 16.55 PARALLEL SESSION 1

GROUP 1– ETIOLOGY

GENETIC AND CLINICAL CONTRIBUTIONS TO CEREBRAL PALSY: A MULTIVARIABLE CASE-CONTROL ANALYSIS

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Scientific background: Cerebral palsy (CP) has well described associations with clinical risk factors such as gestational age and intra-uterine growth restriction; however the majority of cases have no clear specific cause. Candidate single nucleotide polymorphisms (SNPs) were investigated as potential factors that increase genetic susceptibility for CP.

Aim: To examine individual SNP associations with CP in a multivariable analysis including clinical risk factors. Also potential SNP-SNP interactions and interaction between candidate SNPs and maternal infection during pregnancy were assessed.

Methods and subjects: A case/control study of Australian born Caucasian mother-child volunteer pairs was designed. 587 children with CP and 1,154 control children without CP along with their mothers were included in the analysis. DNA from mothers and children was collected using buccal swabs and 39 candidate SNPs were genotyped. Data linkage was performed extracting clinical details from state held perinatal notes and CP registers. A maternal pregnancy questionnaire supplemented clinical details. Secondary analyses were performed on subtypes of CP including diplegia, hemiplegia, quadriplegia and CP cases classified as very preterm, late preterm or term.

Results and discussion: Child SNPs in genes encoding MMP/2 and TNF-α genes and maternal SNPs in genes encoding IL-1β, TGF-β1 and TNF-α genes were significantly (p<0.05) associated with CP after adjustment for potential clinical confounders. Different significant associations were also seen in CP subtypes hemiplegia, quadriplegia and CP at all gestations. Interaction between child and maternal IL-10 SNPs was significant (p=0.012). Interaction between reported maternal infection during pregnancy was also significant for maternal SNPs in genes encoding IL-6 and MTHFR (p= 0.026 and 0.038 respectively).

RARE COPY NUMBER IN CEREBRAL PALSY

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Scientific background: The cause of cerebral palsy (CP) is not resolved, but there is increasing evidence of genetic origins. As with intellectual disability, autism and epilepsy, CP may be caused by many diverse and individually rare genetic abnormalities, including Copy Number Variants (CNVs).

Aim: To determine whether unique/rare CNVs (<0.1% population frequency) contribute to CP causation.
Methods and subjects: Utilising microarray analyses, 50 DNA samples from affected individuals were tested. All were sporadic cases of Caucasian descent.

Clinical data included: type of CP, gestation, birth weight, Apgar score, head circumference and neonatal events. Results were compared with 8,329 adult controls with no known neurological disorders and correlated with the clinical data.

Results and discussion: Three/50 cases were identified with a CNV that included a candidate gene for CP: CTNND2 (446 kb duplication including the first exon), MCPH1 (219 kb duplication including exons 1-8) and COP3 (4 kb deletion including exons 6-8). These regions were selected due to their rarity in the population (<0.1%) and association with specific neurological disorders. CNVs of potential interest in the following genes were also identified: TARP CNTNAP3, NCOR2 FSCB, SH3GL3, C16orf62, MPV17L, CACNA1H, MC2R, MACROD2, and two CNVs 7q21 and 12p12.1p12.2. Potential explanations for pathogenicity of a CNV inherited from an unaffected parent include variable expressivity, reduced penetrance, possible imprinting, or the presence of a point mutation on the other allele in affected children, not identified by CNV profiling. Inherited CNVs may act with an environmental and/or another genetic factor/s, as predicted by the multi-hit hypothesis.

For the first time, inherited CNVs potentially causing CP have been identified. Evaluation of CNVs in a larger cohort of CP families and functional gene studies to help establish their contribution are the next steps in understanding the contribution of genetic alterations in the aetiology of CP.

THE ROLE OF SMOKING IN PREGNANCY IN THE AETIOLOGY OF CEREBRAL PALSY (CP): ANALYSIS OF CCCP DATA

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Scientific background: Growth restriction (GR) is a major risk factor for CP and smoking the most frequent cause of decreased intrauterine growth.

Aim: To identify the role of smoking on pathways to CP in singletons born >=35 weeks.

Methods and subjects: From a total population (Western Australia 1980-95) case control study of CP and gestation matched controls we selected singletons born at 35+ weeks gestation. Outcomes were CP without neonatal encephalopathy (CP-NE), CP with NE and clinically diagnosed birth asphyxia (CP-NE+BA/HIE) and CP with NE without BA/HIE (CP+NE). The odds of each outcome associated with smoking was estimated with and without GR (<2 standard deviations below optimal for gestation, gender and maternal height and parity or clinical diagnosis of growth restriction). Origins of the association with smoking plus GR were sought among quantity smoked, risk factors for GR (pregnancy induced hypertension, urinary tract infection, placental anomalies, oligohydramnios) and for CP (sentinel events, intrapartum inflammation and congenital defects).

Results and discussion: The CP+NE+BA/HIE group differed from other CP. Mothers of 28% controls (93/332), 32.0% CP without BA/HIE (82/256) and 40% CP+NE+BA/HIE (30/75) smoked. Independent of quantity smoked, odds ratio (OR) for CP without BA/HIE of smoking without GR was 1.0 (95%CI 0.6,1.6) and with GR 11.5 (2.6,51). 1.2% of controls were exposed to smoking+GR and 9.7% of CP without BA/HIE. OR with smoking for CP+NE+BA/HIE was 2.6 (0.9,7.3) and unaffected by GR. Of the risk factors investigated, smoking with GR was associated with congenital defects, seen in 31% (12/39) of GR CP born to smokers compared with 5.1% (17/332) of all controls.

Combined with GR, smoking was strongly associated with CP without BA/HIE. Congenital defects contributed to but cannot wholly explain this association, which may arise partly because smoking is associated with other lifestyle choices about which we have inadequate information.
A NEW ANALYTICAL APPROACH TO FURTHER UNDERSTAND THE AETIOLOGY OF CP: ANALYSIS OF CCCP DATA

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Scientific background: The aetiologies of CP for singleton infants 35+ weeks gestation are many yet not well understood.

Aim: To identify if pathways to CP are better understood by analysing risk factors across 5 perinatal outcomes: intrapartum stillbirths (IPSB), neonatal deaths (NND); and three groups with CP: those without neonatal neurologic abnormality (CP-NE); those with neonatal encephalopathy (CP+NE) and; those with NE, in addition to a clinical description of birth asphyxia/HIE (CP+NE+BA/HIE).

Methods and subjects: Total population (Western Australia) Case Control study of all singleton infants with CP born at 35+ weeks gestation (n=497), controls without CP matched by year of birth, plurality, and gestational age (n=508) and perinatal deaths (n=174). Acknowledged risk factors: Sentinel events (intrapartum haemorrhage, placental abruption, uterine rupture, cord prolapsed, severe shoulder dystocia, tight nuchal cord), growth restriction, intrapartum inflammation and congenital malformations were analysed individually and in combination for the following outcomes: IPSB (n=73); NND (n=101); CP-NE (n=351); CP+NE (n=35); CP+NE+BA/HIE (n=102).

Results and discussion: Sentinel events contributed most to IPSB 34% OR10.5(5.6,20) and CP+NE+BA/HIE 21% OR5.3(2.8/10). Congenital malformations contributed most to NND 53% OR27.2(15,49), CP-NE 20% OR5.9(3.5,9.9), and CP+NE 60% OR36.6(16,82). The most important combination of risk factors was congenital malformation + growth restriction, for NND (21.3%) and CP+NE (21.2%). For all CP outcomes combined, congenital malformations contributed most to aetiology 20% OR 6.1 (3.7,10.1) followed by growth restriction 16% OR3.5(2.2-5.5). Less than 13% of CP arose from sentinel events or inflammation in contrast to 36% from congenital malformations or growth restriction.

More homogenous outcomes allow us to better understand CP aetiology. There is much to learn about the most numerous outcome, CP without neonatal neurologic abnormality. For prevention, there is now urgent need for greater understanding of the antecedents and specific sub/syndromes of growth restriction and malformations.

CEREBRAL PALSY AND MATERNAL INFECTION IN TERM BORN BABIES: A POPULATION-BASED CASE-CONTROL STUDY

Ahlin K.1, Jacobsson B.1, Himmelmann K.2, Wennerholm U.B.1, Kacerovsky M.3, Cobo T.4, Hagberg G.5
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Scientific background: Infectious and inflammatory mechanisms have been suggested to be involved in the causal pathway leading to cerebral palsy (CP) but few large and population based studies on term born infants, investigating the link between infection and CP are available.

Aim: The aim of this study was to analyze infection-related risk factors during pregnancy and delivery for CP and its subtypes, in infants born at term.

Methods and subjects: A case control study was performed in a population-based serie of children with CP born at term (n=309), matched with a control group (n=618), between the years 1983-94. All records were
found and were scrutinized in detail for maternal and neonatal signs of infection. Both univariate and multivariate analyses were performed.

Results and discussion: Infection related risk factors were shown to be independent risk factors for CP analyzing all CP subgroups together. Dividing CP into subgroups showed that infections increased the risk of spastic CP. Bacterial growth in urine during pregnancy (OR=4.72, 95% CI=1.47-15.15), any infectious disease during pregnancy (OR=2.89, 95% CI=1.73-4.83), severe infection during pregnancy (OR=15.41, 95% CI=3.04-78.07), antibiotic therapy once during pregnancy (OR=6.33, 95% CI=3.03-15.22) as well as several times during pregnancy (OR=15.57, 95% CI=1.81-134.15) constituted strong independent risk factors of spastic hemiplegic CP. However, only neonatal infection (OR=14.67, 95% CI=1.70-126.54) was significantly associated with an increased risk of spastic diplegia and tetraplegia. No infectious factor was found to be independently associated with dyskinetic CP.

Infection related factors are strong independent risk factors for both the total group of CP and for the subgroup spastic hemiplegic CP in newborns born at term, being less evident in the subgroups with diplegia and tetraplegia and dyskinetic CP. These results indicate that infections are to be taken seriously and should be treated and reported accurately.

GROUP 2- MUSCLE

EFFECT OF CEREBRAL PALSY-INDUCED SPASTICITY ON TENDON STRUCTURE

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Scientific background: Cerebral palsy (CP) is characterized by an impairment of voluntary movement related to hypertonia and spasticity, producing a progressive alteration of the musculoskeletal system components, including tendons.

Aim: The exact mechanism by which spasticity-induced overload affects tendon connective tissue is still poorly understood. Since mechanical loading may affect the homeostasis of the connective tissue of tendons by modifying some of their metabolic, morphological and biomechanical properties, we studied tendon structure in CP patients.

Subjects and methods: For this study were collected tendons of the gracilis and semitendinosus muscles from CP (n=4) and healthy subjects (n=3). Tendon fragments were fixed in 4% paraformaldehyde in 0.1M phosphate buffer saline (PBS), pH 7.4, routinely dehydrated, and paraffin embedded. Tendon structure was analyzed by morphological analysis of paraffin embedded sections stained with hematoxylin-eosin, Sirius red and alcan blue.

Results and discussion: Light microscope analysis of hematoxylin-eosin stained sections revealed that CP induced in tendons hypercellularity and lipoid degeneration. Sirius red staining, specific for collagen fibers, was more evident in CP tendons, suggesting an increase of collagen content induced by spasticity. Alcan blue, a staining for glycosaminoglycans and proteoglycans, revealed an increase of this extracellular matrix components in CP tendons. Considered as whole, this preliminary results suggest that CP-induced tendon mechanical overload induces extracellular matrix remodeling, according to previous molecular data, and some structure modifications consistent with tendinopathy.
TISSUE CHARACTERISATION OF THE GASTOCNEMIUS IN CHILDREN WITH SPASTIC CEREBRAL PALSY

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Scientific background: Ultrasound imaging is a non-invasive, easily accessible and safe method to visualise skeletal muscles in vivo. With quantitative ultrasound techniques such as grey-scale analysis it is possible to detect alterations in muscle tissue composition. Grey-scale analysis characterises muscle images in terms of echo intensity (i.e. whiteness) and spatial structure (i.e. connected homogenous regions). Increased echo intensity has previously been correlated with increased non-contractile tissue (i.e. fat and fibrous tissue) in pathological muscle.1

Aim: To characterise tissue composition of the affected and unaffected medial gastrocnemius in children with spastic hemiplegic cerebral palsy (SHCP).

Methods and subjects: Eleven children with SHCP, GMFCS level I, aged 5 to 14 years (mean 9y 9mo [SD 2y 9mo]), including 5 boys and 6 girls participated. Written informed consent was provided by participating families. Bilateral transverse scans were taken of the medial gastrocnemius using a transportable ultrasound scanner (M-Turbo, SonositeTM, Bothell, USA). Scans were digitised, and muscle images characterised using a customised MatLab program (The Mathworks Inc., USA) to determine mean echo intensity values and the number of spatially connected homogenous regions (i.e. blobs).

Results & discussion: Mean echo intensity was higher in the affected medial gastrocnemius (61.4±27.2) than the unaffected gastrocnemius (40.3±23.1, p < 0.05). Similarly, the number of blobs was greater in the affected medial gastrocnemius (48 blobs, 6% suspected non-contractile tissue) compared to the unaffected gastrocnemius (21 blobs, 1% suspected non-contractile tissue).

Higher echo intensity and a greater number of blobs in the affected medial gastrocnemius suggest structural alterations to the skeletal muscle tissue. Quantitative ultrasound may provide a suitable diagnostic tool for assessing and monitoring structural alterations in muscles affected by spasticity.

References:

HOW TO ASSES ACTIVE AND PASSIVE COMPONENTS OF MUSCLE RESISTANCE IN CHILDREN WITH CEREBRAL PALSY

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Scientific background: Spasticity is a common manifestation in children with Cerebral Palsy (CP). In adults spasticity has been shown very difficult to distinguish from changes in passive muscle properties without the help of objective biomechanical and electrophysiological techniques (Lorentzen et al., 2010; Sinkjær et al., 1994; Dietz and Sinkjær, 2007). If this is also the case in children with CP there is a risk that many children are treated wrongly.

Aim: Spasticity is defined as a motor disorder characterized by a velocity-dependent increase in muscle resistance. It is caused by adaptive changes in spinal cord circuits and seen clinically as increased muscle tone and hyper excitable reflexes. The purpose of the present study was therefore to investigate the relative contribution of passive and active components to muscle resistance in CP children diagnosed clinically with spasticity.
STRETCHED SARCOMERES MAY CONTRIBUTE TO CONTRACTURE IN CEREBRAL PALSY

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Scientific background: It is believed that muscle fibers in children with cerebral palsy (CP) are shortened as compared to typically developing (TD) children, but ultrasound data provide no consensus. A crucial missing piece of information is the lack of sarcomere length measurement, since macroscopic measurements such as ultrasound cannot capture the underlying adaptation in CP.

Aim: The purpose of this study was to quantify fiber length and serial sarcomere number in TD and CP children. Based on previous work by others, we hypothesized that serial sarcomere number would be smaller in CP than in TD children.

Methods and subject: Multiple ultrasound images were taken of soleus muscles of children with CP undergoing tendon lengthening (n=6) aged 4-24 years and TD children undergoing surgery for non calf related injuries (n=11) aged 2-17 years. Average muscle fiber length was calculated as described previously (1) using distance between fascial planes and fiber angle. In children with CP, intraoperative soleus biopsies were obtained with clamps placed over a dissected section of muscle. Samples were fixed in formalin, and sarcomere length was measured by laser diffraction (2). TD sarcomere lengths were obtained from a previous report (3) (n=19).

Results and discussion: Average soleus fiber length was 3.11±0.97 cm for CP and 3.10±0.71 cm in TD patients, which were not significantly different (p>0.98). Average serial sarcomere number was significantly fewer (p<0.001) in CP (7,634±2,639) compared to TD (14,089±3,212) patients. Thus, muscle fibers in CP have the same fiber length because their sarcomeres are highly stretched. This suggests that the contractures observed in CP may be related to highly stretched sarcomeres that create very high deforming forces.

References:
1. Shortland, AP; Harris, CA; Gough, M; Robinson, RO. DMCN 44 (2002)
2. Lieber, RL; Yeh, Y; Baskin, RJ. Biophys J. 44 (1984)
3. Ward, SR; Eng, CM; Smallwood, LH; Lieber, RL. CORR. 467 (2009)
Scientific background: The catch-phenomenon on the Tardieu test is one of the principal clinical tests of spasticity although its biometric characteristics are not well described.

Aim: To study the consistency between clinical assessed catch and involuntary muscle activation during the Tardieu test and passive isokinetic velocities. We hypothesized that clinical catch is accompanied by a velocity dependent increase in muscle activity in the stretched muscle.

Methods and subjects: Fifteen children with unilateral CP (9 boys and 6 girls; mean age: 12.1 years; SD: 2.6) and 15 typically developing children (10 boys and 5 girls; mean age: 11.8 years; SD: 2.8) participated. Surface electromyography (SEMG) of biceps and triceps brachii during passive elbow extension was recorded while performing a clinical Tardieu test and during passive isokinetic movements of 10, 90, 180 and 300°/sec.

Results and discussion: A catch was detected in nine of 15 children with CP at a median peak angular velocity of 350°/sec. A velocity dependent increase in biceps brachii stretch response was found in those with a catch (p=0.019 at isokinetic velocities and p=0.086 with Tardieu), but not in those without (p=0.145 and 0.345, respectively). In controls a trend towards a velocity dependent increase in stretch response was found at isokinetic velocities (p=0.063), but not during Tardieu (p=0.532). These results suggest that the catch-phenomenon is accompanied by a velocity dependent increase in biceps brachii stretch response during passive elbow extension. Moreover, at least some healthy individuals may exhibit a velocity dependent stretch response, questioning at which velocity spasticity is optimally assessed.

GROUP 3– PARTICIPATION 1

ACTIVITY CAPACITY TO PARTICIPATION IN CEREBRAL PALSY: EVIDENCE OF AN INDIRECT PATH VIA PERFORMANCE

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Scientific Background: An understanding of the relationships between activity capacity and the ICF components is needed for goal setting and treatment.

Aim: To test if the influence of activity capacity on participation is mediated through activity performance.

Methods and Subjects: A cross-sectional cohort of 128 children with CP (41% female) participated across GMFCS levels I-III, ages 2-9 yrs. Activity capacity was measured with the Gross Motor Abilities Estimator (GMAE Total score) and walking capacity the One Minute Walk Test (OMWT). Activity performance was the Activities Scale for Kids (ASKp/30) with walking performance the ASKp-30 Locomotion subscale. Participation was measured with the Assessment of Life Habits (Life/H) total, mobility and fitness categories, Children’s Assessment of Participation and Enjoyment (CAPE) and the Assessment of Preschool Children’s Participation (APCP/Total score) assessed diversity. Mediation analysis included regression equations controlling for age, gender, GMFCS and body composition. Indirect effects were examined with the Sobel z test.

Results and Discussion: Activity performance (ASKp-30 summary) mediates 74.9% (β=.83, p <.001) of the direct effect of activity capacity (GMAE) on total participation levels. Activity performance mediates 52.8% (β=.47, p<.001) of the direct effect of capacity on diversity of participation (CAPE/APCP). Walking activity performance (ASKp-30-locomotion) mediates 51.5% (β=.50, p<.001) of the direct effect of walking capacity (OMWT) on mobility participation and 44.0% (β=.35, p<.001) of the effect on fitness participation. The influence of gross motor capacity on total and diversity of life participation in ambulatory children with CP is significantly mediated through their daily performance. Similarly, the effect of walking capacity to mobility and fitness participation in daily life is mediated by free-living walking performance. Thus, interventions should focus on motor performance in day to day life regardless of capacity levels to positively influence participation in day to day life.
INDIPENDENCE IN DAILY LIFE IN ADOLESCENTS WITH CP AND TYPICAL PEERS – A POPULATION-BASED STUDY

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Scientific background: The transition phase from youth to adulthood is vulnerable for all adolescents, and it is expected that most persons with cerebral palsy (CP) will need systematic follow up in this phase to enhance independence and participation.

Aim: The aim of this study was to generate knowledge on independence in daily life in adolescents with CP compared to typical peers, in order to contribute to the provision of goal directed and continuous follow-up during the transition process from youth to adulthood.

Methods and subjects: A population-based cross-sectional study (n=128) on 16-17 years old persons with CP in South-Eastern Norway and typically developing peers was conducted, using The Rotterdam Transition Profile (RTP). RTP is a questionnaire with an ordinal four-graded scale assessing independent participation in nine areas of daily life; education/employment, finances, housing, intimate relationships, transportation, leisure/social activities, care demands, services/aids, and habilitation services.

Results and discussion: Seventy six adolescents (59%), 40 boys and 36 girls participated, 30 with unilateral, 37 with bilateral, 8 with dyskinetic, and 1 with ataxic CP. GMFCS: level I 30, level II 17, level III 6, level IV 18 and level V 15. The reference group was a convenience sample of 39 boys and 64 girls from one rural and one urban high school. Nearly all the participants attend general education and live with their parents. However, nearly 50% of the participants with CP had no pocket money, 75% had no experience with dating, 52% were transported by parents and only 21% arranged social activities with peers outside home, compared to 7%, 28%, 25%, and 95%, respectively, in the reference group. The results confirm that adolescents with CP are less independent than their peers, underlining the need for goal-directed continuous follow-up during the transition phase from youth to adulthood across professional and administrative borders.

PARTICIPATION AND AUTONOMY OF YOUNG ADULTS WITH CEREBRAL PALSY. THE PERRIN TRANSITION STUDY

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¹Transition and Lifespan Research group, Erasmus MC - University Medical Centre, Rotterdam, The Netherlands, ²Rijndam rehabilitation center, Rotterdam, The Netherlands and Erasmus MC- University Medical Center, Rotterdam, The Netherlands

Scientific background: Most children with cerebral palsy (CP) nowadays make the transition to adulthood; little is known about their participation in adult life.

Aim: To present empirical data on participation and autonomy of young adults with CP in several life areas and associated factors.

Methods and subjects: Young adults with CP (n=103) known at eight rehabilitation centers and departments in the Netherlands, aged 16-20 years, without intellectual impairment, 83% GMFCS level I-II participated in a prospective cohort study over a four-year period. We assessed participation and autonomy with the LIFE-Habits questionnaire, indicators of employment, romantic relationships, sexual experience and the Rotterdam Transition profile. Effects of potential determinants were analyzed using multivariable regression analyses. Experienced problems were assessed with the Canadian Occupational Performance Measure.

Results and discussion: Young adults with CP showed a delayed transition to adulthood in housing, employment, romantic and sexual relationships. At this age, 25-30% had difficulty in participation. Participation was associated with levels of gross motor functioning, manual ability, education, age, as well as with social self-efficacy or being involved in peer group activities. Seventy percent reported one or more experienced problems, addressing functional mobility and employment as priority problem areas. Only 40% visited a rehabilitation physician in the past year.
These results underline the need to support youth and young adults with CP in their transition to adult life. Dutch rehabilitation centres are currently innovating young adult care.

FREQUENCY OF PARTICIPATION OF ADOLESCENTS WITH CEREBRAL PALSY – COMPARED TO THE GENERAL POPULATION

1National Institute of Public Health, University of Southern Denmark, 2UMR 1027, Inserm, Toulouse III University, 3Institute of Health Science, Newcastle University, 4Laboratoire TIMC-IMAG UMR CNRS 5525, Université Joseph Fourier, CHU Grenoble, 5MSc (Physio) MISC, 6Department of Child Neuro-psychiatry, AUSL Viterbo, 7Department of Pediatrics, Queen Silvia Children’s Hospital, Sahlgrenska University Hospital, 8Queen’s University Belfast, 9Klinik für Kinder- und Jugendmedizin, Universität zu Lübeck, 10University Hospital Copenhagen

Scientific background: Children with cerebral palsy (CP) participate less often in everyday activities compared with children in the general populations and continue to be disadvantaged with respect to employment and social relationships into adulthood. Participation in children with CP varies between countries and is accessible to intervention. During adolescence, rapid physical and psychological changes occur which may be more difficult for adolescents with disabilities.

Aim: To compare frequency of participation of adolescents with CP with that of the general population in nine European regions, after adjusting for severity of CP.

Subjects and method: Frequency of participation was measured by a short version of the Questionnaire of Young People’s Participation within the population based study SPARCLE. In total 666 adolescents with CP age 13-17 years from nine European regions completed the questionnaire at home visits, and 4666 adolescents from the general population completed during a school lesson. Parents of adolescents with severe intellectual disability completed the questionnaire. Domains “getting on with people”, “autonomy” and “recreation” were analysed using linear regression, single items using logistic regression.

Results and discussion: Adolescents with CP spend less time with friends, were less autonomous and participated less in recreational activities compared to adolescents in the general population. Adolescents with CP were severely disadvantaged according to participation in sport, while they watched TV and played electronic games at least as often as adolescents in the general population. There were regional differences and differences by severity level. Adolescents with CP were at a greater risk of low levels of physical activity and high levels of sedentary behaviour. Identifying factors in the local environment and within the individual that enhance participation and are amenable to intervention are crucial to increase autonomy and participation in physical and social activities.

DEVELOPMENTAL TRAJECTORIES OF SOCIAL PARTICIPATION IN INDIVIDUALS WITH CEREBRAL PALSY AGED 1-24

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Scientific background: Although increasingly important, little is known about the long-term consequences of cerebral palsy (CP) on social participation.
Aim: To describe developmental trajectories of social participation by Gross Motor Function Classification System (GMFCS)-level in individuals with CP aged 1-24. This prospective cohort study was part of the Dutch Pediatric Rehabilitation Research in the Netherlands (PERRIN)+ study.

Subjects and methods: Individuals aged 1-24 were recruited at rehabilitation departments of rehabilitation centres and (university) medical centres in the Netherlands. A total of 424 individuals agreed to participate (97 toddlers, 116 children, 108 adolescents and 103 young adults). Individuals covered all levels of gross motor function (GMFCS: 50% level I, 15% level II, 12% level III, 11% level IV and 12% level V). Each individual was longitudinally followed up to 4 years. Social participation was assessed with the Vineland Adaptive Behavior Scales (VABS, domain ‘Social functioning’) and Pediatric Evaluation of Disability Inventory Caregiver Assistance Scale (PEDI-CAS, domain ‘Social functioning’). Multilevel analyses were performed with MLwiN version 2.21.

Results and discussion: The developmental trajectories for individuals categorized as GMFCS level I/IV did not significantly differ from each other. The trajectory was more favorable for level I/IV individuals compared to level V individuals (Wald statistic: P < 0.001). Although the individuals of each GMFCS level were increasingly engaged in social participation over time, this increase reduced during adolescence. Decreasing social participation was observed regarding the subdomains of ‘inter-relationships’ and ‘play & leisure time’, but not regarding ‘coping’. For all GMFCS levels, cognitive impairment was systematically associated with poorer social participation (P < 0.001). This first study on social participation covering toddlers, children, adolescents and young adults will contribute to support individuals with CP, families and professionals in setting realistic long-term expectations and in optimizing the choice of interventions at an early age.

GROUP 4 – UPPER LIMB ASSESSMENT

ARM AND HAND FUNCTION IN CHILDREN WITH UNILATERAL CEREBRAL PALSY: A ONE-YEAR FOLLOW-UP STUDY


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Scientific background: In children with unilateral cerebral palsy (CP), development of arm and hand function is often compromised by the underlying motor and sensory impairments, although knowledge about the evolution of arm and hand function in this population is limited.

Aim: The aims were to map the evolution of scores on upper limb measures over one year in children with unilateral CP and to identify factors that influence time trends.

Methods and subjects: Eighty-one children (43 males, 38 females; mean age 9y11mo (SD 3y3mo) range 5-15 y) were tested at baseline, at 6 and 12 months. Body function measurements included passive range of motion, muscle tone, manual muscle strength and grip strength. Activity measurements included the Melbourne Assessment, the Jebsen-Taylor test, the Assisting Hand Assessment and the Abilhand/Kids questionnaire. Age, gender, etiology (congenital or acquired lesions) and Manual Ability Classification System (MACS) levels were analyzed as predictive factors, using mixed models.

Results: Scores for grip strength (p = 0.001) and manual dexterity (Jebsen-Taylor test, p < 0.0001) increased significantly over time. MACS level (p = 0.03) and etiology (p = 0.02) had a significant influence on the time evolution of the Jebsen-Taylor scores. Children with MACS level I obtained the best JebseneTaylor scores at baseline and had most potential for improvement over one year. Also, children with congenital lesions improved in JebseneTaylor scores whereas children with acquired lesions remained stable. Other assessments showed no significant changes.

Conclusion: Motor impairments, movement quality and hemiplegic hand use in bimanual tasks do not spontaneously improve over one year, except for an age-related change in grip strength. However, an improvement was observed in manual dexterity, suggesting that some children can learn more adaptive
movement strategies. These findings should be kept in mind when interpreting changes arising as response to therapy.

**UPPER LIMB MOVEMENT PATHOLOGY IN CHILDREN WITH UNILATERAL CP: THE ARM PROFILE SCORE**

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Scientific background: Three-dimensional movement analysis (3DMA) is increasingly used in upper limb (UL) evaluations, though the interpretation of the multiplicity of data remains complex.

Aim: To facilitate data interpretation, we introduce a new summary index, the “Arm Profile Score” (APS), to quantify UL movement pathology in children with unilateral cerebral palsy (UCP).

Method and subjects: Twenty children with UCP (10.9ys±2.9ys) and 20 age/matched typically developing children (TDC; 10.9ys±3.0ys) were included. All children were assessed by one trained physiotherapist using a standardized UL/3DMA protocol, including reach, reach/to/grasp and gross motor tasks. Marker tracking was done with the Vicon MX/system (Oxford Metrics, UK) and kinematics calculated following the ISB/recommendations. In children with UCP, the House-score, and clinical measures of muscle tone, and muscle and grip strength were also assessed. The APS was calculated similar to the “Gait Profile Score”. The index is the root/mean/square difference between kinematic data of the individual child and the average data from TDC. The APS can be decomposed into 13 Arm Variable Scores (AVS), representing deviations in individual joint angles. Spearman/rank correlation coefficients were calculated between the APS and the House-scores and motor impairments for each task.

Results and discussion: Significant good to high negative correlations were found between the House-scores and the APS, indicating that children with lower House-scores had more deviating kinematics. Correlation analysis also showed that increased wrist tone, decreased forearm strength and lower grip strength were highly correlated with higher APS/scores, especially for the reach and reach-to-grasp tasks.

This study provided a sound base to use the APS to evaluate UL movement pathology in children with UCP. Current results confirmed the role of distal muscle tone and strength in the emergence of kinematic deficits. This suggests that treatment aimed at distal tone reduction, e.g. BTX/injections, strength training, could improve the amount of movement pathology.

**QUANTIFICATION OF BIMANUAL DEXTERITY IN CHILDREN WITH HEMIPLEGIA WITH A MODIFIED PEG TEST**

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Scientific background: Deficits in bimanual dexterity are seen in children with hemiplegia and adversely affect performance of many activities, yet there is still no simple test of bimanual dexterity suitable for this group.

Aim: To quantify impairment in bimanual dexterity with respect to unimanual impairment in children with hemiplegia compared with a large normative dataset.

Methods and subjects: 26 children (4-15y) with hemiplegia (16 male; 20 left hemiplegia) and 460 age-matched controls completed unimanual and bimanual tasks using an adapted 9-hole pegboard test (2 adjacent boards; electronically timed; large pegs). The unimanual task involved moving pegs as quickly as possible from one board to the other - first with the dominant, then the non-dominant hand. The bimanual task involved using one hand to pick up pegs from one board and pass them through a hole in a midline Perspex screen to the other hand, which was used to place the pegs on the second board. Both tasks were completed in both directions. Global unimanual (GUD) and bimanual dexterity (GBD) scores were derived...
from completion times. Bimanual dexterity indices \[ \text{BDI} = (\text{GBD}/\text{GUD})/\text{GUD}\times100 \] for hemiplegics were compared with control reference ranges.

Results and discussion: Controls showed an inverse relationship between age and BDI, i.e. bimanual dexterity was less at younger ages even when corrected for unimanual dexterity. Children with hemiplegia showed much variability in the severity of bimanual dexterity deficits: however the BDI was above the age-matched control mean for all hemiplegics, with only 4/26 less than 1 S.D. above the mean, 6/26 1-2 S.D. above and 16/26 over 2 S.D. above control means. This indicates significantly longer bimanual task completion times in most hemiplegics than controls even when accounting for age and unimanual dexterity. We anticipate our assessment tool will be valuable in evaluating the outcome of bimanual therapeutic approaches in hemiplegia.

COMPUTER VISION BASED ASSESSMENT OF MIRROR MOVEMENTES IN ADOLESCENTS WITH UNILATERAL CEREBRAL PALSY

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Scientific background: Individuals with unilateral cerebral palsy (CP) often present mirror movements (MM) of the contralateral hand and quantitative assessment tools are lacking.

Aim: To investigate if MM can be quantified using a computer-based video analysis tool.

Methods and subjects: Eighteen adolescents and young adults (9 boys, median age 15 years, range 13-20 years) with unilateral CP were recruited and video recorded while opening and clenching the fist. The amount of MM was scored using the MM intensity scale (Woods and Teuber). Variables reflecting the mean Quantity of Motion (QoM) and variability of a spatial Centroid of Motion (CoM) of contralateral hand movement, derived from calculating the pixel difference between subsequent video frames, were correlated with the Woods and Teuber scores using Spearman’s rho.

Results and discussion: The QoM correlated strongly with the Woods and Teuber scores both in the affected and non-affected hand (r = 0.80; p < 0.001 and r = 0.85; p < 0.001 respectively). High correlation was also found using the variation of the spatial CoM (r = 0.76; p < 0.001 and r = 0.66; p < 0.003 respectively). These findings suggest that mirror movements (MM) in individuals with unilateral cerebral palsy can be quantified using regular video recordings. The computer vision based assessment may provide a better understanding of the relationship between brain lesions, mirror movements and hand function. Moreover, it may be used in future intervention studies, and may consequently contribute to a better decision making of future treatment strategies.

CLINICAL AND COMPUTER-BASED ASSESSMENT OF MIRROR MOVEMENTS AND HAND FUNCTION IN CEREBRAL PALSY


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Scientific background: Mirror movements (MM) of the contralateral hand are common among children with unilateral cerebral palsy, but how they affect bimanual performance or manual dexterity is unclear.

Aim: To investigate how MM relate to unimanual dexterity and bimanual performance.

Methods and subjects: Eighteen adolescents (median age 15 years, range 13-20 years) with unilateral CP participated. While opening and clenching the fist of one hand, MM of the contralateral hand were video recorded. MM were scored using the MM intensity scale (MMIS) (Woods and Teuber), or by calculating
the pixel difference between subsequent video frames as the mean amount of contralateral hand movements (Quantity of Motion - QoM). Bimanual performance was assessed using Assisting Hand Assessment (AHA) and manual dexterity using the Box and Blocks test (B&B). Spearman’s rho was calculated to study correlations between hand function and MM.

Results and discussion: MM were observed in 10 participants with MMIS, and in 7 with QoM. In the non-affected hand MM assessed with MMIS did not correlate with B&B ($r = -0.27; p = 0.30$), but borderline non-significant with AHA ($r = -0.43; p = 0.07$), while QoM did not correlate with B&B or AHA. In the affected hand MM were inversely correlated with B&B (MMIS: $r = -0.64; p = 0.01$; QoM: $r = -0.49; p = 0.05$). MMIS also correlated inversely with AHA ($r = -0.49; p = 0.04$), while there was no correlation between QoM and AHA ($r = -0.17; p = 0.49$).

Our results suggest that a higher amount of MM in the affected hand adversely affects both manual dexterity and bimanual hand function. Clinical classification identified more children with MM and was more strongly related to hand function than the computer-vision-based analyses. This may be explained by subtle movements being lost in the computer-vision-based analyses, probably through filtering techniques. Further development of this methodology is therefore needed.
PREGNANCY INDUCED HYPERTENSION AND AETIOLOGY OF CEREBRAL PALSY (CP): ANALYSIS OF CCCP DATA

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Scientific background: Growth restriction (GR) is a major risk factor for CP and pregnancy induced hypertension (PIH) the most frequently occurring medical factor decreasing intrauterine growth.

Aim: To identify the role of PIH on pathways to CP in singletons born >=35 weeks.

Methods and subjects: From the CCCP, a total population (Western Australia 1980-95) case control study of CP, gestation matched controls and perinatal deaths we selected all singletons born at 35+ weeks gestation. Outcomes were CP without neonatal neurological abnormality (CP-NE), CP with NE and clinically diagnosed birth asphyxia (CP+NE+BA/HIE) and CP with NE without BA/HIE (CP+NE), neonatal death and intrapartum stillbirth. The odds ratio of each poor outcome associated with PIH (BP rise during pregnancy of >20mm with or without proteinuria) was estimated with and without GR (</2 standard deviations below optimal for gestation, gender and maternal height and parity or a neonatal clinical observation of growth restriction).

Results and discussion: 12.3% control (62/503), 16.9% CP (81/478), 19% neonatal deaths (19/100) and 26.4% intrapartum stillbirths (19/72) experienced PIH. The odds ratio (OR) with PIH varied between outcomes. The risks of CP-NE and CP+NE (comprising 78.5% of all CP) with PIH were only marginally increased whether or not they were GR. PIH was associated with CP+NE+BA/HIE both without GR OR=3.7(95%CI 1.2,11) and with GR OR=7.6 (0.7,80) as were perinatal deaths OR=1.8(1.1,3.1) and 10.8(3.8,31) without and with GR respectively. Despite the high OR estimate, only 4/103 CP+NE+BA/HIE experienced PIH plus GR, contributing 0.8% of all CP, compared with 6% of neonatal deaths and 9.7% intrapartum stillbirths.

PIH, particularly if associated with GR, is a significant risk factor for perinatal death and CP+NE+BA/HIE which may be considered near miss perinatal death. PIH is not a risk factor for the majority of CP that do not experience birth asphyxia.

CYTOMEGALOVIRUS AND EPSTEIN-BARR VIRUS ARE ASSOCIATED WITH SOME CASES OF CEREBRAL PALSY

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Scientific background: Intrauterine infection is a risk factor for cerebral palsy. It has been suggested that neurotropic viruses could be involved. These viruses have the potential to cross the placenta and blood-brain barrier, infect the fetal brain and cause damage to developing neural tissue, although evidence of damage may not be clinically apparent until later in childhood.

Method and subjects: The population based case control study comprised newborn screening cards (NSC) of 339 Caucasian children with cerebral palsy and 594 controls. Genotyping was performed on DNA extracted from dried blood spots of NSC. Viruses tested were herpes simplex viruses 1 and 2 (HSV1 & 2), varicella zoster virus (VZV), Epstein-Barr virus (EBV), cytomegalovirus (CMV), human herpes viruses 6, 7 and 8 (HHV6, HHV7 & HHV8), and parvovirus B19.
Results: CMV and EBV were detected in 5 (1.5%) and 3 (0.9%) of 339 cases, respectively, but not in controls ($p = 0.047$ and 0.006). Frequencies of detection of the other viruses examined were similar for cases and controls. DNA from at least one of the nine viruses tested was found in 4.4% of cases and 3.1% of controls [OR 1.4 95% CI (0.71-2.76)].

Conclusion: Evidence of congenital viral infection was uncommon in cases of cerebral palsy and controls. However, CMV and EBV, the glandular fever virus, were significantly associated with cerebral palsy. To the best of our knowledge this is the first report of an association of EBV with cerebral palsy. The frequency of these viruses was low in these stored neonatal blood samples and this retrospective methodology may under represent active infection and viremia earlier in pregnancy. If larger studies and earlier sampling were possible, higher infection rates might merit pregnancy vaccination strategies.

BEGINNING TO UNRAVEL THE CAUSAL PATHWAYS TO CP FOR LOW RISK TERM INFANTS: ANALYSIS OF CCCP DATA

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Scientific background: Infants born at term who only require routine care in the neonatal period make up 45% of all CP. Little is known about the aetiology of this group, although recent research has identified independent risk factors in the neonatal period.

Aim: To determine if term infants who require only routine care in the neonatal period have preconceptional, antenatal and intrapartum risk factors that increase their risk of CP.

Methods and subjects: Singletons born at term (37+ weeks) and not requiring special neonatal care were selected from a total population case control study of CP in Western Australia (CCCP). Risk factors were identified by logistic regression.

Results and discussion: 67% (295/442) of all term born singletons with CP did not require special care in the neonatal period. No neonatal predictors were identifiable for 58% (Asymptomatic group), 42% had at least one predictor suggesting a mild neonatal encephalopathy (Mild NE group). Three preconceptional risk factors attained statistical significance in the Asymptomatic group: Mothers age <18 OR4.1(1.8,9.3), 4+previous births OR2.6(1.0,6.7), and a family history of CP/birth defects/intellectual impairment OR1.8(1.1,2.9); and four in the Mild NE group: rural residence OR1.5(1.1,2.1), maternal migraine OR2.5(1.0,6.0), first birth OR1.4(1.1,2.8) and single mother OR1.8(1.0,3.2). Statistically significant antenatal and intrapartum risk factors were the same for Asymptomatic and Mild NE groups, but with different levels of risk: abnormalities of fluid volume OR4.5 and 7.2, first bleed between 24-31 weeks OR6.1 and 10.5, placental abnormalities OR1.6 and 1.8, breech presentation on OR2.9 and 3.1 and meconium OR2.3 and 2.5.

The proximal cause of brain damage in this large group of term infants with CP is unknown, but it is unlikely to lie in the intrapartum or neonatal periods. Further research is required into how these antenatal and preconceptional risk factors constitute risks for brain damage.

SEVERITY OF CEREBRAL PALSY (CP) AND APOLIPOPROTEIN E4 (ApoE4)

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Scientific background: It has been hypothesized that ApoE4 has a beneficial effect on neurodevelopment in children, in contrast to the adverse effect on neurological disorders in adults.

Aim: The aim of this study was to test if the presence of the ε4-allele in genes coding for ApoE4 (APOEε4) was associated with less severe CP than absence of the ε4 allele.

Methods and subjects: Among 684 children with CP enrolled in the CP Register of Norway, APOE genotyping was performed on buccal epithelial cells from 255. Main outcome measure of severity was the gross motor function classification system (GMFCS). Secondary outcome measures were fine motor function, epilepsy and the need for gastrostomy tube feeding (GTF). To study the possible association between APOE4 and GMFCS levels and other outcome measures, we did binary or ordinal logistic regression analyzes.

Results and discussion: There was no association between the APOEε4 genotype and GMFCS levels (OR: 1.17, 95% CI 0.67-2.04). However, APOEε4 genotype was more often present among children with epilepsy (OR:2.2, 95%CI 1.1-4.2) and GTF (OR:2.7, 95%CI 1.1-6.6). Among children with unilateral CP, presence of APOEε4 was more common among those with the most severe fine motor function impairment (OR 3.0, 95% CI 1.3-6.9).

We were not able to confirm our main hypothesis of a protective effect of APOE4 on the severity of gross motor impairment in children with CP. Instead, subgroup analyses suggested detrimental effects. Judged by GMFCS, APOEε4 genotype does not seem to affect overall “brain repair” mechanisms. However, we speculate that the association with epilepsy, gastrostomy tube feeding and fine motor function may suggest a negative impact of APOEε4 genotype on the plasticity of the developing brain after injury.

TRENDS IN PREVALENCES POST-NEONATAL CEREBRAL PALSY: A EUROPEAN REGISTER-BASED STUDY (NEW VERSION)

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Aim: To analyze the trends over time of prevalence of cerebral palsy (CP) cases of post-neonatal origin (occurring between the 28th day after birth and 24 months) and to investigate whether changes are similar according to aetiology and severity.

Methods: Post-neonatal CP cases, birth years 1976 to 1998, were identified from a European database of CP registers (Surveillance of Cerebral Palsy in Europe collaboration - SCPE).

To explore trends in prevalence and to take into account the rareness of events studied in time series analysis, specific graphical methods (Lowess and Cumsum control chart) and statistical analysis (Mann-Kendall test and negative binomial regression model) adapted for rare events have been used.

Results: Over the whole study period, post-neonatal CP cases accounted for 5.6% (404/7208) of all CP cases and prevalence rate was 1.20 per 10000 live births (IC 95%: [1.08 - 1.31]). There was a significant downward trend in the evolution of the prevalence of cerebral palsy of post-neonatal origin with an acceleration of this phenomenon after 1989. In 46% of cases, an infectious aetiology was reported; the corresponding prevalence significantly decreased during the study period (p=0.016). No significant decrease was observed for the rate of post-neonatal CP with a vascular episode or a traumatic origin. Severe cases accounted for 34.8% of post-neonatal CP cases, with a significant decrease in prevalence over the period (p<0.001). Results of trends analyses were concordant whatever the method used.

Conclusion: Our results showed a significant downward trend of the prevalence of post-neonatal cerebral palsy cases which interpretation remains quite complex. The development of legislation supporting the development of educational programs or immunization programs in place in various European countries could be a beginning of an explanation.
ASSESSMENT OF WALKING ABILITY IN YOUTHS WITH CP BY USING THE ICF – A STUDY OF TEST-REST REABILITY

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Scientific background: This study wanted to explore the use of the ICF (International Classification of Functioning, Disability and Health) generic qualifier when assessing self and parent reported walking ability

Aim: To evaluate test-retest reliability for nine selected tasks, regarding “Walking and moving around”, in the ICF-CY, by letting youths themselves and one parent assess their walking ability. Also investigate whether there were any assessment differences between youths and parents.

Subjects and method: Thirty-three youths with cerebral palsy, GMFCS I-III (Gross Motor Function Classification System), 13-20 years with respective parent answered a questionnaire on two occasions ten days apart estimating the walking ability of the youths by the use of the generic qualifier in the ICF.

Concordance between the two occasions was investigated using Spearman Correlation Coefficient (SCC) together with ‘the method of stability between two instances of measurement’ by Svensson (ES) (1). Differences between the assessments were calculated using Fisher’s Exact Test together with calculations of confidence interval and Z-score based on Svensson’s method.

Results and discussion: The results from the two methods confirmed each other and showed that, six of the nine tasks were estimated as having satisfactory reliability, SCC 0.82/0.91 and ES 58%-79%, when parents performed the assessment - only three when self reported, SCC 0.78-0.92, ES 73%-91%.

According to differences between self and parent reported assessment two tasks differed on the first and one task on the second occasion.

What became obvious was the need to individualize and delimit the content of the selected tasks to improve reliability. This study support parents as more reliable assessors. The use of the ICF qualifier needs further investigation but recommendations can be made for the use of this assessment as an easily administered evaluation of parent reported walking ability.

References:

FURTHER TESTING OF THE CHALLENGE MODULE – A NEW MEASURE OF ADVANCED MOTOR SKILLS IN CHILDREN WITH CP

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Scientific background: The Challenge Module (Challenge) was created by our research team as a proposed extension to the GMFM-66 to give physiotherapists (PTs) a tool to identify advanced motor skill strengths/limitations and evaluate change in high-functioning children with CP.

Aim: To confirm response option suitability of the 25-item Challenge with respect to difficulty when used with children with CP, and conduct pilot inter-/intra-rater reliability testing when scored by 2 PTs (assessor, observer) from live performance (inter-rater:live) and review of videotaped performance (inter-rater/intra-rater:video). Speed targets for its 5-point scale had been derived from mean scores of 34 typically-developing children (4.5-10 years) tested previously by our team.

Results: Sixteen children (9 males, 7 females) in GMFCS Level 1 (mean age 10 years, SD 2.9) participated. Challenge total mean live scores were 51.7% (SD 17.4%) for assessor and 52.4% (SD 17.1%) for observer. Inter-rater:live reliability was excellent (ICC=0.99; 95%CI 0.98-1.00). Three of 25 items had mean scores <1.0, indicating extreme difficulty and need for revision. Eight items had mean scores 1.0 to <2.0, suggesting room to make items less demanding. Revisions were done for these items at the 3 lower score levels. Revised Challenge scores (video) varied from 23.3 to 85.2% with fairly normal distribution. The
Challenge total mean score was 54.2% (SD 18.3). This was higher than the original Challenge (P < 0.05) verifying slight reduction in difficulty. Inter-rater and intra-rater ICCs for the revised Challenge were 0.97 and 0.98 (95% CI 0.85-0.99), and MDD90=4.7% points.

Discussion: Pilot study results confirm the Challenge’s reliability. The mean score of 54% and our experience with its use in CP suggest potential for change measurement while also not being too difficult for children in GMFCS I. A funded three-year, multi-centre measurement study is underway that will link the Challenge and GMFM-66 using Rasch methods.

LINKS BETWEEN PHYSICAL EXAMINATION AND GAIT ABNORMALITIES IN VERY YOUNG CHILDREN WITH CP

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Scientific background: Gait abnormalities present in development of gait in children with CP are commonly linked to the static and dynamic muscle shortening.

Aim: To verify whether this common assumption is true in the group of the youngest walkers with CP.

Methods and subjects: Physical examination data - passive range of motion (PROM) and angle of catch (AOC) in the lower extremities were analysed along with abnormalities of stance and swing phases of gait according to the Modified Amsterdam Gait Classification in 75 consecutive children (150 extremities) with bilateral CP GMFCS II-IV selected for Botulinum Toxin (BTX) treatment before the age of 3 years.

Results and discussion: Our study revealed that there is a relation between gait deviation patterns in midstance (MST) and swing and physical examination findings. Children demonstrating increased number of shortened muscle groups had more severe gait deviations in stance. Statistically significant differences were observed between gait type 2 (MST: flat foot + knee hyperextension) and types 3 (MST: heel rise + knee extension) and 4 (MST: heel rise + knee flexion) in hip adductors (ADD), hamstrings (HS) and rectus femoris (RF) length and dynamic length of ADD and RF. Significant differences between type 3 and 4 were found only in hip flexors (HF) length and medial HS static and dynamic length. Abnormalities in swing were significantly related to: static length of HS, RF and soleus (SOL) and dynamic length of ADD in dropfoot; static length of RF and SOL in stiff knee; static length of HF and HS in both limited knee extension in terminal swing and hip adduction in terminal swing respectively.

Mainly static muscle shortening observed in the study group was related to gait deviations. Early development of structural changes might indicate the need for reconsideration of therapeutic strategies in the group of very young walkers with bilateral CP.

DOES FEMORAL DE-ROTATION OSTEOTONY IMPROVE TRANSVERSE PLANE PELVIC KINEMATICS IN CHILDREN WITH CP?

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Scientific background: Internal femoral torsion is a common bony deformity in children with cerebral palsy (CP) that can result in gait problems including excessive internal hip rotation and pelvic retraction, hence femoral de-rotation osteotomy procedures are routinely undertaken to treat the femoral torsional deformity.

Aim: To assess the effect of unilateral femoral de-rotation osteotomy on transverse plane pelvic and hip kinematics during gait in children with CP.

Subjects and methods: In this retrospective cohort study we included 9 patients that had been assessed at the Queensland Children’s Gait Laboratory between 2005 and 2011. Inclusion criteria stipulated that participants had a diagnosis of spastic hemiplegia or diplegia (asymmetrical), been treated with a unilateral femoral de-rotation osteotomy and have pre- and post-surgery gait analysis data. Gait kinematics were captured at 100Hz using an 8-camera, three-dimensional, motion capture system (Vicon, Oxford, UK). A
2×2 ANOVA was used to assess the effect of surgery on peak internal hip rotation and peak pelvic retraction during gait. Within subject factors were surgery (pre- and post-surgery) and side (ipsilateral and contralateral to the surgery). Statistical analyses were performed in SPSS (Version 20, SPSS, USA). Significance was accepted at P<0.05.

**Results:**
There was a significant main effect of surgery on peak internal hip rotation (P=0.01), a significant main effect of side on peak pelvic retraction (P=0.02) and peak internal hip rotation (P<0.01) and a significant surgery × side interaction on peak pelvic retraction (P=0.01) and peak internal hip rotation.

**Discussion:**
As expected unilateral femoral de-rotation surgery significantly reduced peak internal hip rotation during gait. Furthermore, surgery corrected asymmetrical pelvic transverse plane motion. In sum, femoral de-rotation surgery was effective in correcting transverse plane gait abnormalities at the hip and pelvis in a group of children with cerebral palsy.

**PROPOSAL OF A DIAGNOSTIC PROTOCOL FOR IDIOPATIC TOE WALKING**

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**Scientific background:**
Idiopathic Toe-Walking (ITW) is defined as persistent toe walking in a normal child in the absence of developmental, neurological or neuromuscular conditions.

**Aim:**
The purpose of our study is to identify an easy and objective diagnostic protocol to help clinicians in the differential diagnosis and treatment of ITW.

**Methods and subjects:**
The diagnostic protocol that we propose is divided into two parts. The first one aims at a differential diagnosis from neuromuscular and mild neurological diseases; it includes past and present medical records, evaluation of muscular enzymes, Gower test, evaluation of tendon reflexes and clonus. The second part evaluates the gait pattern and the muscular and joint impairment through the Ashworth scale, the Selective Motor Control scale, the Physician’s Rating Scale, the goniometric measurement of the ankle range of motion and the baropodometry. We applied this diagnostic protocol to all the children referred to our paediatric orthopaedic clinic who use to walk on their toes without a specific diagnosis after an orthopaedic examination.

**Results and discussion:**
Between January 2011 and April 2012, we collected data about 23 children who use to walk on their toes. All of the children are aged between 4 and 9 years. After the evaluation with our diagnostic protocol we found out that 4 children were affected by mild diplegia, 4 by childhood transient dystonia and 15 were affected by idiopathic toe walking. The diagnosis of idiopathic toe-walking is one of exclusion. The diagnostic protocol allowed us to make a differential diagnosis with cerebral palsy, muscular dystrophies, tethered cord syndrome, diastematomyelia and other neuromuscular diseases.

In our experience, the use of a diagnostic protocol can help the physiatrist in making a differential diagnosis and choosing the best treatment available.

**GROUP 7– UPPER LIMB TREATMENT 1**

**EFFICACY OF UPPER LIMB THERAPIES FOR CHILDREN WITH CONGENITAL HEMIPLEGIA: SYSTEMATIC REVIEW UPDATE**

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**Scientific background:**
A large number of upper limb training approaches exist for children with unilateral CP.

**Aim:**
To determine efficacy of interventions for upper limb (UL) dysfunction on activity outcomes.
Method and subjects:
Methods: Systematic review and meta-analysis of randomised/quasi randomised trials. Systematic search of 5 databases. All RCTs comparing UL intervention (including neurodevelopmental treatment (NDT); splinting; Botulinum Toxin-A (BoNT-A); Constraint Induced Movement Therapy (CIMT), mirror therapy, bimanual training, occupational therapy (OT) with no intervention or comparator. Qualitative analysis using PEDro Scale and quantitative analysis using effect size calculator and RevMan 5.
Results and discussion: The review identified a large number of RCTs evaluating activity outcomes with marked variation in results. Thirty-eight studies were reviewed independently by 2 raters investigating BoNT-A (n=12); CIMT (n=18); NDT (n=2); forced use therapy (n=1); intensive bimanual training (n=1); mirror therapy (n=1); OT home programs (n=1); functionally focused therapy (n=1); lycra splints (n=1). Most trials had strong methodological quality (PEDro≥6), 8 had poor quality (PEDro<6) and were excluded from meta-analysis. There is strong evidence that CIMT is more effective than usual care to improve the amount of use of the impaired UL [2 studies, n=40; WMD 1.09 (0.12, 2.06]; performance of individualised goals [1 study, n=50; MD 2.3 (1.63, 2.97)]; bimanual performance [1 study, n=50; MD 4.7 (1.58, 7.82). There is weak evidence that CIMT is more effective than equal dose bimanual therapy for all outcomes. There was moderate evidence of effect on activity limitation with UL training enhanced with BoNT-A; a medium to strong effect of CIMT and HABIT compared with no treatment on the amount of use of the impaired limb; a medium to large effect of BoTX-A and OT on achievement of individualised goals. Upper limb treatment options available to children with congenital hemiplegia have variable treatment effect on activity performance.

TRAINING ASPECTS OF FINGER MOVEMENTS WITH A COMPUTER GAME IN CHILDREN WITH UNILATERAL PALSY

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Scientific background: Little is currently known about the possibility to improve specific motor functions such as speed, timing and accuracy of finger movements in children with unilateral CP by intensive training with a computer game.
Aim: To investigate if finger movement speed, timing and accuracy can be improved by the use of a computer game in children with unilateral CP.
Methods and subjects: The study included 17 children with unilateral CP, mean age 11.4 (SD 2.8) years, 10 males, MACS level I-II, GMFCS I. Scores on the Jebsen/Taylor hand function test ranged between 53-1080s (mean 340.95s ) prior to training. Training was conducted at home, or in a group setting, for up to 30 min/day using a standard laptop and a computer game that was designed specifically to meet the aim of this study. The results from eight days of training were logged on the laptop and used as the primary outcome measure.
Results and discussion: All children improved regardless of initial ability. Repeated measures ANOVAs showed significant improvements on movement speed (p<.01), timing (p<.01) and accuracy (p<.01). The significant change in performance on the variables; speed, timing and accuracy occurred within four days of training, corresponding to 2h of active training during which a mean of 7267.94 (SD 3610.86) keystrokes were performed.
Conclusions: The results from this study show that it is possible for children with unilateral CP to improve their speed, timing and accuracy of finger movements by intensive training with a computer game and that a significant change in performance can be achieved within four days of training. This new information on intensity and dosage of training can be of great importance for therapists when planning and executing training regimes.
DESIGN AND EVALUATION OF A VIRTUAL REALITY “EXERGAME” FOR YOUTH WITH CEREBRAL PALSY (GMFCS III)

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Scientific background: Teenagers with CP (GMFCS III), experience a decline in their physical functioning. Poor physical fitness and muscle weakness secondary to disuse are significant contributors.

Aim: We aim to develop and evaluate virtual exercise video games (“exergames”) to improve fitness and social interaction. We report on the design of the exergame and initial evaluation of physical exertion.

Methods and subjects: The “exergame” was designed through an iterative participatory design process with computer scientists, game and equipment designers, health professionals (MD, PT) and 8 youth (mean age 15.5 yrs, range 13.5 - 19) with bilateral spastic CP, GMFCS III. Physical exertion was assessed in 6 youth through HR monitoring during the “exergame” over two - ten minutes periods. Perceived exertion was measured by the OMNI Scale.

Results and discussion: The “station” combines a physical seat allowing youth to cycle providing pedaling input into online customized games, a standard Xbox 360 controller, and algorithms for interpreting the cycling input. The station required redesigns including a specialized seat (lateral supports, seatbelt, cushioned non-slip surface), a telescoping frame, and straps to secure the foot on the pedal of the PC GamerBike mini. Initially 3 of the 8 youth could independently pedal. At the end of the redesign 7 of 8 could pedal. With direct design input from the youth with CP, a virtual reality “world platform” has been designed with 4 “exergames”. While playing the games over 20 minutes, 4 youth achieved >70% maximal HR, and 2 achieved >60%. The average score on the OMNI scale (measured 7 minutes into play time) was 3.5 (getting more tired) for game 1 and 6.7 (tired) for game 2.

VIRTUAL REALITY BASED THERAPY FOR POST-OPERATIVE REHABILITATION OF CHILDREN WITH CEREBRAL PALSY

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Scientific background: Virtual reality is the use of interactive replication created with computer hardware and software to impart users with opportunities to engage in environments that appear to feel similar to real world objects and events. The use of virtual reality based training (VRBT) for rehabilitation of cerebral palsy is not common.

Aim: To find out the efficacy of Virtual Reality Based Therapy (VRBT) in Post- Operative Rehabilitation of Children with Cerebral Palsy.

Methods and subjects: This is a retrospective cohort study in which 29 subjects participated (study group - 14 and control group - 15). Nintendo Wii sports and Wii fit were used for VRBT. The study group received VRBT along the conventional rehabilitation modalities, whereas, control group received only conventional rehabilitation modalities. The subjects of the study group were assigned to play the games (VRBT) in every three alternate days in a week. The outcome measures used were Manual Ability Classification System (MACS) for upper limb function, Pediatric Balance Score (PBS) for balance, level of participation, motivation, cooperation and satisfaction of the child. Both the measures were collected before the treatment and after completing the treatment (after three weeks).

Results and discussion: The balance and manual ability were significantly improved in both the groups (Balance: study: t=2.28, p<0.05; control: t=3.5, p<0.01; Manual ability: study: t=5.58, p<0.001; control: t=7.06, p<0.001). Level of participation, motivation, cooperation and satisfaction of the child were also reported to be significantly higher among the study group as compared with control group. Results of this
study showed that improvement in balance of postoperative children with cerebral palsy was possible through the use of VR-based therapy in the form of Wii-Fit. VRBT is an effective method in Post-Operative Rehabilitation of Children with Cerebral Palsy.

**ACTION OBSERVATION TREATMENT MAY IMPROVE UPPER LIMB MOTOR FUNCTIONS IN CHILDREN WITH CEREBRAL PALSY**

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Scientific background: Action Observation Treatment (AOT) is a novel rehabilitation approach exploiting a well assessed neurophysiological mechanism for which the observation of object directed actions automatically recruits the motor representations of those same actions in the brain of the observer.

Aim: Aim of this randomized controlled trial was to assess whether AOT may improve upper limb motor functions in children with cerebral palsy.

Methods and subjects: All children with cerebral palsy admitted to our Unit from May 2009 to May 2010 for rehabilitation were eligible. Inclusion criteria were: age between 6 - 11 yrs, IQ > 70, no major visual and/or auditory deficits. Fifteen children were enrolled and randomly assigned to either a case (n= 8, 4 males; median age: 7.5 yrs) or control (n= 7, 5 males; median age: 8 yrs) group. Cases were asked to observe video-clips showing daily age-appropriate actions, and afterwards to imitate them. Controls were asked to observe video-clips with no motor content and afterwards to execute the same actions as cases. The primary outcome measure was score on the Melbourne Assessment Scale. Children were scored twice at baseline (two weeks apart), and at the end of treatment, by a physician blind to group assignment.

Results and discussion: At baseline groups did not differ on functional evaluation. After treatment functional score gain (\(\Delta\)) of cases differed significantly from that of controls (\(p = 0.026\)). The present results support the notion that AOT may become part of the rehabilitation program in children with cerebral palsy.
LONG TERM FOLLOW-UP IN DYSTONIC CEREBRAL PALSY TREATED WITH DEEP BRAIN STIMULATION

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Dystonia is one of the most frequent movement disorders in childhood and, considering the limited benefit of medical treatment, recently has been proposed GPi DBS as an additional therapeutic strategy. Its effectiveness has been convincingly proven for primary generalized dystonia, but it is rarely diagnosed when compared to the secondary forms. Little is known about DBS effect in this population, in particular in children with cerebral palsy (CP).

We describe 10 patients (M/F=8/2, mean age at intervention = 162 months) with generalized secondary dystonia who underwent bilateral GPi DBS. The aetiology was neonatal asphyxia (6 patients), hyperbilirubinemia (2 patients) and encephalitis (2 patients). Five patients had bipolar electrode setting. Parameter setting were: Rate =130 Hz; Pulse width = 120/450 \(\mu\)sec and Amplitude = 3-4.5 V.

They performed motor (BFM scale), cognitive (IQ) and speech evaluation (in particular semantic fluency) before and after the intervention. Follow-up duration ranged from 12 to 84 months. Mean basal BFM-MS was 74,15 (range: 50/96,5) and BFM-DS was 23,5 (range: 11/29). Percentage improvement at the end of the follow-up ranged from 0 to 48\% for MS and 0 to 27\% for DS. Although poor outcome demonstrated with the rating scale, families showed a good satisfaction.

Intellectual disability was present in 6 patients. In 5 patients a cognitive and speech follow up was possible demonstrating a stable cognitive profile and an improvement of semantic fluency.

In conclusion, a variable response to DBS was described in our patients with dystonic CP. Long term benefit was achieved in 8 patients in terms of motor and speech abilities. Bilateral GPi DBS can be thus proposed in patients with dystonic CP provided that the variability in expected outcome is taken into consideration when discussing this option with families. Further investigations will be necessary to define specific inclusion criteria and prognostic factors.

PHARMACOLOGICAL TREATMENT IN DYSKINETIC CEREBRAL PALSY

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Aim: Evaluation of the effect of Levo/Sulpiride, Trazodone and combined treatment (Levo/Sulpiride and Trazodone) in S affected by Dyskinetic Cerebral Palsy.

Subjects and Methods: We examined 46 subjects (S) (26 males, 20 females; mean age: 12y8m, range: 2y11m-23y6m). The disability level (GMFCS - E & R, Palisano et al, 2007) was: level V: 30S; level IV: 10S; level III: 3S; level II: 1S; level I: 2S. 21S received Levo-Sulpiride (mean dose: 1,3 mg/kg/die), 10S Trazodone (mean dose: 1,3 mg/kg/die), 15S Levo-Sulpiride and Trazodone (mean dose: respectively 2 and 1,3 mg/kg/die). Follow-up: mean: 4y. The results were assessed according to “Dystonia Movement Scale” (Burke, 1985) and "Neuromotor Disorders Assessment Scale” (Papini et al, 1995, 1998, 2006) in serial videorecordings; the data were fed into the specific Data Base.

Results and Discussion: Symptoms: significant improvement: Levo-Sulpiride: stiffness (19/21), motorhoea (9/11), involuntary movements (9/11), irritability (9/12), opisthotonos (13/19), torsion spasm (6/9); Trazodone: gaze avoiding (6/6), oral dyskinesias (4/4), startle (5/7); combined treatment: stiffness (15/15),
opisthotonos (15/15), irritability (10/12), gaze avoiding (6/8), startle (11/14), torsion spasm (9/12).

Functional Competences: 18/46S showed better performances; passage to a less severe level (from IVth to 3rd): 3S. Side effects: Levo-Sulpiride: dose-related drowsiness (5/21), floppyness (3/21), increase of prolactin level (2/21); Trazodone: none; combined treatment: drowsiness (4/15), floppyness (1/15), drooling (1/15), increase of prolactin level (1/15). These results show the positive effect of the two drugs on target symptoms, the specificity of response and the synergy of the pharmacotherapeutic effect. The response of very disabling symptoms such as stiffness, opisthotonos, motorrhea, torsion spasm, involuntary movements, which interfere with neuromotor performance, allowed a significant improvement of functional competences, up to a passage to a less severe disability level in 3S; in the most severely affected S an improvement in basic functional abilities with facilitating management of the S was observed.

EXPLORING STAKEHOLDERS’ VIEWS ON RECEIVING TRANSCRANIAL DIRECT CURRENT STIMULATION IN CEREBRAL PALSY

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Scientific background: Transcranial direct current stimulation (tDCS) is a non-invasive stimulation technique that modulates brain function by increasing or decreasing cortical excitability, and has been shown to improve function of the affected arm in patients with chronic stroke. Its potential as a treatment for hemiplegic cerebral palsy has not yet been explored, despite the ease of use of the equipment, its portability; and that the stimulation can be applied in conjunction with simultaneous motor training in both clinical and home settings.

Aim: To assess the views of young people with cerebral palsy and their parents on receiving non-invasive brain stimulation (tDCS) as a potential form of therapeutic treatment and advantages of, or barriers to this approach.

Methods and Subjects: Qualitative data were collected through semi-structured interviews (audio-recorded and fully transcribed) conducted with an ad-hoc convenience sample (n=11) consisting of 3 adolescents with cerebral palsy and 8 parents. The Framework approach was used to identify a priori and emergent themes.

Results and Discussion: Exploration of tDCS as potential therapy in cerebral palsy has been received with interest. Preliminary findings from the interviews showed that the stakeholders welcome a treatment that is non-invasive and not painful. The prospect of home-based treatment was preferred over treatment in a clinical setting. Interviewees raised concerns over the application of electricity on the scalp and how little is currently known about tDCS effects in cerebral palsy. However, these would be resolved when effectiveness and safety are established in cerebral palsy through continued research. The expressed concerns can be addressed and have informed the next stage of our work exploring tDCS effects in hemiplegic cerebral palsy.

GOAL-DIRECTED OUTCOMES FOLLOWING PAEDIATRIC DEEP BRAIN STIMULATION (DBS) USING THE CANADIAN OCCUPATIONAL PERFORMANCE MEASURE (COPM)

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Background: Paediatric dystonic movement disorders (MD) are characterised by their heterogeneity, both in clinical features, age at onset and disease course, and in the many associated genetic and acquired causes
and co-morbidities. Deep Brain Stimulation (DBS) is increasingly accepted as an effective treatment option for primary dystonias but the efficacy of DBS in secondary dystonias has not yet been well described.

Aim: To report changes following 1 year of neuro-modulation (DBS) in paediatric dystonic movement disorders using COPM and to explore outcomes in relation to aetiology.

Subjects and method: The COPM was implemented at baseline, 6 months and 1 year following DBS. Twenty-five parents or primary carers of children and young people with dystonic movement disorders completed COPM interviews at 6 months and 28 at 1 year. Children and young people were aged 3-18 years. Data was obtained through retrospective audit of cases who had undergone DBS and had participated in formal routine goal setting preoperatively.

Results were firstly explored statistically in relation to aetiology (primary/primary-plus and secondary dystonia groups). Given the heterogeneity of the secondary dystonias, a sub-group analysis of the secondary dystonic group including only those with static lesions (cerebral palsy and stroke) was also performed. Kruskal-Wallis testing was used to analyse the distribution of groups at baseline, 6 months, and 1 year following DBS. To explore the median differences between baseline and post intervention we used the related samples Wilcoxon Signed Ranked Test with p value <0.05.

Results and discussion:
The majority of the cohort comprised secondary dystonias including children with CP, metabolic disorders, acquired brain injuries and mitochondrial disorders. The primary/primary-plus dystonic group included children with and without known gene mutations.

No significant difference was found in baseline COPM between the primary or secondary groups. Statistically, non-parametric testing demonstrated no significant difference between the 2 classification groups at 6 or 12 months.

COPM results for the overall cohort show statistical significant changes for both performance (6m p=0.065, 1 year p=0.000) and satisfaction (6 months p=0.020, 1 year p=0.000). Over half of the cohort achieved clinical significant change at 6 months in performance and satisfaction (52% and 56% respectively) and was improved at 1 year review (59% for performance changes and 69% satisfaction). No children demonstrated deterioration. Whilst 9 cases did not show clinical significant change in performance and 6 in satisfaction at any point in time when cases were reviewed individually, all cases but 2 had achieved clinically significant change in some of the goals identified preoperatively.

Statistically significant change was obtained for the primary dystonia/dystonia-plus group following one year for performance and satisfaction following DBS (p=0.012). The secondary dystonia group showed changes that were statistically significant at 6months and 1 year for both performance and satisfaction (6 months p=0.008, 12 months p=0.002). The dystonic CP group achieved statistical change, both in performance and satisfaction (p=0.008 at 6m, p=0.002) at 1 year.

The use of outcome measures such as COPM will allow us to identify gaps in current knowledge and understand which groups respond best to DBS and which domains and functional concerns can be achieved in relation to motor severity, age and aetiological background. Finally, COPM used in conjunction with other outcome measures and biomarkers could assist us in identifying best response to intervention.
Methods and subjects
We tested 25 children aged 0-3 years and 43 patients aged 4-18 years, affected by various MD of different aetiology, treated with specific oral drugs.

The first group included 25 children (21 males and 4 females), aged 0.6-3.10 years at basal time with a mean age of 1.9 years (SD 0.7). The second group is represented by 43 patients (24 males and 19 females) aged 4-18.3 years at basal time with a mean age of 10.1 years (SD 4.5).

We evaluated all patients at basal time (T0), after 6 months (T1) and after one year (T2) of treatment. A 2 sided Student t test was performed to evaluate functional improvement of all patients.

Results and discussion
Index I, Index II and Global Index showed significant changes between follow-up times (T1 and T2) and basal time (T0) both for MD/CRS 0-3 and MD/CRS 4-18.

The results of our study confirm the responsiveness of MD/CRS that could be used as outcome measure of MD in children and adolescent during various specific treatment.

1. Battini et al, Ped Neurol 2008
2. Battini et al, Ped Neurol 2009

EFFECTS OF DEEP BRAIN STIMULATION ON THE CYCLE OF PAIN IN DYSTONIA IN A PAEDIATRIC COHORT.

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Introduction
Children with cerebral palsy frequency have painful secondary movement disorders. There are treatment modalities available to help this aspect of their conditions; therapies, pharmaceutical interventions such as analgesics, Benzodiazepines and Botulimum Toxin injections. These treatments however appear to be short lived, ineffective in some cases or produce contra-indications such as fatigue, drooling and drowsiness. Deep Brain Stimulation is a recognised treatment for dystonia, however little is known about the short and long term effects of Deep Brain Stimulation on the painful aspects of this movement disorder.

Methods
42 children with implanted DBS systems reported pain pre-operatively.. This group of children have both primary, secondary and heterogeneous movement disorders of varying underlying causes. Approximately 50% of this cohort sit under a ‘Cerebral Palsy Umbrella’.

All reported pain as a major limiting factor and a specific goal for treatment. The cohort reported a total of 60 pain episodes in 17 specific areas of the body. Patients were reviewed at 3, 6, 12 and 24 months post-surgery in a multi-model assessment.

Results
23 out of the 42 patients were reviewed at 3,6,12 and 24 months post-surgery, more so were reviewed 12 months post-surgery and had not yet hit the 24 month marker. Assessments included evaluation of CPChild Comfort and Emotions domain scores, analysis of Paediatric Pain Profile scores and Numerical Pain Rating scores, appraisal of self-reports and feedback from parents and finally use of analgesics. By 2 years a sustained pain improvement was maintained by all primary dystonic patients. Secondary dystonias appear to have dramatic early improvements that later deteriorate due to co-morbidities. 60% of children who received regular analgesics pre-surgery are without any by 2 years, 20% continue to be on a weaning pathway with only 7% needing an increase in medications by 2 years. An overall consensus is that DBS is an effective pain management strategy for dystonia, irrelevant of cause.

Conclusion
Children with complex motor disorders suffer from chronic and acute episodes of pain. This pain impacts upon many aspects of daily living including function, participation, development and quality of life. Treatments available are often ineffective or short-lived.
EARLY PREDICTORS OF HIP DISPLACEMENT BY SCHOOL AGE IN YOUNG CHILDREN WITH CEREBRAL PALSY

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Background: To identify the best early radiological predictors of severe hip displacement at 48-60mths in children with Cerebral Palsy (CP).

Participants/Setting: Prospective longitudinal population-based cohort study. Participants were entered from a sample of 329 children and were included if they had early (18-36 mth c.a.) and late (48-60mth) pelvic radiographs (n=103; hips=206, male=57). Gross Motor Function Classification (GMFCS) levels were (I=86, II=34, III=20, IV=34, V=32).

Materials/Methods: Motor capacity was classified using GMFCS. Pelvic radiographs were assessed for Migration Percentage (MP), proximal Femoral Epiphysis to Hilgenreiner’s Line Angle (FEHLA), and Acetabular Index (AI) (inter/rater reliability ICC= 0.93, 0.89, 0.72 respectively). FEHLA is a valid measure of femoral head orientation (ICC=0.89). Hips were classified according to FEHLA (low=0/10deg, moderate=11/20deg, high>21deg) and GMFCS (I-III & IV-V). Need for orthopedic review defined MP>30%.

Results: Early FEHLA, MP, AI and NSA together provided best prediction of late MP. Multivariate analysis demonstrated that a unit change in early FEHLA, MP, AI or NSA produce changes in late MP of /0.33, 0.29, 0.72, 0.18 respectively (p<0.02); the combined model explains 40% of the variation in MP. FEHLA was the only radiological measure predictive of late NSA (coef=0.48,p<0.001). Low FEHLA hips <36mth developed more displacement and steeper acetabulae and were more likely to require intervention by 48-60mth (odds ratio=3.31,p<0.01). Mean FEHLA were worse in children GMFCS IV-V (15.7deg) vs I-III (17.6deg,p=0.08); however the groups were not significantly different, suggesting femoral development is not simply related to functional severity.

Discussion: Data that combines the degree of femoral head displacement, femoral orientation and steepness of the acetabulum provides the best prediction of later displacement in young children with CP. Children with low/FEHLA hips at 18-36mo are at greatest risk of progressing to marked hip displacement/orthopedic surgery by school age.

RISK OF HIP DISPLACEMENT IN YOUNG CHILDREN FOLLOWING ACQUIRED BRAIN INJURY

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Introduction: Children who acquire brain injury (ABI) post-natally have been identified as having a risk of progressive hip displacement (Kentish et al 2011). This paper aims to provide further evidence regarding risk of hip displacement for children with ABI.

Methods: Review of Queensland’s state-wide hip surveillance database (HIPS-IMS) was undertaken to identify children who had an ABI. The database and medical records were reviewed to confirm age at injury, Gross Motor Function Classification System (GMFCS) equivalent, and Reimers Migration Percentage (MP). Children with no motor limitation or where time of injury was unclear were excluded. The primary outcome was MP ≥ 30% in one or both hips.
Results: The HIPS-IMS database identified 1890 children of whom 172 had a diagnosis of ABI resulting in some limitation of mobility, with 15 excluded as timing of ABI was not defined. The remaining 157 had clearly identifiable post-natal injury and were classified into 3 groups as those with: (i) no radiological data (n=28); (ii) “hips not at risk” MP remained <30% (n=92) and (iii) “hips at risk” MP of ≥30% (n=37). For the “hips at risk” group mean age of ABI was 47 months (range from 1 month to 9 years), the average time from injury to progression of MP ≥30% was 27 months and GMFCS equivalent was II=1, III=1, IV=8, and V=27. Seven (19%) had progressed to dislocation with mean period of 14 months from injury to dislocation and 27 (73%) have received or were booked for hip surgery.

Conclusion: While this report is limited by incomplete recruitment and data collection, we have identified a number of children within the cohort (24%) with progressive hip displacement or dislocation. This highlights the need for systematic hip surveillance following brain injury, with prospective surveillance of an ABI population-wide cohort required to confirm incidence and relative risk.

IS IT POSSIBLE TO PREVENT HIP DISLOCATION IN CHILDREN WITH CP? THE ROLE OF POSTURAL MANAGEMENT

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Objectives: To determine the effect of a siège moulé postural management on the progression of hip displacement in children with CP.

Background: Musculo-skeletal disorders and hip deformity play a key role on future development of adaptive functions in children with CP. Lateral migration of the femoral head increases on average of 7.7% per year and may progress to hip dislocation.

Methods: A prospective comparative study was conducted. 70 patients with bilateral CP were included into the study and evaluated by clinical examination and radiological measurements (MP migration percentage). 36 children were treated with neurodevelopmental treatment (NDT) and postural management 4/5 hours a day, and 34 children were treated with NDT alone.

Statistical analyses: Crude analyses for continuous variables were performed using Wilcoxon matched-pairs signed-ranks test for analyses within treatment group over time and Wilcoxon rank-sum test for unpaired comparisons between treatment groups. Categorical variables were analyzed using McNemar chi-squared test (for paired comparisons) and chi-squared test (unpaired comparisons). MP was analyzed either as a continuous variable or categorized into normal (MP<21), at risk (21-33), or subluxated (>33).

Results: At baseline the treatment (TG) and control group (CG) were similar for all clinical relevant characteristics except for average MP that was significantly higher in TG (28.9) compared to the CG (19.1) (p=0.004). There was substantially no change of MP over time in the TG, while the CG showed a significant worsening at year 1 (average MP=30.2; p<0.0001) and further important MP increase at year 2 (average MP=39.3; p<0.0001). From the multiple GEE model, we found a strong negative statistical interaction between treatment and time (p<0.0001).

Conclusion: The study supports the evidence that conservative management of hip deformity and preservation of muscle length and balance may prevent or reduce femoral head migration.
THE NATURAL PROGRESSION OF HIP DISPLACEMENT IN CEREBRAL PALSY

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Background/Objective: A population-based hip screening programme for children with cerebral palsy (CP) in South-East Norway was established in 2006, aiming at early diagnosis and treatment to prevent hip dislocation. The purpose of this study was to evaluate this programme and to assess the natural history of progression of hip displacement.

Subjects and methods: The study comprised 335 children (56% boys) with CP, born during the 5-year period 2002 to 2006 in the 10 South-Eastern counties. Their mean age at the first radiograph was 3.0 (0.5-7.9) years. The children were followed up until operative treatment or until the most recent radiograph in those not operated on. The mean patient age at the most recent follow-up was 5.4 (2.0-9.6) years. The children were divided into 5 groups according to the Gross Motor Function Classification System (GMFCS). On the radiographs, the migration percentage (MP; percentage of the femoral head lateral to the acetabular rim) was measured.

Results: Hip displacement (MP 33% or larger) occurred in 88 patients (26%). The prevalence of subluxation was 22%. Total dislocation (MP 90% or higher) occurred in 14 children (4% of all children and 12% of the nonambulators) at a mean age of 4.4 (1.8-9.6) years. The mean MP was 20% at the initial radiographic examination and 34% at the last follow-up. The progression in MP increased markedly with decreasing functional level, from 0.2% per year at GMFCS level I to 9.5% at level V.

Conclusions: There is a pronounced trend towards hip displacement in nonambulant children. Close surveillance from age 1-2 years is needed to find the appropriate time for preventive surgery. Since 12% of the children without gait function developed dislocation, our routines for radiographic hip surveillance and treatment need improvement.

THE CPCHILD QUESTIONNAIRE IS RESPONSIVE TO HIP SURGERY IN CHILDREN WITH SEVERE CEREBRAL PALSY

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Background: The Caregiver Priorities & Child Health Index of Life with Disabilities (CPCHILD) questionnaire was developed to evaluate the effectiveness of interventions for the health-related quality of life of children with severe cerebral palsy (CP).

Aims: Establish whether the CPCHILD is responsive (sensitive to change) to surgery for hip displacement in children with severe CP.

Participants/Methods: Parents of 40 children with severe CP (GMFCS IV & V) and progressive hip displacement completed the CPCHILD. 20 children (Cases) underwent hip surgery, and the CPCHILD administered at 3, 6 & 12 months post-operatively. For the 20 (Controls) who did not undergo surgery, the CPCHILD was completed 12 months after baseline. Change in CPCHILD scores and responsiveness were estimated by paired t-test of the pre/post scores; Standardized Response Means (SRM); & Effect Sizes (ES).

Results: Cases & controls were comparable at baseline for age; co-morbidities; hip displacement; and mean(SD) Total CPCHILD scores: 46.8(14.6) and 46.5(10.3) respectively (p = 0.93). For Cases the total CPCHILD score was 50.6(12.1) at 3 months; 54.4(12.6) at 6 months; and 59.2(10.5) at 12 months after surgery. For Controls at 12 months, the total CPCHILD score was 48.4(11.9), unchanged from baseline. At 12 months there were significant improvements (mean differences of +2.3 to +18.4 points) in 5 of 6 subscales of the CPCHILD for Cases; whereas subscale scores remain unchanged or deteriorated in Controls. In the Cases, SRM was 0.95 for the total CPCHILD score (0.18 to 1.44 for the subscales); ES was 0.85 for the total score (0.16 to 1.32 for the subscales).

Discussion: The CPCHILD is responsive to hip surgery. Following reconstruction there are large improvements in total scores and in the expected subscales 12 months after surgery, whereas scores...
remained stable or declined in controls. The CPCHILD may be recommended as an outcome measure of hip interventions for children with non-ambulant CP.

CRITICALITY ON THE EMPLOY OF THE BACLOFEN PUMP IN CHILDREN WITH CEREBRAL PALSY

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Recent literature reports the development of a rapid scoliotic deterioration following intrathecal baclofen pump (ITB) insertion which requires subsequent spinal fusion, instead other authors confirm that since, in the majority of patients, the pumps are often implanted before the age of skeletal maturity, the scoliosis can coincide with their normal development.

In this retrospective study, we have investigated twenty four patients: but only twenty patients (seventeen (90%) were male and three (15%) female), who were under eighteen years of age when the ITB pump was implanted, were examined. We have developed an evaluation card to photograph the actual situation of the patients and to try to go back to the clinical situation at the moment the ITB pump was implanted and, where possible, even earlier.

For diagnostic placement we referred to the functional classification of the spastic forms of cerebral palsy suggested by Ferrari. Fourteen patients had a diagnosis of orrizontal tetraplegia (70%), three (15%) had diskinetic tetraplegia, two (10%) had vertical tetraplegia and one (0,5%) had akinetic tetraplegia. Patients’ mean age was 12,4 years. Fifteen patients were unchanged curve progression while five patients revealed a worsening, developing a scoliosis (40° and 60°).

In conclusion we report that the use of ITB is very favorable for some critical and important “aspects” of the quality of life of these patients, such as assistance, tolerance to the postural aids, quality of sleep, hygiene maneuvers and management of the pain. It is, very important to pay attention to the selection of the patients who must be carefully and thoroughly evaluated both from the diagnostic and the clinical point of view. Finally, it is necessary to consider and take advantage of the help that the trunk orthosis and the postural aids can give in containing the evolution of the spinal deformity.

GROUP 10 – COMMUNICATION

COMMUNICATION IN THE PANORAMA OF CEREBRAL PALSY IN WESTERN SWEDEN

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Scientific background: More than half of the children with cerebral palsy (CP) have accompanying impairments, which sometimes is more disabling than the motor impairment. Communication impairment may be one of them.
Aim: To study the relationship of Communication Function Classification System (CFCS) with CP subtype, gross motor function, manual ability, learning disability and neuroimaging findings in the population-based register of western Sweden.
Methods and subjects: CFCS, Gross Motor Function Classification System (GMFCS) and Manual Ability Classification System (MACS) were used. Learning disability and neuroimaging findings were recorded.

Results and discussion: Twenty-eight percent were at CFCS level I, 13% at level II, 21% at level III, 10% at level IV and 28% at level V. Half of the children used speech, 32% used communication boards/books, and 16% were confined to body language. CFCS levels I-II (communication with unfamiliar partners) were found in 71% in unilateral spastic CP, in 46% in bilateral spastic CP and in 11% in dyskinetic CP (p=0.03). CFCS correlated with GMFCS and MACS and cognitive function (p<0.01). Periventricular white matter lesions were associated with speech and lower, more functional, CFCS levels, while cortical/subcortical and basal ganglia lesions were associated with the absence of speech and higher, less functional, CFCS levels (p<0.01).

This is the first population-based report on CFCS, a new classification of communication, and the first report relating CFCS to CP type, cognitive level and neuroimaging findings. Good communication ability is associated to lesions acquired early, rather than late, in the third trimester. Communication function profiles in CP can be derived from CFCS, which correlates to gross and fine motor and cognitive function as well as neuroimaging findings.

THE COMMUNICATION DIFFICULTIES OF CHILDREN WITH CEREBRAL PALSY AT TWO YEARS OF AGE

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Background: Children with cerebral palsy (CP) often have speech difficulties which affect their quality of life and social participation. At present it is not clear which children with CP will have persisting speech difficulties. We are undertaking a prospective cohort study of children with CP and communication difficulties to examine if predictors for intelligible speech can be ascertained.

Aim: To examine the characteristics that are associated with speech production at 2 years.

Subjects and methods: All children with non-progressive motor disorders residing in North of England Children’s Cerebral Palsy Survey area born between 1.2.2006 and 31.12.10, whose communication is giving cause for parental and/or clinician concern at age two years are eligible to join the study. Demographic information, early medical history and diagnostic information (CP type, distribution, vision, hearing) is gathered from medical notes. Data on motor function (GMFCS), cognition (Mullen), language (PreSchool Language Scales), methods of communication, ratings of intelligibility (Coplan and Gleason scale) and expressive spoken vocabulary (MacArthur Communicative Development Inventory) is collected during home visits.

Results and Discussion: To date we have seen 93 children at two years of age (M=61, F=32). Type and distribution of CP: 24 (26%) unilateral spastic type; 48 (51%) spastic bilateral; 12 (13%) dyskinetic; 9 (10%) mixed; GMFCS (med=III; Q1=I;Q3=V). Diagnosed sensory impairments were common: 57 (61%) had no hearing difficulties; 39 (42%) had no visual impairments. Cognition, language and speech scores varied: (nonverbal cognition % rank med 1; Q1=1 Q3=24), receptive language (% rank med 1; Q1=1; Q3=20), expressive language (% rank med 1; Q1=1; Q3=20), expressive vocabulary (med=4, Q1=0; Q3=77). The best fitting model for predicting number of intelligible words at 2 years is a linear combination of the GMFCS and nonverbal cognition (R = 0.577, R2 = 0.333, F (2,48) = 12.000, p < .001).

Clinical implications will be discussed.

DYSARTHRIA AND COMMUNICATION IMPAIRMENT IN CEREBRAL PALSY

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Scientific background: Dysarthria is a very common disorder in cerebral palsy (CP) and predominantly accounts for communication impairment.

Aims: The aims of this study were 1) to weight different dysarthric symptoms for their impact on the individuals’ communicative abilities and 2) to investigate if different CP types (i.e. spastic, dyskinetic, ataxic) manifest in corresponding dysarthria syndromes.

Methods and subjects: Twenty-two adult patients with CP participated in the study (18 - 56 years, 12 women). Dysarthria was assessed using the Bogenhaus Dysarthria-Scales (BoDyS) (1) that provide a detailed profile of dysarthric symptoms. To measure the degree of communication impairment, intelligibility was assessed in a sentence transcription task conducted by 30 naïve listeners, who also rated the naturalness of each patient’s speech on a five point scale. All patients were classified by a neurologist for their CP type, dysarthria syndromes were classified based on the BoDyS-profiles.

Results and discussion: CP type and dysarthria syndromes dissociated in many cases (e.g. some of the patients with dyskinetic CP type showed symptoms of spastic dysarthria exclusively), therefore detailed assessment of dysarthria independent from CP type is needed. Most patients had pronounced communication impairment with intelligibility and naturalness scores in the lower range. Imprecise articulation and monotonous speech were determined as predictors for intelligibility and naturalness by linear regression analyses. These symptoms, relevant for communication, should be focused on in assessment and treatment of speech in cerebral palsy.

References

SCALES FOR ASSESSMENT OF COMMUNICATION ABILITY IN THE SURVEILLANCE OF CHILDREN WITH CEREBRAL PALSY

Virella D.1, Pennington L.2, Da Graça Andrade M. ,1, Greitane A.3, Prasauskiene A.4, Rackauskaite G.5, Himmelmann K.6, Andersen G.L.7, De La Cruz J.8, SCPE-Net Task 4.2 Team9
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Background: Frequently affected in patients with cerebral palsy, communication ability is difficult to assess.

Aim: To choose a classification system for assessment of communication ability to be used on the Surveillance of Cerebral Palsy in Europe.

Methods and subjects: Communication classification tools were identified by systematic literature review. Identified scales were classified with an agreed score, and those selected for assessment were submitted to a standard translation protocol, and to assessment of their intra and inter-rater agreement, test-retest stability, construct strength, ease of application and feasibility of application. Scales were applied to 4-to-9 years-old children with cerebral palsy (through every GMFCS levels) from eight European countries, in child rehabilitation and neurodevelopment centres, by their parents/caretakers, speech therapists and other health professionals using their knowledge of the child and direct observation, and by different health professionals using information from case notes only.

Results and discussion: The tools selected for assessment were Communication Function Classification System (CFCS), Functional Communication Classification Scale (FCCS) and Viking Speech Scale (VSC). 160 children were assessed. Test-retest stability was higher for VSS (kappa ≥ 0.90) than for CFCS (kappa 0.80-0.70) or FCCS (kappa 0.85-0.75). Overall inter-rater agreement was high (ICC >0.95) for all three
scales. The best agreement between parents/caretakers and speech therapists was achieved by VSS. VSS was considered the easiest instrument to apply, by every rating method. Second ratings of performance were higher than initial ratings for CFCS and FCCS. VSS, which assesses speech function, appears fit for use in registries of cerebral palsy in children. However, wider assessment of the activities of communication is desirable. Further knowledge and practice with both CFCS and FCCS may provide ground for recommending their use in this setting.

EARLY PREDICTORS OF COMMUNICATION FUNCTION IN CHILDREN WITH CEREBRAL PALSY

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Scientific Background: The Communication Function Classification System (CFCS) categorizes people’s communication performance into 1 of 5 levels (lower numbers reflect better function):

Aims: 1) to investigate the relationship between CFCS levels and communication methods and associated impairments; and 2) to identify potential predictors of CFCS levels.

Methods and Subjects: 200 children met the case definition: children diagnosed with CP, aged 2-17 years, born in Michigan. CFCS and methods of communication were reported by mothers. CP types and associated impairments were obtained from physical referral forms. Potential predictors were obtained from maternal interview. Chi-square tests explored the relationships between CFCS levels, associated impairments, and methods of communication. Potential predictors of CFCS level were identified by univariate and multivariate analyses using proportional odds models with assessment for possible interactions.

Results and discussion: The percentage of children with CFCS levels I to V were 38%, 20%, 19%, 16% and 7%, respectively. Many children used multiple methods of communication. 27% children were reported with a cognitive deficit, and 35% had speech impairment, and in general these children had less functional CFCS levels. Children with seizure disorder (28%) also had less functional CFCS levels. In each CFCS level, about 30% of cases had vision impairment. Children with seizures and cognitive deficit tended to communicate via methods other than speech. The results of the univariate and the final multivariate proportional odds model found: the children’s GA was a significant inverse predictor of communicative performance in the univariate model but was no longer significant in multivariate model. Children with seizure were more likely to have less functional CFCS level than those without seizure. The age talking had the highest univariate and multivariate odds ratio. A table with the complete univariate and multivariate model results will be included in the presentation.

LANGUAGE ABILITIES OF CHILDREN WITH CEREBRAL PALSY AT AGE 5 AND 6 YEARS

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Scientific background: There is uncertainty regarding the prevalence and severity of receptive and/or expressive language deficits in cerebral palsy (CP) with substantial variations in reported figures.

Aim: Using a population-based sample, this study aimed to identify the frequency and severity of language impairment in children with CP and determine the association between language abilities and associated impairments (e.g., speech, motor and cognitive), and children’s personal and environmental characteristics.
Methods and subjects: 308 children aged 5 and 6 years (born between 25/08/2005 and 24/08/2007) have been identified from the Victorian Cerebral Palsy Register. 108 families have been approached to take part in the study (recruitment will cease July 2012). A range of speech, language, cognitive and motor assessments were administered to children. Language impairment was defined as a score greater than 1 standard deviation below the mean. Personal and environmental variables encompassed children’s psychosocial health, parental mental health and socioeconomic status.

Results and discussion: 56 children have been recruited to date. At the time of the presentation, data will be available for approximately 100 children. Preliminary findings indicate 65% of children demonstrate impaired language involving isolated receptive (6%) or expressive (10%) skills, or both receptive and expressive abilities (48%). Not surprisingly, 60% demonstrated co-morbid cognitive impairment. GMFCS and MACS levels IV-V were always associated with language impairment. All of the children with impaired language also demonstrated speech and functional communication deficits (e.g., difficulty communicating with unfamiliar people). For the first time, this study will use a birth cohort of children with CP to comprehensively document children’s receptive and expressive language abilities. Initial findings highlight a relatively high frequency of language impairment and a high rate of associated impairments. The representativeness of the recruited sample will be determined by examining the distribution of children according to CP type and severity, and cognition.
CREATINE - A MULTI-ORGAN PROTECTANT AGAINST HYPOXIC INJURY

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A challenge for therapies to prevent hypoxic-ischemic (HI) injury at birth is the complexity of events that follow global hypoxia. The 'pleiotropic' properties of creatine make it potentially important in preventing tissue damage at birth because it targets several pathways involved in the initial and secondary responses to HI.

Aim: To determine if maternal dietary creatine supplementation protects the newborn from multi/organ injury induced by hypoxia.

Methods and Subjects: Pregnant spiny mice were fed a control (n=32) or 5% creatine/supplemented (n=24) diet from day 20 of gestation (term ~39 days). Pups were delivered on day 38 either immediately (caesarean section, n=20 dams), or after retaining pups in the excised uterus for 7.5 mins (birth asphyxia, n=36 dams). Pups were then resuscitated by manual palpation of the chest and cross/fostered to a nursing dam for 24h.

Results and Discussion: Brain injury at 24h after hypoxia was characterized by lipid peroxidation, and extensive apoptosis (increased BAX, cytoplasmic cytochrome C, caspase 3) in the cortical sub-plate, thalamus and piriform cortex; these changes were prevented in pups from mothers fed creatine during pregnancy. The diaphragm showed severe injury at 24h after hypoxia, with fibre atrophy (-20% cross-sectional area) and reduced contractile function (-26% maximum calcium activated force); this was also prevented by maternal creatine supplementation. Kidney structure was significantly impaired after birth hypoxia, with evidence of shrunken glomeruli, dilated tubules, and disrupted medullary structure. Expression of neutrophil gelatinase-associated lipocalin (Ngal), a marker of tubular injury, was significantly upregulated after birth hypoxia. These changes in kidney structure were significantly reduced in birth asphyxia pups from creatine-fed mothers.

Conclusion: Creatine supplementation during pregnancy significantly protects fetal organs from hypoxia-induced damage at birth. We suggest that creatine should be considered a promising prophylactic therapy for pregnancies classified as high-risk for fetal hypoxia.

TOWARD A PROMISING RODENT MODEL OF CP BASED ON PRENATAL ISCHEMIA

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Perinatal brain injury including white matter damage (WMD) is highly related to sensory, motor and cognitive impairments in humans born prematurely or who develop later cerebral palsy (CP). Our aim was to examine the neuroanatomical, functional and behavioral changes in adult rats that experienced prenatal ischemia (PI), thereby inducing WMD. PI was induced by unilateral uterine artery ligation at E17 in pregnant rats. We assessed performances in gait, cognitive abilities and topographical organization of maps, and neuronal and glial density in primary motor and somatosensory cortices, the hippocampal complex and prefrontal/cingulate cortex, as well as axonal degeneration and astrogliosis. We found WMD/axonal degeneration in the corpus callosum, brainstem, hippocampal complex, frontal and somatosensory cortices, but not in the motor cortex after PI. Astrogliosis was detected in almost all these areas, except in the frontal
areas. PI rats exhibited mild locomotor impairments associated with musculoskeletal histopathology including signs of spasticity. Motor map organization and neuronal density were normal in PI rats, contrasting with major somatosensory map disorganization, reduced neuronal density, and a marked reduction of inhibitory interneurons, as well as imbalance of excitatory/inhibitory neurotransmission. PI rats also exhibited spontaneous hyperactivity in open-field test, short and long-term deficits in object recognition memory tasks associated with abnormal neuronal density, axonal degeneration and astrogliosis in related brain areas. However, spatial navigation in the classic watermaze and neuronal density within the hippocampus were preserved. Thus, our rodent model of WMD recapitulates the main deficits observed in children that were born preterm or later develop catastrophic diseases, such as ADHD or CP and may offer new opportunities to explore neuroprotective strategies to prevent or limit immature brain damage.

**NEUROSTEROIDS PROTECT THE FETAL AND NEONATAL BRAIN AGAINST HYPOXIA AND EXCESS GLUCOCORTICOIDS**

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Progesterone and its 5-alpha reduced metabolites such as allopregnanolone have anti-excitatory effects in the brain due to agonist activity at GABA-A receptors. In fetal sheep we have shown that endogenously synthesized allopregnanolone down-regulates spontaneous CNS activity and promotes cell division and brain growth. We now provide evidence that neurosteroids are protective against the effects of hypoxia and/or the presence of glucocorticoid excess in the following experiments:

1) In near term fetal sheep inhibition of allopregnanolone synthesis by the 5-alpha reductase inhibitor Finasteride results in increased cell death following brief global asphyxia produced by temporary interruption of umbilical blood flow.

2) In hypoxic, growth retarded fetal sheep the CNS lipid peroxidation and apoptosis induced by maternal betamethasone administration are significantly less after co-administration of allopregnanolone.

3) In guinea pig neonates preterm birth causes premature decrease of CNS allopregnanolone due to loss of placental sources of the precursor steroids progesterone and pregnenolone, but administration of progesterone prevents the postnatal loss of myelin.

4) In 3-day old rat neonates subjected to hypoxia for up to 30 mins, prior administration of allopregnanolone prevents the development of epileptiform CNS activity at 30 days of age.

5) In 5 day old spiny mouse neonates, birth asphyxia results in decreased hippocampal long-term potentiation, which is ameliorated by administration of allopregnanolone to the mother 1 hour prior to birth.

Conclusion: Neurosteroids are important endogenous compounds that promote brain development and serve to minimize brain damage caused by hypoxia and glucocorticoid administration in preterm and term fetuses, and by hypoxia in postnatal life. Therapies using either progesterone or a 5-alpha metabolite should be considered as a possible protective treatment for the newborn brain at risk of hypoxic-ischemic encephalopathy.

**CEREBRAL PALSY AND PERIVENTRICULAR WHITE MATTER INJURY: DOES GESTATIONAL AGE AFFECT FUNCTION?**

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Scientific Background: Periventricular white matter injury (PWMI) associated with cerebral palsy (CP) was thought to occur mainly in children born ≤34 weeks but is increasingly identified in children born nearer term.

Aim: To determine differences in functional profiles and motor impairment patterns of children aged 4-12 years with CP and PWMI born >34 weeks compared with those born earlier.

Subjects and methods: Children with CP and PWMI born between 1999 and 2006 were recruited through the Victorian CP Register. Motor type and topographical pattern were classified using the Surveillance of Cerebral Palsy in Europe (SCPE) classification. Functional profiles were determined using the Gross Motor Function Classification System (GMFCS), Manual Abilities Classification System (MACS), Communication Function Classification System (CFCS), the Functional Mobility Scale (FMS) and the Bimanual Fine Motor Function (BFMF). Wilcoxon-signed rank tests were used to compare the distribution across levels for each outcome for children born ≤ 34 weeks with those born >34 weeks.

Results and Discussion: 40 children born >34 weeks (27 males, mean age 8y 9mo [SD 2y 1mo]) and 48 children born ≤34 weeks (29 males, mean age 8y 5mo [SD 2y 3mo]) were recruited. There was evidence that the distribution of participants across the levels of the GMFCS (p= 0.03), and the FMS 5, 50 and 500 (p= 0.02, 0.02 and 0.05) was different in the two gestational age groups, with a greater number of children born ≤34 weeks classified as more impaired. There was a trend for more children with bilateral motor impairment in the ≤34 week group. Both groups were similarly distributed across levels for communication, manual ability, motor type and topography. These findings suggest that insults affecting the periventricular white matter in children with CP result in less severe limitations in gross motor function and mobility in those with longer gestations.

OUTCOMES IN RCTS AND META-ANALYSES OF INTERVENTIONS FOR INFANTS AT RISK OF CP: IS THERE CONSENSUS?

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Scientific background: Meta-analyses (MAs) in niche conditions such as CP are difficult to conduct because of lack of standardisation in outcome measures, precluding the aggregation of randomised controlled trial (RCT) findings.

Aim: To systematically review MAs and RCTs of interventions for infants at risk of CP to determine if consensus exists in outcome measures and definitions.

Methods: MAs: Two investigators independently considered MAs in the “Neonatal “and “Pregnancy and Childbirth” Review Groups of the Cochrane Database of Systematic Reviews and identified those that had the potential to impact on CP. Reviews were included if published in 2010 or 2011, or if cited 20 times or more in SciVerse Scopus. RCTs: A maximum of 20 RCTs per MA were sourced. We extracted outcome measures, definitions, and cut points and calculated their frequencies.

Results and discussion: MAs: The “Pregnancy and Childbirth” and “Neonatal” Review Groups in the Cochrane Database of Systematic Reviews yielded 685 systematic reviews. After applying inclusion/exclusion criteria, 22 MAs and 167 RCTs were appraised. There was high consistency in outcome domains listed as important for meta-analysis despite the diverse risk factors being addressed; they were: infant death (22/22), neurodevelopmental outcomes (18/22), measures of infant respiratory function (18/22), type of infant brain injury (16/22), and health system usage (16/22). For 10 out of the 16 most frequently cited outcome domains, less than half of included RCTs contributed data for meta-analysis.

RCTs: The most frequently reported outcomes were infant death (n = 123), gestational age (n = 112), intrauterine growth (n = 112), and Apgar scores (n = 105). There was low consistency in their definitions and cut points; e.g., Apgar scores used 30 different cut points in 105 studies.

These results show there is no consensus of measures, definitions, and cut points for important outcomes, but consensus could accelerate research.
DEVELOPMENT OF THE MINI-ASSISTING HAND ASSESSMENT: EVIDENCE FOR CONSTRUCT AND INTERNAL SCALE VALIDITY

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Scientific background: Young children with unilateral cerebral palsy (CP), require appropriate assessment tools to evaluate the development of bilateral hand function and outcomes of early intervention since this is a time when a child’s motor skills are rapidly developing, and when interventions may be best able to influence motor outcomes.

Aim: To develop and evaluate a new test, the Mini-Assisting Hand Assessment (Mini/AHA) for children with clinical signs of unilateral cerebral palsy (CP) aged 8-18 months, and to examine the internal scale validity as well as influence of age on test outcomes.

Method: 108 assessments of children with unilateral CP were entered into a Rasch Measurement Model analysis to assess internal scale validity. A Spearman correlation analysis explored the relationship between age and ability measures for children with unilateral CP. A chi squared analysis tested the frequency of maximum scores in 40 children with typical development (TD).

Results: The Rasch analysis confirmed internal scale validity and a unidimensional construct for 20 items rated on a 4-point scale. The item calibration values covered the range of person ability measures well. The Mini/AHA scale demonstrated excellent separation reliability and thereby high potential for evaluating change. There was negligible correlation between age and ability measures for children with unilateral CP ($r = 0.149$), strengthening the evidence that the test measures degrees of the severity of hand involvement rather than age related development. All children with TD achieved maximum scores ($p = 0.035$).

Conclusion: The results show that the Mini/AHA validly measures assisting hand use during bimanual performance for children with unilateral CP aged 8-18 months. The Mini-AHA has the potential to become a useful assessment tool for clinicians and researchers to evaluate functional use of the affected hand and effects of intervention in an age group when potential for change is high.

MINI-MACS; DEVELOPMENT OF MANUAL ABILITY CLASSIFICATION SYSTEM FOR CHILDREN WITH CP BELOW 4 YEARS

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Scientific background: The Manual Ability Classification System has successfully been used for children with cerebral palsy between 4-18 years, however there is a need to use MACS also younger children.

Aim: To investigate reliability and validity of a research version of Mini-MACS based on parents’ and therapists’ descriptions of the children’s ability to handle objects.

Method and subjects: The structure of the original MACS using five levels was kept but some of the wording was adjusted to fit younger children’s manual ability as described from an age-related perspective. Twenty-four 15-47 months old children were represented by their parents and a therapist. The respondents rated the child’s Mini-MACS level after being introduced to the classification. After this a short interview was performed about the reasons for choosing the specific level and for collecting descriptions about the child’s manual ability. Thereafter a new rating of Mini-MACS was performed. Intraclass correlation coefficient (ICC) was used to investigate test-retest reliability for both parents and therapists ratings and for inter rater reliability between parents and therapists.
Result and discussion: Test-retest consistency before and after the interview was high, ICC was 0.99 for both parents and therapists. Inter rater reliability was 0.83 between the parents and therapists. There was a tendency that parents scored the children higher than therapists did. In the interviews, both parents and therapists expressed that they found the wording of Mini-MACS suitable and easy to understand. Parents appreciated that Mini-MACS helped them to find words describing the child’s ability. This study showed results supporting content and construct validity of the preliminary version of Mini-MACS for this young age group.

PSYCHOMETRIC PROPERTIES OF THE REVISED ASSISTING HAND ASSESSMENT (VERSION 5.0)

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Scientific background: The Assisting Hand Assessment (AHA) measures and describes how effectively children with unilateral disability in arm and hand use their affected hand in bimanual tasks.

Aim: To evaluate the psychometric properties of a revised version of the AHA (version 5.0).

Methods and subjects: The AHA has been widely used for children with unilateral cerebral palsy (CP). The first version of the AHA containing 22 items was published in 2003 and even though it has sound psychometric properties, a few items have shown potential for further development. The AHA was revised by the rewording of four items, one new item “frequency of use” was constructed. Old and new items were scored in 164 assessments of children with unilateral CP aged 18 months to 12 years. Data was analysed using the Rasch measurement analysis. The scale was scrutinized for internal scale validity by evaluating rating scale functioning, item and person goodness-of-fit and uni/dimensionality. Further, targeting and scale reliability was evaluated.

Results and discussion: The rating scale was well functioning, indicating that scale steps were used in the intended manner. After removal of misfitting items a 20 item scale showed acceptable goodness-of-fit. Thus, 95% item fit and 95.7% person fit to the model was achieved, which is within the criteria. Further, unidimensionality was confirmed by a principal components analysis. The item difficulty was well suited to the ability level of the sample. Scale reliability analyses showed a high person reliability coefficient of 0.98, indicating high separation ability of the scale. Compared to the previous AHA 4.4, the AHA 5.0 has improved internal scale validity and person reliability and is thereby promising to be more sensitive to change. Information making comparison between outcomes of the current version 4.4 and the new version 5.0 possible will be made available to AHA-users.

MANUAL ABILITY CLASSIFICATION SYSTEM (MACS); EVIDENCE OF STABILITY OVER TIME

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Scientific background: MACS describes how children with Cerebral Palsy (CP) use their hands when handling objects in daily life, if children’s MACS level is shown to be stable over time the classification could be used for predictive purposes.

Aim: To evaluate the stability of MACS levels over time for children with CP.

Methods and subjects: In this prospective study 1 267 children with CP were followed from 2005 to 2010 with two or more registered MACS classifications rated at least one year apart. Thirty-five percent of the children (n=445) had four ratings. Children were between 4-17 years old (mean 6y 6m, SD 2y 11m) at their first rating, 59% were boys, and all MACS levels I-V were represented. The percentage of children remaining in the same level during 4 ratings was calculated. Children’s first and second ratings (n=1267) as well as first and last ratings (n=445) were compared. Stability of the levels for children aged 4 years when first classified was compared with children aged 10 years at the first classification.
GMFCS, MACS AND CFCS IN YOUNG CHILDREN WITH CP: A PROSPECTIVE LONGITUDINAL CASE SERIES

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Scientific background: The Gross Motor Function Classification System (GMFCS) and the Manual Ability Classification System (MACS) are considered gold standard instruments to describe motor function and manual ability in children with cerebral palsy (CP). The Communication Function Classification System (CFCS) is a relatively new addition to the suite of available classification systems, developed to describe and categorize communication at the activity/participation level of the International Classification of Functioning, Disability and Health.

Aim: The aim of this study was to describe the relationship between gross motor, manual ability and communication function, at the first data point, for young children with CP in a prospective case series.

Methods and Subjects: Fifty-one children, born 2008-2011, drawn from a population-based secondary prevention program for children with CP in NSW, Australia, were examined. (32 with bilateral spastic CP, 12 with unilateral spastic CP, 6 with dyskinetic CP, and 2 with ataxic CP). CP subtype, GMFCS, MACS, and CFCS data was determined by the child’s clinical team. The relationship between GMFCS, MACS, and CFCS was investigated using Spearman’s rho correlation coefficient.

Results and discussion: There was a strong positive correlation between the three classification systems, with more severe GMFCS levels associated with more severe MACS (r=.71, n=51, p=0.01) and CFCS (r=.59, n=51, p=0.01) levels. MACS was also associated with CFCS (r=.57, n=51, p=0.01).

In this sample the majority of children’s GMFCS, MACS, and CFCS were associated. Whilst still significant, the association between CFCS and GMFCS was lower than expected. This may reflect complexities of using the CFCS with this age group, stability issues with the system or that difficulties with communication may be more prevalent in children with less severe motor function than previously considered. These emergent findings highlight the importance of evaluating functional areas separately in order to support clinical decision-making.

GROUP 13 – PARTICIPATION 2 & QoL 1

EARLY INCLUSIVE EDUCATION OF CHILDREN WITH CEREBRAL PALSY IN THE PORTUGUESE CP SURVEILLANCE PROGRAM

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Background: National surveillance allows a population analysis of early inclusion of children with cerebral palsy (CP) in the education system, which should occur as soon as allowed by the conditions of the child and its environment.

Aim: To assess early inclusion of children with CP in the school system in Portugal and the influence of CP types, comorbidities and other factors.

Methods and subjects: Cross-sectional study with nested case-control analysis, based on active surveillance data. 5-years-old children born in Portugal in 2001-2004 (National Surveillance of Cerebral Palsy in Portugal). SCPE definitions and functional classifications (GMFCS, BMFM, MACS, IQ, vision, hearing) were used, as well as Portuguese scales for assessment of communication (as producer), feeding ability and drooling control. Education inclusion was graded in 5 levels, from full inclusion to segregated schooling and education at home (non-inclusion). Risk factors for non-inclusion were identified by bivariate and logistic regression analysis (LRA).

Results and discussion: Information about education inclusion was recorded in 299 of 646 children with CP (46.3%). Non-inclusion was reported in 49 children (16.4%). LRA identified bilateral spastic CP, GMFCS or BMFM levels IV-V and severe epilepsy as associated to absence of reporting education inclusion. Full or partial inclusion was reported for 250 children (83.6%). Bivariate analysis identified several factors associated to non-inclusion (OR; 95%CI): bilateral spastic CP (9.0; 2.1-38.6), dyskinetic CP (2.6; 1.1-6.1), GMFCS and BMFM grade (2.0; 1.6-2.7), IQ (0.9; 0.85-0.94) or severe epilepsy (2.2; 1.5-3.8). LRA identified GMFCS (2.0; 1.5-2.6) and severe epilepsy (1.5; 0.985-2.35) as the most significant associated factors. In Portugal, inclusive education is achieved early by a large majority of children with CP. Gross motor function and severe epilepsy are strong markers for early non-inclusive education.

REGIONAL PATTERNS OF PARTICIPATION AMONG CHILDREN AND YOUTH WITH CEREBRAL PALSY

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Scientific Background: Knowledge of regional patterns of participation in recreational and leisure activities by children and youth with cerebral palsy (CP) is limited.

Aim: Examine recreational and leisure participation among children/youth with CP in Australia, Ontario, Quebec, and the U.S. as a function of region, age group, and gender.

Methods and Subjects: Data from 1076 children/youth with CP from Australia (114), Ontario (217), Quebec (245), and the U.S. (500) were analyzed. Children/youth included 611 males; 317 were ages 6 to 10, 383 ages 10+ to 16, and 143 ages 16+ to 21; 358 at GMFCS level I, 405 at level II/III, and 313 at level IV/V.

Children/youth completed the Children’s Assessment of Participation and Enjoyment (CAPE). The effect of region, age, and gender on the number of recreational, physical, social, skill-based, and self-improvement activities done in the past 4-months were analyzed by analysis of covariance controlling for family income, education, and GMFCS level. Effect sizes (partial eta-squared; $\eta^2$) were calculated.

Results and Discussion: Region, age group, gender, income, education, and GMFCS level all significantly affected the number of activities done by the children and youth. The largest effects were for region on active physical ($p<.0001$, $\eta^2 = 0.08$), and self-improvement ($p<.0001$, $\eta^2 = 0.12$); age group on recreational ($p<.0001$, $\eta^2 = 0.17$); and GMFCS level on recreational ($p<.0001$, $\eta^2 = 0.10$), active physical ($p<.0001$, $\eta^2 = 0.12$), and self-improvement activities ($p<.0001$, $\eta^2 = 0.08$).

Children/youth from the U.S. took part in the fewest active physical activities; those from Ontario took part in the most self-improvement activities. The youngest age group took part in the most recreational activities, and those in GMFCS level IV/V did the fewest number of recreational, active physical, and self-improvement activities. The differences across regions may have important implications for rehabilitation and community-based services for children/youth with CP.
PARTICIPATION PREFERENCES OF CHILDREN WITH CEREBRAL PALSY: A CAPE INTERNATIONAL NETWORK STUDY

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Scientific Background: Little is known about the extent to which children with cerebral palsy (CP) take part in the leisure activities they prefer.

Aim: As part of a larger study examining geographic variation in participation patterns of children with CP in Canada, Australia, and the U.S, this study examined (a) the extent to which children with CP took part in their most preferred activities and (b) regional differences (Canada/Australia) in activity/preference congruence scores.

Methods/Subjects: The sample (n=236) included 148 boys and 88 girls, 10 to 13 years, living in Victoria (n=110), Ontario (n=80) or Quebec (n=46); GMFCS Level I: 99(41.9%); Level II/III: 89(37.7%); Level IV/V: 48(20.3%). All participants had completed the Children’s Assessment of Participation and Enjoyment (CAPE) and Preferences for Activity of Children (PAC). An activity/preference congruence score was calculated to determine whether children were doing or not doing preferred activities. Mean congruence scores were calculated for each activity type (Recreational, Active Physical, Social, Skill-based and Self Improvement) and proportions of children Not Doing Preferred and Doing Not Preferred activity items examined. Regional comparisons were performed for activity types using one way ANOVA.

Results and Discussion: Proportion of children Doing Not Preferred activities in each activity type was generally low (2 to 17%). More children in Ontario were Doing Not Preferred Self improvement activities than those in Victoria or Quebec (p=.006). There were no regional differences in the proportions Not Doing Preferred activities (all p>0.05). However, in each region, relatively high proportions were Not Doing Preferred Active-physical (29.1% Australia; 28.5% Ontario; 23.2% Quebec) and Skill-based activities (23.4% Australia, 27.9 % Ontario, 21.7% Quebec).

Although regional differences were few, children with CP did not always participate in preferred active physical and skill-based activities. Understanding incongruities between preferences and actual involvement may allow rehabilitation professionals to address barriers to participation.

LIFE-HABIT ACCOMPLISHMENT AND SATISFACTION IN SOUTH AFRICAN ADULTS WITH CEREBRAL PALSY

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Scientific Background: A number of outcome studies have reported life habits in adults with cerebral palsy. These have been published from developed countries and furthermore, seldom contain detailed information about treatment history and the possible impact of personal characteristics.

Aim: To describe accomplishment and satisfaction levels in life habits in adults with bilateral spasticity, living in a developing country (South Africa), more than 15 years after Selective Dorsal Rhizotomy and Orthopaedic (‘SDR+Orth’) or only Orthopaedic (‘Orth’) interventions. A secondary aim was to determine if relationships existed between these accomplishment and satisfaction levels and personal characteristics.
Methods and subjects: Levels of accomplishment and satisfaction were determined based on the Life-Habit questionnaire. In addition, personal characteristics such as age, education, employment, marital and socio-economic status were captured. The study cohort consisted of 61 subjects of which 31 received ‘SDR+Orth’ (mean age: 28.7 ± 5.5 years, range: 21-44 years) and 30 ‘Orth’- (mean age: 33.1 ± 7.7 years, range: 19-47 years) during their childhood in hospitals of Cape Town, South Africa.

Results and Discussion: On average over all domains 73% of the study cohort experienced no difficulties and were fully independent in accomplishing all life habits. This level of performance was substantially higher in the ‘SDR+Orth’ than in the ‘Orth’ group, with 80% and 66% respectively. Most limitations were reported in the domains Mobility and Recreation, also resulting in lower satisfaction scores. Over all domains, accomplishment levels were significant correlated with satisfaction levels ($r=0.67$, $p<0.001$). However, no relationships were found between Life-Habit outcomes and personal characteristics. In conclusion, the majority of adults with bilateral spasticity who received SDR and/or Orthopaedic interventions in South Africa are able to accomplish all life habits independently and reported high levels of satisfaction, which is not dependent on their socio-economic status or other personal characteristics.

SELF-MONITORING IN YOUTH WITH MILD SPASTIC CEREBRAL PALSY

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Background: Executive functioning is compromised in many children with mild cerebral palsy. Aim: The investigation of self-monitoring, defined as the ability to detect own error making and performance adjustments on future trials. To this end, the intimate interplay between cognitive and motor related processes before, during and after error making on a memory recognition task was explored, using the event-related brain potential methodology.

Subjects and methods: Eleven children with mild cerebral palsy (4 girls, age range: 7 to 15 years, IQ above 85, normal vision, able to walk independently), and twelve controls participated in the experiment carried out in the university of Tampere, Finland. Dependent variables: mean reaction time, performance errors, the late contingent negative variation indexing motor preparation, the parietal P300 indexing stimulus evaluation, and the response-locked negativity indexing error detection.

Results and discussion: Patients’ incorrect responses were slow, which was associated with weak motor preparation. However, patients were detecting their own errors, and improved their performance on a future trial.

Overall, it was concluded that important keys in learning are intact in the participating group of children with mild spastic CP. More specifically, the evaluation and decision-making about the nature of complex stimuli, the ability to identify own error-making (without the help of external feedback) plus necessary performance adjustments after error-making are not compromised in youth with mild spastic cerebral palsy. However, the source of their error making, resulting in weak motor preparation, remains unknown and awaits future research. It is obvious that the findings need replication using a larger sample.

FACTORS ASSOCIATED WITH HEALTH-RELATED QUALITY OF LIFE OF CHILDREN WITH SEVERE CEREBRAL PALSY

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Scientific background: Knowledge about which factors are associated with the health-related quality of life (HRQL) of children with severe cerebral palsy (CP) is lacking.

Aim: The aim of the study was to investigate which factors are associated with HRQL of children with severe CP (GMFCS level IV and V) and to determine whether these factors are similar to those of children with CP in general (GMFCS level I - V).

Subjects and methods: Participants were 66 primary caregivers of children with severe CP aged between 5 and 18 years. The Dutch version of the 'Caregiver Priorities and Child Health Index of Life with Disabilities' (CPCHILD-DV) was used as a measure of HRQL. The following factors were taken into account: age, gender, GMFCS level, visual function, hearing function, pain, seizures, feeding status, verbal communication, cognitive level, hip dislocation, scoliosis, operations, hospital admissions, ITB pump, primary caregiver educational qualifications, parental occupation, family structure, child’s siblings. Univariate linear regression analyses were carried out to analyse the association between described factors and the CPCHILD-DV domain scores and total score. The factors which were correlated with the CPCHILD-DV scores were entered into multivariate linear regression analyses for each domain separately and for the total score, using the backward stepwise method, to determine the relative contribution of the different factors on the CPCHILD-DV scores.

Results and discussion: The factors ‘pain’, ‘hospital admissions’, ‘GMFCS level’, ‘seizures’, ‘cognitive level’, ‘operations’, ‘feeding status’, ‘hip dislocation’, ‘verbal communication’ and ‘primary caregiver educational qualifications’ influence the child’s HRQL, reported by the parents. ‘Pain’ and ‘hospital admissions’ seem to be the most important factors influencing the HRQL of children with severe CP. There are a lot of similarities between the associated factors for HRQL for children with severe CP and children with CP in general.
EFFECTIVENESS OF ENRICHMENT ON MOTOR OUTCOMES IN CEREBRAL PALSY: SYSTEMATIC REVIEW

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Scientific Background: Motor learning, neuroplasticity evidence from animals favours an early enriched environment for promoting optimal brain injury recovery. Intense training post adult stroke similarly enhances neuroplasticity. In infants, environmental enrichment improves cognitive outcomes but the effect on motor skills is less understood with reviews suggesting traditional therapy has little effect on motor outcomes.

Aim: To appraise the effectiveness evidence about environmental enrichment (i.e. parent training; individualised, variable and frequent task practice; and stimulating learning opportunities) for improving the motor outcomes of infants at high risk of cerebral palsy (CP).

Method and subjects: A systematic review was conducted. Cochrane, Embase, ERIC, Medline, CINAHL, OT Seeker, PEDro and PsychINFO databases were searched for literature meeting inclusion criteria: randomised controlled trials (RCTs) or controlled studies; >33% “at high risk”/diagnosis of CP; >25% participants <2 years; parent or infant interventions post discharge; and motor outcomes reported. Two reviewers independently extracted data using the Cochrane protocol regarding participants, intervention characteristics, and outcomes. Strength-of-evidence was rated using the Oxford Scale. Methodological quality was assessed using the PEDro scale.

Results and Discussion: 254 studies were identified, after removing duplicates and unrelated studies, 37 full-text articles were reviewed, of which 8 studies met inclusion (n=7 RCTs, n=1 controlled trial). Mean PEDro score was 6.4/10. Enrichment interventions varied in type and focus making comparisons difficult. Most CP interventions started late (mean age 17.3months). Neonatal interventions (n=2) utilised intensive parent education, with neither study demonstrating favourable motor outcomes. Toddler interventions were: individualised task practice (n=2), extra therapy or family support (n=1), modified learning environment (n=2), or general infant stimulation (n=1). Of these, n=2 demonstrated favourable motor outcomes via intensive task practice (n=1) or an individualised program with variable developmental stimulation (n=1). Environmental enrichment looks promising for CP and therefore high quality studies with well-defined environmental enrichment are urgently required.

CEREBRAL PALSY IN CHILDREN: MOVEMENTS AND POSTURES DURING EARLY INFANCY

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Scientific background: The motor repertoire of infants aged 3 to 5 months consists not only of fidgety movements but also of other movements and postural patterns and a deviant motor behavior is predictive of cerebral palsy.
Aim: Particular features of the early motor repertoire even proved predictive of the degree of functional limitations in children with CP, born preterm. We aimed to determine whether this also holds true for children born at term.
Subjects and methods: Video recordings of 79 infants (60 boys and 19 girls; 47 infants born at term; recorded between 9 and 20 weeks postterm age) who developed CP were analysed for qualitative and quantitative aspects of movement and postural patterns. The Gross Motor Function Classification System was applied at age 2 to 5 years.

Results and discussion: Motor optimality at age 3 to 5 months showed a significant correlation with functional mobility and activity limitation at age 2 to 5 years in both children born at term and born preterm. Infants born preterm were more likely to show normal movement patterns than infants born at term. A normal posture and an abnormal, jerky (yet not monotonous) movement character resulted in higher levels of self-mobility. With the exception of one, none of the infants showed fidgety movements. A cramped/synchronized movement character, repetitive opening and closing of the mouth, and abnormal finger postures characterized children with lower later levels of self-mobility. Assessing the quality of motor performance during early infancy (irrespective of the gestational age) improves our ability to predict later functional limitations in children with CP.

KINETIC-KINEMATIC PATTERNS IN ACQUISITION OF PRONE-LOCOMOTION IN INFANTS WITH/OUT CEREBRAL PALSY

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Scientific background: Robotics increasingly used to promote mobility in children with disabilities, but little is known about how the children interact with the technologies to learn a new skill.

Aim: Examine kinematic and kinetic movement patterns during the development of independent prone locomotion in infants using the self-initiated prone progression crawler (SIPPC).

Methods and subjects: Descriptive study with repeated measure design. Six infants, 4 - 6 months old with and without risk for CP. Infants were encouraged to use the SIPPC following a set protocol of three five-minute trials, two times a week for up to 12 weeks. The SIPPC represents an integration of robotic and sensor technologies designed for a dual purpose of influencing movement effort and data collection as infants learn to crawl. We used the positional input sensors on the SIPPC and an infant sensor suit with limb-mounted accelerometers as control signals and to measure performance. Graphs generated by the SIPPC controls were used to qualify and quantify continuous infant-SIPPC data captured during prone locomotion effort.

Results and discussion: Early crawling efforts were marked by diffuse high pressures on the SIPPC load-cells that became distinguishable as the infant became competent in moving the device, and bursts of linear rotation and translational trunk movements that progressively intensified in frequency and amplitude. Kinetic changes corresponded with unilateral arm swiping movements and the translational trunk movements for both groups of infants. Increase in velocity coincided with uncoupled arm and leg trajectory movements that became more coupled as intensity increased. The transition and timing findings raise important questions about the dynamics of perception-action theories and neuroplasticity in the area of human-machine learning for infants with CP. Despite variability across infants and sessions, results suggest that uniquely integrated sensor and robotic technology may shape complex movement learning in a predictable and qualifiable manner.

NETWORK CEREBRAL PALSY: THE GERMAN HIP SURVEILLANCE PROGRAM

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Scientific background: Hip displacement is the most common focal motor problem in children with cerebral palsy (CP), second only to equinus foot deformity.  
Aim: In 2008, the German hip surveillance program (www.CP-Netz.de) was initiated with the purpose to avoid hip luxation, to develop and establish standardized treatment concepts and to answer open epidemiological questions. 
Methods: Physicians and therapists entered data from children and adolescents with CP via the website www.CP-Netz.de. Comprised were - beside other clinical data - type of CP, gross motor function classification system (GMFCS) level and Reimer’s migration index (MI) as a measurement of hip lateralisation. According to the “Hüftampel”-algorithm, patients were stratified into three groups with moderate (“group GREEN”), intermediate (group “YELLOW”) and high (group “RED”) risk to develop progressive hip lateralisation. The attending physician or therapist gets a feedback and individual recommendations for further therapies are developed. 
Results and discussion: N=186 patients (mean age 9.42 ± 4.63 years, 84 females) from 18 centres in Germany were included into the CP network. N=139 had bilateral spastic CP, n=37 unilateral spastic CP and n=11 dyskinetic or atactic CP. A valid analysis of hip development could be performed in n=44 patients, to date. N=36 of these patients had a higher risk to develop further hip displacement (GMFCS Level ≥III, MI >25%). We observed no progressive hip lateralisation in n=32 patients under surveillance. Nine patients developed progressive lateralisation of the hip (δ MI >10%) and in n=2 patients, hips were already luxated at time of inclusion. One patient with GMFCS level V and bilateral spastic CP developed hip luxation (increase of left MI 35% to 77%). Our preliminary results support the need of a central, Internet-based hip surveillance of children with CP to avoid hip luxation and to develop new appropriate treatment concepts.

CHILDREN WITH CP-IMPLEMENTATION OF STANDARDIZED MEASUREMENTS AND ICF BASED TREATMENT PLANS

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Scientific background: In an evidence-based clinical practice the use of standardized methods to classify gross motor, functional mobility and manual ability with GMFCS, FMS, MACS and HOUSE and documentation of treatment goals is inevitably. 
Aim: To describe the implementation of GMFCS, FMS, MACS and HOUSE and a standardized treatment plan in the healthcare to children with cerebral palsy in a hospital unit and three municipalities in Denmark. 
Methods and subjects: This study is a prospective follow-up study over a period of 1 year. The Gross motor function classification system (GMFCS), Functional Mobility Scale (FMS), Manual Ability Classification System (MACS) and Classification of hand function (HOUSE), were implemented in clinical practice of 33 physiotherapists and 12 occupational therapists, as part of the implementation of the CPUP follow-up program. The standardized treatment plan uses the matrix of ICF as a frame of reference for the documentation of treatment goals after an interdisciplinary consultation by a pediatric orthopedic surgeon, a pediatric neurologist, a physiotherapist and an occupational therapist. A total of 78 children with cerebral palsy were followed throughout the year. The results have been analyzed with descriptive statistics. 
Results and discussion: During the study period 66 children were classified with GMFCS, FMS, MACS and HOUSE at least once, a total of 98 interdisciplinary consultations were completed and 93 ICF based treatment plans were made. 
Parents and healthcare professionals experienced the GMFCS, FMS, MACS, HOUSE and the treatment plans, as very useful tools in clinical practice and in the development of specific treatment goals in the domains of ICF.
A TEST TO ASSESS THE DORSAL VISUAL STREAM PERCEPTUAL FUNCTION OF CP CHILD

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The visual-spatial function appears to be particularly sensitive to early cerebral lesions. This emphasizes the clinical importance of developing and using tools to specifically test the visuo-spatial function in CP Child and compare individual scores with typical performance at any given age.

We selected elementary visuo-spatial tasks likely to involve the dorsal occipital cortex (comparison of lengths and sizes) or the posterior parietal cortex (midline localization, angle processing, and relative dot/square localizations). We tested 96 children between 4 and 12 years old, a group of adults and two adult patients (IG and CF) with acquired bilateral damage of the dorsal visual stream. First, none of the elementary visuo-spatial abilities tested was acquired at 4 years old, in contradiction with the idea of early maturation of the dorsal visual stream (as compared to the ventral visual stream) which can be found in the literature. Second, performance increased between 4 and 6 years old and reached the adult performance for the comparison of lengths and sizes, while it increased more progressively during childhood for the other subtests. Third, changing the response mode by adding a multi-choice selection did increase performance in healthy children as soon as 6 years old but decreased drastically the performance of patients IG and CF with attentional deficits.

We conclude that these results in healthy children may serve as control for age-specific comparisons with CP children in which visuo-spatial perceptual and/or attentional selection defects are suspected.

HIGHER VISUAL ABILITIES AND LEARNING DIFFICULTIES IN CHILDREN WITH CEREBRAL PALSY


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Children with spastic cerebral palsy are often affected by linguistic and cognitive disorders, which directly involve learning processes. Up to now there are a few studies analyzing the learning skills of CP children, most of them describing the expression of specific learning disorders in CP children caused by focal damage. The collected data are often limited to the measurement of IQ and don’t take into consideration academic skills.

The aim of our study is to present the neuropsychological profile of learning difficulties in a cohort of school aged children with cerebral palsy, evaluated with a specific assessment protocol.

From the children with cerebral palsy referred to the Unit of Child Neurology and Psychiatry at the Civil Hospital of Brescia during the last year we selected 15 children according to the following criteria: school age, pre and perinatal brain injury documented by MRI, verbal IQ levels > 70, normal or near normal visual acuity. The neuropsychological protocol comprises standardized tests for the study of intelligence, higher visual abilities, executive functions, memory and academic skills.

Our results show that CP spastic children experience functional difficulties in several neuropsychological domains.
With regard to executive functions and memory abilities, we found mild difficulties in working memory (30% of the sample), relevant difficulties in visual attention (40%) and visual-spatial memory (40%), in spite of good performance in verbal memory.

Our sample shows a widespread impairment of higher visual processing in about 75% of the sample, involving both visual-motor and visual-perceptual skills in 40% of CP children, supporting the idea of an integration between dorsal and ventral stream.

Regarding learning difficulties, we found impairment in reading (50%) and arithmetic skills (55%).

These data confirm the usefulness of a visual cognitive and neuropsychological assessment that enables to identify in advance the difficulties connected to school achievement and to arrange for appropriate habilitation strategy.

DIFFERENCES IN THE DYNAMIC ACCOMMODATION OF CHILDREN AND ADOLESCENTS WITH AND WITHOUT CEREBRAL PALSY

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Background: To read or focus on a moving object, accommodation of the eye needs to be sustained and quickly adapted. Such dynamic accommodative abilities, have previously not been investigated in children with CP and require new assessment techniques.

Aim: The aim of the study was to investigate and describe the dynamic accommodation of children with and without CP.

Methods/subjects: Eighteen typically developed children, median age; 12.3y (range 9.6-17.7y) and thirteen children with CP, representing the different subtypes, median age; 14.0 years (range 8.2-18.6y) were included. GMFCS levels were; I (n=8), II (n=1), III (n=3) and IV (n=1). All children had an ophthalmological exam including visual acuity (KM-chart), cover test and TNO stereo test. Children with CP were also examined with retinoscopy in cycloplegia. Accommodation was measured monocularly with the Power Refractor, an eccentric infrared photo refractor while the children watched a cartoon binocularly from a distance of 1m while the focus was changed by adding “minus lenses” in periods of 15s (this mimic a situation when an object is observed at different distances). The data allows analysis of accommodative response (in diopters) to each stimulus.

Results/discussion: Children with typical development displayed an accommodative response that increased with increasing stimuli. The response to 1.5D was 1.29D (±0.22) and to 2.5D was 2.04D (±0.3). This produced a lag of accommodation (focusing error) of 0.21D (±0.22) and 0.46 (±0.3) respectively, which is considered as a normal response.

For the children with CP the accommodative response was less. The response to 1.5D was 0.54D (±0.54) and to 2.5D was 0.73D (±0.7). This produced a lag of accommodation of up to 1.76D (±0.7). In addition, children with CP accommodated slower and more variable.

Children with CP display hitherto unknown problems in generating an appropriate accommodative response. This can impact everyday living and reading skills.

CORTICAL VISUAL IMPAIRMENT IN DIPLEGIC LEARNERS ATTENDING SPECIAL SCHOOLS IN JOHANNESBURG

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Cortical visual impairment (CVI) in the child with cerebral palsy (CP) reduces the capacity of the child to process visual information. This can adversely affect the child’s ability to learn and also impacts on the performance of activities of daily living.
The purpose of this cross sectional study was to evaluate two aspects of CVI, namely visual motor impairment (VMI) and visual perception (VP) in learners with diplegic CP, and to correlate these outcomes with their birth history.

A consecutive sample of 50 children and adolescents with diplegic CP attending four special needs schools in Johannesburg, South Africa, were eligible for inclusion in the study. Forty parents gave consent and 36 children were tested. The participants were 6 to 19.5 years of age (Mean 13 yrs SD 3.5yrs). There were 23 males and 13 females. A parent questionnaire was distributed requesting the birth history. Beery tests to assess VMI and VP were conducted by an experienced occupational therapist. The educational status of the learner was documented.

Gestational ages were >34 weeks (N=17), 28-34 weeks (N=9), and <28 weeks (N=10). Mean VMI Z scores were -2.27 (SD 0.83) and mean VP scores were -2.29 (SD 1.04). There was a significant correlation between VMI and VP scores (p=0.003). There was no significant difference in VMI and VP Z scores between the full term and premature diplegics. Fifteen children were in the appropriate grade for their age, 7 in a lower grade and 14 in special classes with a modified curriculum.

The majority of the children in this study (whether born prematurely or full term) had CVI, and more than half had learning difficulties. Early functional visual assessment is recommended as identification of visual impairment will enable strategies to be implemented to maximise learning opportunities.

**VISUAL IMPAIRMENT IN CEREBRAL PALSY**

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Aim: Cerebral Visual Impairment (CVI) is actually considered a main symptom of clinical picture of Cerebral Palsy (CP), as stated by classification of CP (Rosenbaum P. et al., 2005). CP and CVI share a common origin; 60-70% of children with CP also have CVI. We set out to describe visual dysfunction, expression of CVI, in children with CP with the aim to improve diagnostic accuracy and to plan specific rehabilitation tools.

Methods: 70 CP (13 with diplegia, 30 with tetraplegia and 27 with hemiplegia) were recruited at the Unit of Child Neurology and Psychiatry of Brescia in the period 2010-2012 (30 girls and 40 boys; age range 1-11 yrs, mean age 4 yrs) underwent a tailored neuro-ophthalmological evaluation (including ophthalmological assessment, evaluation of visual acuity, contrast sensitivity, optokinetic nystagmus, visual field and stereopsis) associated to the clinical assessment including neurological examination, developmental and/or cognitive assessment, and neuroimaging.

Results: Visual involvement in subjects with diplegia is characterised mainly by strabismus, abnormal saccadic movements, reduced visual acuity (mild/moderate) and refractive errors, present in at least 75% of cases. Visual profile in subjects with hemiplegia is similar but less severe than diplegic ones, peculiarly characterized by alterations of visual field. Children with tetraplegia show a severe involvement of all neuro-ophthalmological functions where the main symptom is a reduced visual acuity (moderate/severe) present in all cases.

Conclusion: Neuro-ophthalmological disorders are a main symptom in CP. Each clinical type of CP is associated with a distinct neuro-ophthalmological profile. Early and careful neuro-ophthalmological assessment of children with CP is essential for an accurate diagnosis and for personalised rehabilitation tools.
GROUP 16 – ADULTS

CARDIOVASCULAR DISEASE RISK IN ADULTS WITH SPASTIC BILATERAL CEREBRAL PALSY

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Scientific background: Cardiovascular disease (CVD) is a leading cause of morbidity and mortality worldwide. Little is known about CVD risk factors in cerebral palsy (CP). However, persons with CP may be at increased risk of developing CVD because they have low levels of both aerobic fitness and everyday physical activity.

Aim: To explore CVD risk factors and the 10-year clustered risk of a fatal cardiovascular event in adults with spastic bilateral CP (SBCP), and relationships between the 10-year risk and body fat, aerobic fitness and physical activity.

Subjects: Forty-three adults with SBCP without severe cognitive impairment (mean age 36.6±6 years; range 25-45 years; 27 males).

Methods: Biological risk factors [blood pressure, blood lipids, body fatness, aerobic fitness (VO2peak)], lifestyle/related risk factors [everyday physical activity (accelerometry), alcohol consumption, cigarette smoking] and the 10-year risk according to the European Systematic Coronary Risk Evaluation (SCORE) were assessed. Relationships were studied using multivariable linear regression analyses.

Results: The following single risk factors were present: hypertension (n=12), elevated total cholesterol (n=3), low HDL-C (n=5; all men), high-risk waist circumference (n=8), obesity (BMI; n=5; all men), reduced aerobic fitness (on average 80% of reference sample), reduced level of everyday physical activity (on average 78% of reference sample) and smoking (n =9). All participants had a 10/year risk ≤1 %.

Corrected for gender, participants with higher waist circumference (β=0.27; p=0.06) or BMI (β=0.25; p=0.08) tended to have a higher 10/year risk.

Discussion: In this sample of relatively young adults with SBCP the 10-year fatal CVD risk was low, but several single CVD risk factors were present, of which (pre)hypertensive blood pressure was prominent. A higher level of body fat tended to be related to a higher 10-year risk. Future research is required to investigate the CVD risk at older ages and the effectiveness of preventive strategies in CP.

AN URGENT NEED FOR MULTIDISCIPLINARY, TRANSITIONAL/ADULT CARE IN CP: TRENDS ACROSS 37 YEARS

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Background/Aims: With advances in medical care over 90% of patients with cerebral palsy (CP) reach adulthood. Their complex needs have resulted in a growing demand for health services. However, there is no literature relating these demographic and healthcare trends. This study investigates the healthcare trends of patients with CP to identify the optimal environment for them.

Methods: The National Hospital Discharge Survey was used to extract characteristics of hospitalized CP patients. Values were normalized and procedures grouped into 14 specialties. The procedures were analyzed for each year and divided into pediatric (0-19 yrs), transitional (20-29 yrs), and adult (>30 yrs). The percentage of procedures by specialty was expressed for each age range. The ages of CP patients visiting NewYork-Presbyterian Hospital (NYPH) from 2003-2007 were gathered.
Results/Discussion: From 1970-2007, the number of specialties caring for CP patients increased in the transitional and adult age ranges (from 4 and 6 specialties in 1970 to 12 and 14 specialties in 2007, respectively). Concurrently, the procedures performed by each specialty became more evenly distributed. Orthopaedics, which represented 66.4% of procedures in 1970, fell to 14.2% in 2007. Cardiovascular and gastrointestinal increased across all ages between 1970-2007. The national age distribution of procedures shifted from a majority being pediatric to transitional/adult ages by 2007. Pediatric, transitional, and adult age patients seen at NYPH increased by 17%, 105%, and 72%, respectively from 2003-2007. There was a movement towards care provided by multiple specialties, suggesting the single healthcare provider model is not feasible and multidisciplinary, collaborative care is needed. The second trend is a shift in the age distribution. Most notably, CP is no longer a pediatric condition. With transitional/adult patients making up a majority, there is a pressing need for teams of specialists that are capable and trained to take care of this aging population.

PHYSICAL STRAIN OF WALKING RELATES TO ACTIVITY LEVEL IN ADULTS WITH CEREBRAL PALSY

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Scientific Background: Knowledge of the underlying mechanisms of inactive lifestyle in persons with CP is prerequisite to improve interventions stimulating active lifestyles.
Aim: The aim of this study was to determine whether aerobic capacity, oxygen uptake during walking or physical strain during walking explain why people with bilateral CP have an inactive lifestyle.
Methods & Subjects: Persons were eligible if they had bilateral CP, had GMFCS level I-III, and were aged 25-45 years.
Physical strain during walking was defined as oxygen uptake during walking as a percentage of the peak aerobic capacity. The participants walked at preferred walking speed in a laboratory setting for 3 minutes. The oxygen uptake was measured with a portable breath-by-breath gas analyser. Peak aerobic capacity was measured during maximal progressive cycle ergometry.
An accelerometry-based Activity Monitor was applied to measure the duration of walking in daily life.
Regression analyses were performed to assess the relation between aerobic capacity, oxygen uptake during walking, and physical strain of walking on the one hand and the amount of walking in daily life on the other hand.
Results and discussion: Neither aerobic capacity, nor oxygen uptake during walking was related to the duration of walking in daily life (p=0.10 & p=0.16). However, a significant inverse relationship was found between physical strain of walking at preferred walking speed and the duration of walking in daily life (r2=0.44, p<0.01).
Physical strain, which is composed of aerobic capacity and oxygen uptake during walking, is moderately related to the duration of walking in daily life. This implies that people with CP with high strain during walking are likely to walk less in daily life. This may have important implications for interventions aiming to increase physical activity level in a CP population, since physical strain can be reduced by increasing one’s aerobic capacity.

QUALITY OF LIFE AND PARTICIPATION IN ADULTS WITH CEREBRAL PALSY

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This work aimed to describe the life satisfaction of adults with cerebral palsy and know the characteristics associated with better quality of life, particularly the association with the level of participation.
Sixty adults with Cerebral Palsy (22 females and 28 males) with a mean (± SD) age of 30.8 ± 8.5 years recruited by invitation the services available to people with Cerebral Palsy at Association of Port of Cerebral Palsy (APPC). Participants were classified by the Gross Motor Function Classification System and collection of information included the Portuguese version of the Life Satisfaction Index (LSI-A), the short version of the Measure of Life Habits (LIFE-H) as a measure of participation and a structured questionnaire to collect clinical and socio-demographic information. The values obtained in the LSI-A (M = 25.1, SD = 5.8) did not differ from those obtained in other studies in other populations. The results obtained in LIFE-H indicate that there are restrictions in participation (M = 7.4, SD = 1.8). The results showed that satisfaction with life can be partly explained by the level of participation, especially by the performance of social roles (r² = 0.25) and that there is a difference in the level of participation among individuals classified as level I second the Gross Motor Function Classification System and the other groups. Thus, assessment of quality of life in its subjective dimension in adults with cerebral palsy seems to be no different from the general population, but is influenced by levels of participation, particularly by related with social roles. This study shows that there are restrictions on the participation of people with cerebral palsy, in many areas and categories. The work suggests the deepening of the topic and strategies for monitoring these individuals in adulthood.

PSYCHOLOGICAL GROUP INTERVENTION FOR INDIVIDUALS WITH CEREBRAL PALSY: LONGITUDINAL RESULTS

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Scientific Background: Psychological Well-Being (PWB) is a multidimensional concept that includes (Ryff, 1989): Self-acceptance, Personal growth, Purpose in life, Positive relations with others, Environmental Mastery and Autonomy. Self-efficacy reflects the belief that one is capable of performing in a certain manner to attain certain goals (Bandura, 1995). Hope is “a cognitive set based on a reciprocally derived sense of successful agency (goal-directed determination) and pathways (planning of ways to meet goals)” (Snyder et al., 1991, p. 571).

Aims: This study evaluates the impact of a Psychological Group Intervention in promoting PWB, Self-Efficacy and Hope in individuals with Cerebral Palsy (CP).

Subjects and Methods: The sample consisted of 107 individuals with CP, aged between 16 to 38 years, being 59% male and 41% female. 42 individuals have participated in Group Intervention (IG) and 65 belonged to the Comparison Group (CG). The intervention lasted 8 months, with 16 sessions of 1:30. PWB, Self-Efficacy and Hope were assessed before and after the intervention, 6 and 12 months later; using the Portuguese versions of the Scales of PWB (Ryff, 1989, adapted by Novo, Silva & Peralta, 2003), the Self-Efficacy Scale (Sherer & col., 1982, adapted by Pais/Ribeiro, 1995) and the Future Scale (Snyder et al., 1991, adapted by Pais-Ribeiro, Pedro & Marques, 2006).

Results and Discussion: For the IG, after the Intervention it was noticed an increase of Hope. 6 months later, an increase of PWB and Self-Efficacy was noticed. 12 months after the Intervention it was again noticed an increase of PWB, Self-Efficacy and Hope. The CG showed no significant change over time. Statistically significant differences were not found between the IG and CG at any time. These results suggest a positive impact of the Psychological Group Intervention in the PWB, Self-Efficacy and Hope, indicating that the benefits are maintained over time.
CLINICAL CHARACTERISTICS OF IMPAIRED TRUNK CONTROL IN CHILDREN WITH SPASTIC CEREBRAL PALSY

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Scientific background:
Trunk control is often impaired in children with cerebral palsy (CP), however, research on clinical characteristics of impaired trunk control is scarce.

Aims:
The aim of this study was to identify clinical characteristics of impaired trunk control in different topographies and severity levels in children with spastic CP.

Subjects and methods:
Hundred children with spastic CP (mean age 11.4 ± 2.1 yrs, range 8-15yrs) were included. Children varied in topography (diplegia N=46, hemiplegia N=38, quadriplegia N=16) and severity of motor impairment according to the Gross Motor Function Classification System (GMFCS) (level I N=47, level II N=28, level III N=16, level IV N=9). Trunk control was evaluated with the Trunk Control Measurement Scale (TCMS), consisting of three subscales: static sitting balance, selective movement control and dynamic reaching. The TCMS was administered while sitting on a table without support.

Results:
Total TCMS and subscale scores differed significantly between the three topographies of CP and GMFCS levels (p<.001). Children with GMFCS level I scored best on the TCMS, and with increasing GMFCS level, the scores on the TCMS significantly decreased (p<.001). Children with hemiplegia obtained the highest scores while children with quadriplegia the lowest. Analysis of static and dynamic aspects of trunk control indicated that thirty percent of children with diplegia and hemiplegia scored maximally on the subscale static sitting balance. The second and third subscale revealed best performances for these topographies on items evaluating dynamic trunk movements in the sagittal plane. Nearly none of the children with quadriplegia obtained a maximal score on any item of the scale.

Conclusion:
Characteristics of impaired trunk control differed clearly within subtypes of children with spastic CP. The findings of this study can provide specific clues for treatment interventions targeting impaired trunk control in these children.

MOTOR INFIRMITY OF CERVICAL SPINAL CORD ORIGIN?

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Beside a clinical examination showing spasticity the diagnosis of cerebral palsy relies upon a contributive clinical story and the presence of MRI peculiar abnormalities such as periventricular leukomalacia. Brain malformations and acquired postnatal lesions as well as some genetic syndromes should also be considered. However in many cases no cerebral lesions can be seen.

We are describing here 3 cases in which more extensive exploration have led to the showing of a signal abnormality within the cervical spinal cord. Excepted for the slightly premature 3rd case all 3 were born after an uneventful pregnancy and without any significant perinatal difficulties. All 3 have presented a free interval before spasticity and motor difficulties were diagnosed. Their symptoms are almost exclusively
distributed in the inferior limbs excepted for the 1st who also exhibited spastic attitude at the superior level. The 2nd kid also showed ossification delay at occipital level. All 3 had a normal psychomotor and cognitive development. All biological and genetic evaluations have been no contributive. No neuroradiological lesions have been seen at cerebral level. However a hypersignal was found at the level of C1-2 in case 1 and 2 and in C5-7 in case 3. Disturbances of the somesthetic and motor evoked potentials have been also found. In conclusion we propose that palsy of cervical spine origin could also occur beside of classical cerebral palsy. This could rely upon lesions of local gliosis or “pericanalar leucomalacia”. This can be due to local constraints within the cranio-cervical region at the end of the pregnancy. It can also be linked to ischemic insult of the cervical spinal cord occurring during the 3rd trimester. Thus in absence of explicit lesion at cerebral level we recommend a very attentive evaluation of the cervical spinal cord.

ASYMMETRICAL PRESSURE DISTRIBUTION IN SITTING POSITION AMONG CHILDREN WITH CP

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SCIENTIFIC BACKGROUND: Most children with moderate to severe cerebral palsy (CP) spend most of their time sitting in their wheelchairs. Improvement of sitting posture is an important factor in maintaining physical functioning in these children.

AIM: This study investigated the influence of asymmetrical pressure distribution in the sitting position on motor function, abdominal muscle thickness, and longitudinal changes in physical functioning of children with CP.

METHODS AND SUBJECTS: Static pressure distribution in the sitting position was measured in 15 children with CP (nine boys, six girls) with a mean age of 11 years, 6 months (SD: 3 years, 1 month). On the basis of this information, the position of center of pressure and deviation from the midline were calculated as indicators of asymmetry in the sitting position (ASP). The Pediatric Evaluation of Disability Inventory (PEDI) and three dimensions of the Gross Motor Function Measure (GMFM) were evaluated. Muscle thickness of the abdominal muscles (MTA) was also measured bilaterally using ultrasound. Participants were divided into two groups on the basis of the results of the ASP. The same measurements were taken after 1 year. The Mann-Whitney U-test was used to detect differences between groups. Longitudinal changes in each group were analyzed using the Wilcoxon signed-rank test.

RESULTS AND DISCUSSION: Values for the PEDI, MTA, and results for the “Sit” dimension of the GMFM were significantly lower in the asymmetry group than in the symmetry group (p < 0.05). After 1 year, values in the asymmetry group for ASP significantly improved, and a significant increase in MTA was observed (p < 0.05). These results suggested that the asymmetry of pressure distribution influenced motor function in the sitting position. Improvement in asymmetry may be related to increased abdominal muscle thickness.

THE EFFECT OF BOTOX TREATMENT IN THE SPINE MUSCLES FOR CEREBRAL PARESIS SCOLIOSIS

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SCIENTIFIC BACKGROUND: Intramuscular injection of Botox has been used off label to reduce muscle spasticity of the lower and upper extremities in cerebral paresis (CP) with only a few prospective, randomized double-blinded studies documenting the effect - especially in the CP spine, where only one study has been published.

AIM: We wanted to examine the effects of intramuscular injection of Botox in the CP scoliotic spine in a prospective, randomized triple-blinded cross-over design using NaCl and Botox.
SUBJECTS AND METHODS: 9 CP children using a brace for scoliosis met the inclusion criteria and were injected in the M. Ileopsoas, M. Quadratus Lumborum and M. Erector Spinae with either NaCl or Botox targeted by ultrasonic guidance every 6 months. Standardized X-rays of the spine were performed before and 6 weeks after for every injection. Changes in Cobb's angle and Nash and Moe's classification were evaluated by 3 experienced doctors separately. Clinical results were evaluated by the pediatric quality of life (PQL) score and open questioning of the parents about the child's wellbeing. One serious adverse, but unrelated event of pneumonia resulting in death was recorded.

RESULTS AND DISCUSSION: 2 test subjects had positive radiological outcome in Cobb's angle, 4 had no change and 3 had worsening. 8 out of 10 parents of the children indicated better stability in standing or when sitting in a wheel chair and 2 indicated no change. No changes in PQL were detected. Based on these findings treatment cannot be recommended.

MATSUO'S PROCEDURE, THE MUSCLE RELEASE FOR TREATMENT OF HIP SUBLUXATION OF CEREBRAL PALSY.

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SCIENTIFIC BACKGROUND: The concept of Matsuo’s procedure is release of both of antagonistic poliarticular muscles, while preserving monoarticular muscles as possible.

AIM: We have performed Matsuo’s procedure for treatment of CP since 2003. The purpose of this study was to evaluate the short-term results of treatment for subluxation of the hip in children with CP.

METHODS AND SUBJECTS: We had surveyed children with CP who were performed Matsuo’s procedure for their hip subluxation in Saga Handicapped Children's Hospital from 2003 to 2008. All patients were classified with the Gross Motor Function Classification System (GMFCS) before surgery. We excluded patients with matured pelvis at surgery and/or within one year after surgery at the survey. We examined the medical records retrospectively about gross motor function and the radiographic images by Migration Percentage (MP%) to evaluate subluxation of the hip.

RESULTS AND DISCUSSION: Fifty-four hips in 27 patients (18 boys and 9 girls) were included. Two patients were in GMFCS Class II, 5 were in Class III, 4 were in Class IV, and 16 were in Class V. The average age at surgery was 6.0 years of age (2.7-14.5). Observation period after surgery was 3.9 years on average (1.0/6.3 years). Forty-eight hips in 24 patients were performed Matsuo’s procedure alone, and 6 hips in 3 patients were combined with derotational/varus osteotomy of the proximal femur (DVO). MP% improved from 48.0% to 29.2% on average (p < 0.01, Wilcoxon signed-ranks test). Gross motor function improved in 6 patients whereas did not change in 19 patients, and worsened in 2 patients. We proposed that Matsuo’s procedure was useful for treatment of subluxation of the hip of cerebral palsy, although severely subluxated hips needed DVO in addition to muscle release.

POSTURAL MANAGEMENT PROGRAMS: CLINICAL RECOMMENDATIONS BASED ON A SYSTEMATIC REVIEW

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AIM: Postural management programs are a relatively new concept for children and adults with cerebral palsy (CP). Through a systematic review of the evidence, articles on postural management programs, adaptive seating, sleeping systems and standing frames were rated and specific clinical recommendations made and will present.

CONTENT 1: The database search included MEDLINE, CINAHL, Google Scholar, High Wire Press, PEDro, Cochrane Library, and APTAs Hooked on Evidence from January 1985 to August 2011. Main publications on postural management programs have been published by Pountney and her colleagues, from
the Chailey Heritage School, UK. The studies published by this group have shown a significant reduction in hip subluxation and reconstructive surgeries in children with CP who used at least 2 positioning system components (seating, standing and/or sleeping). Results were further enhanced if the systems were used from an early age. Picciolini (2009) was able to establish a significant reduction in hip subluxation in two case studies (part of a bigger study with 82 children) using specific French sitting and standing postural management devices. Hägglund (2007) reported similar results in 272 children with CP, and showed statistically significant improvements in hip location in children who followed a postural management protocol combined with spasticity management, had early and bilateral hip surgery and attended a multi-disciplinary follow up clinic. In this program, all positioning systems were reviewed and adjusted at least every 6 months. The remaining publications on postural management that were located and reviewed were rated as CEBM level 5, and consisted of expert opinion and clinical recommendations.

CONTENT_2: The literature described the use of seating systems to increase comfort and quality of life (Telfer, 2010), improve upper extremity function (Stavness, 2006) and improve respiratory function and/or prevent or delay deformities (Holmes 2003). Littleton (2011) demonstrated the positive effect of sitting and side lying on respiratory measurements (oxygen saturation, heart rate, respiratory rate, and chest wall excursion) on adults with cerebral palsy. The publications that looked at activity and participation, concluded that pelvic alignment is essential for hand function, and recommended 0-15 degrees of anterior tilt. (Chung, 2008, Nwaobi, 1987), use of hip belt, abduction orthosis, footrest and a tray (Stavness, 2006). In order to achieve upright functional seating, the authors recommended that the trunk, shoulder and head should be anterior to the ischial tuberosities (Stavness, 2006). Kangas (2009) and Lange (2004) have stated that loading the ischial tuberosities and thigh can result in a “co-activation” position that can increase alertness and participation. Carlberg (2005) suggested that the seating system should support the trunk loosely in order to enable better hand and arm functioning.

CONTENT_3: There were very few studies on the effects of sleep systems on posture, range of motion, hip integrity or any other outcomes. One study showed a significant decrease in percentage of hip migration after one year of sleep system use that included 20 degrees of hip abduction (Hankinson, 2002). Parents reported improvements in their children’s posture, muscle tone and sleep pattern (Goldsmith 2000) and seating position and toileting (Hankinson, 2002) with use of a sleep system. Hill (2009) documented that children with severe CP risked respiratory compromise during sleep irrespective of positioning. The authors suggested that assessment of respiratory function is needed when determining optimal positioning for children using night-time positioning equipment.

CONTENT_4: One systematic review concluded that use of a standing device improved bone mineral density, ROM, bowel function and spasticity (Glickman, 2010). However, a question regarding the consequences of the wide range of weight bearing loads between standers and subjects has been raised (Kecskemethy, 2008, Herman, 2007). Standing in abduction further improved hip placement (Martinsson, 2010, Macias, year). Incorporation of movement, oscillation and/or vibration appeared promising in improving outcomes with shorter standing times (Semler, 2008, Ahlborg, 2006).

CONTENT_5: The postural management program must consider many child-centered personal factors including; family situation, child and family's ability to cooperate, child’s pain, child and family sleep patterns/preferences (incl. family bed), child’s hip migration percentage and scoliosis, and child’s long-term prognosis. Each child needs multiple positioning options for across the day and night, not just during the school day. Each positioning component or device needs to afford participation in an activity as well as address body function and structures. In addition, each positioning component or device must have the ability to offer multiple orientations. For example, the seating system needs to be able to tilt anteriorly for playing video games, posteriorly after a seizure and upright for bus transportation. Each system should have easily removable components so that the child can transition between resting and active postures. For example, after a rigorous activity the child may need lateral supports and a headrest, but these should be removed when the child is working on the skill of gaining better head control. The therapist also needs to have a method of knowing which components are weight bearing so these areas can be relieved or loaded periodically. The child may need more than one seating/positioning device for different daytime activities and environments and to ensure variability in posture. The child may sleep in full supine one night, partial right side-lying the next and partial left side-lying on the following night. There exists a need for empirical mechanistic evidence to guide clinical postural management programs across practice settings and with various-aged participants, particularly when considering a life-span approach to practice.
EFFECTIVENESS OF A SIX-MONTH PHYSICAL ACTIVITY STIMULATION PROGRAM FOR CHILDREN WITH CEREBRAL PALSY

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SCIENTIFIC BACKGROUND: Children with cerebral palsy demonstrate lower levels of physical activity compared to typically developing children.

AIM: To evaluate the effectiveness of a six-month physical activity stimulation program for children with spastic cerebral palsy, aged 7-13 years.

Subjects and methods: 46 children with spastic cerebral palsy (26 male, 20 female; mean age 9y 8mo, SD 1y 8mo) and classified as Gross Motor Function Classification System level I (n=26), level II (n=12), or level III (n=8) were included in this multi-center randomized controlled trial. Children were randomly allocated to either the intervention or the control group. The intervention group followed a six-month physical activity stimulation program, consisting of counseling, physiotherapy at home, and fitness training. The control group continued regular pediatric physiotherapy. Data were collected by a blinded assessor at baseline, at four months, and after six months. The primary outcome measure included ambulatory activity measured with a StepWatch™ Activity Monitor, and self-reported physical activity. Secondary outcome measures included mobility capacity (gross motor function measure [GMFM-66]), walking capacity, and functional muscle strength, fitness, and self-reported fatigue and self-esteem.

RESULTS AND DISCUSSION: No intervention effect was found for ambulatory activity, but both groups improved ambulatory activity. Self-reported time at moderate to vigorous activity demonstrated an intervention effect in favor of the intervention group (Odds ratio=1.98, p=0.03). Gross motor capacity measured with the GMFM-66 significantly improved in the intervention group (Beta=2.8, p<0.03). No effect was found on the other secondary outcomes. These findings show that attention to and information about physical activity might be beneficial to elicit improvement in physical activity level of children with cerebral palsy. The combination of a lifestyle intervention and fitness training appears to be effective to improve mobility capacity.

EFFECTS OF STRENGTH TRAINING ON THE HABITUAL ACTIVITY OF YOUNG PEOPLE WITH DIPLEGIC CEREBRAL PALSY

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SCIENTIFIC BACKGROUND: Strength training may be a promising intervention for increasing habitual activity of people with cerebral palsy. However, habitual physical activity has not been assessed with an objective measure after strength training in young people with diplegic cerebral palsy (CP).

AIM: To examine whether a progressive resistance strength training program could increase habitual physical activity levels and decrease sedentary behaviour of adolescents and young adults with diplegic CP.

SUBJECTS AND METHODS: Forty seven adolescents and young adults with diplegic CP were randomly assigned to a lower limb progressive resistance strength training program (N=23, Age=18.2 ± 1.7) or to usual care (N=24, Age=18.8 ± 2.7). Intervention group participants completed 2-3 sets of 8-10 repetition maximum for each exercise with a 2-3 minute break between each set. The program was implemented 2 times per week for a total of 12 weeks. Outcomes included one-repetition maximum (1RM) of a leg press, habitual physical activity and sedentary behaviour. A monitor was used to measure habitual physical activity and sedentary behaviour that had demonstrated evidence of criterion validity and retest reliability in young people with diplegic CP. Outcomes were measured at baseline, post-intervention (at 12 weeks) and 12 weeks after the program stopped (at 24 weeks). Data analysis was performed with two-way ANOVA.

RESULTS AND DISCUSSION: Post-intervention, a significant mean difference of 38.0 kg (95%CE: 15.5-
60.5) in favour of the intervention was found between the two groups for 1 RM leg press strength. No between-group differences were found for any measure of habitual physical activity or sedentary behaviour (p≥ .8). No significant adverse events related to training were reported. At 24 weeks, no significant between-group differences were observed for any outcome. The most optimum components of a program aiming to increase habitual activity and decrease sedentary behaviour still need investigation.

PHYSICAL ACTIVITY QUESTIONNAIRE - PSYCHOMETRICS AND FACTORS RELATED IN CHILDREN WITH CEREBRAL PALSY

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SCIENTIFIC BACKGROUND: Assessment of physical activity (PA) is important as it is associated with morbidity and well-being. Therefore, identifying factors which are related to PA is crucial, more so in children with cerebral palsy (CP).

AIM: Validation of the Physical Activity Questionnaire (PAQ) in children with CP and examination of different informants' concordance (parents and children). In addition, to explore the correlation of the PAQ with demographics, impairment and activity measures.

SUBJECTS AND METHODS: Fourteen children with CP (mean age 12.57±3.35) participated in this study. The children and their parents completed the PAQ. In addition, the parents reported the child's Functional Mobility Scale5,50,500. Therapists evaluated the child using various measures: 'Selective control assessment of lower extremities' (SCALE), timed 500 meters walk, ability to jump, ascend and descend stairs, and 10 meters walk test. Discriminative validity was assessed with one sample t-test to compare the PA of children with CP to published norms. Agreement between informants and overall reliability was evaluated with the Intraclass Correlation Coefficient (ICC) and paired samples t-test. Associations were examined with Pearson correlations. The impact of categorical measures on PAQ score was explored via independent t-test.

RESULTS AND CONCLUSIONS: The PAQ has a discriminative validity as it was able to differentiate between children with CP and norm values (2.75 vs. 1.97 respectively). PAQ was found to be reliable (ICC=0.8). No significance differences in PAQ means and a moderate concordance were found between informants (ICC= 0.73). No significant correlations were found between PAQ and demographics, impairment and activity measures. The PAQ is a useful tool for assessing PA in children with CP both by parents and children. Other Factors such as personal, environmental, cultural and emotional may be important determents of PA.

PHYSICAL STRAIN OF WALKING IN CHILDREN WITH MOTOR DISABILITIES: WALKING ECONOMY OR FITNESS PROBLEM?

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SCIENTIFIC BACKGROUND: The physical strain (PS) of walking depends on walking economy, (preferred) walking speed and maximal aerobic capacity.

AIM: To describe the physiological strain of walking and its three components (walking economy, walking speed and aerobic capacity) in children with motor disabilities.

METHODS AND SUBJECTS: Children with walking limitations due to cerebral palsy (CP, n=12, GMFCS I (n=5) II/III (n=7)) or other motor disabilities (MD, n=8) were included (age: 11.4±4yrs). All children performed a 6-min walk test at their comfortable walking speed. Oxygen consumption (VO2walk, ml/kg/min) and walking speed (m/min) were measured, and used to calculate the energy cost (i.e. walking economy, J/kg/m). Maximal aerobic capacity (VO2peak, ml/kg/min) was assessed using an incremental maximal exercise test on a bicycle ergometer. PS was expressed as [VO2walk/VO2peak]*100%. Group means were compared to estimated values for age and gender-matched children with typical development.
RESULTS AND DISCUSSION: Compared to estimated values for TD (34±2%), PS of walking was high and variable in all groups, showing the highest values in GMFCS II/III (65±24%), and lower values in GMFCS I (54±14%) and MD (52±7%). Energy cost (8.4±4.0, 5.7±0.5, 5.5±1.4J/kg/m) was higher, and VO2peak lower (32.8±8.7, 38.3±5.7, 36.8±9.0ml/kg/min) compared to estimated TD values (4.2±0.4 J/kg/m, and 44.2±2.4 ml/kg/min). Walking speed was low in GMFCS II/III (52±8m/min), and almost unaffected GMFCS I and MD (70±7 and 71±7m/min).

Both an increased energy cost and decreased aerobic capacity can lead to an increased physical strain of walking in children with motor disabilities, indicating that these different components should be assessed in detail to support clinical decision making, i.e. whether walking economy should be improved and/or training of the aerobic capacity is indicated.

HABITUAL PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOUR OF YOUNG PEOPLE WITH DIPLEGIC CEREBRAL PALSY

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SCIENTIFIC BACKGROUND: Young people with diplegic cerebral palsy (CP) who have difficulty walking tend to be particularly prone to low levels of physical activity and therefore at risk of secondary health problems.

AIM: To describe habitual physical activity levels and levels of sedentary behaviour of adolescents and young adults with diplegic CP who have difficulty walking. Also, to determine significant predictors of habitual activity and sedentary behaviour of these people.

SUBJECTS AND METHODS: Forty seven adolescents and young adults with diplegic CP (18.5 ± 2.4 yrs) of GMFCS levels II and III were recruited in this observational study. Physical activity and sedentary behaviour (dependent variables) were measured over 7 days with an activity monitor (ActivPAL™). The monitor had demonstrated evidence of criterion validity and reliability in young people with diplegic CP. Monitor data were included for analysis if at least 2 full days of data were obtained. Independent variables were age, gender, height, weight, GMFCS levels, GMFM-D, GMFM-E, bilateral leg press strength, bilateral reverse leg press strength and six minute walk distance. Simple Pearson correlations examined relationships between variables. A hierarchical multiple regression identified significant predictors of habitual activity and sedentary behaviour.

RESULTS AND DISCUSSION: Habitual activity levels of adolescents and young adults with diplegic CP were low and levels of sedentary behaviour were high compared to published norms for healthy people. The GMFM-E scores were the only significant predictor of habitual physical activity and sedentary behaviour (at least 82%; p≤ .02) in the multiple regression. However, reverse leg press strength and six minute walk distance were also significantly associated factors of habitual activity in Pearson bivariate analysis. Assuming a causal relationship exists between physical activity and its significant associated factors, interventions that address these factors may be effective in increasing habitual physical activity.

STEP RATE IN COMPARISON TO HEART RATE RESERVE IN CHILDREN WITH CEREBRAL PALSY

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SCIENTIFIC BACKGROUND: Children with cerebral palsy (CP) have lower step activity levels compared to children who are developing typically (TD). However, the intensity of the step activity is unknown because children with CP have a higher energy cost of walking.

AIM: To compare the intensity, estimated by heart rate reserve (HRR), of different step rate activity levels
between TD and children with CP with different levels of motor involvement, classified with the Gross Motor Function Classification System (GMFCS).

METHODS AND SUBJECTS: Eighty children (age 9y9m±1y4m), 49 CP (GMFCS I (n=28), II (n=12) and III (n=9)) and 31 TD wore both a Step Watch activity monitor and a heart rate (HR) monitor for three days, with a sample frequency of 1 min. Step rate activity was categorized into 3 levels: low (<15 steps/min), moderate (16-30 steps/min) and high (>30 steps/min) step rate. The HRR \( \frac{[100\%\times((HR_{step}-HR_{rest})/(HR_{max}-HR_{rest}))]} \) corresponding to the different step activity levels was determined and compared between TD and the different GMFCS levels. Data were analyzed with a one-way ANOVA (p<0.05).

RESULTS AND DISCUSSION: In the low step rate activity level there was no difference in average HRR for TD (30.6±3.9), GMFCS I (33.9±4.6) and GMFCS II (29.9±6.1), whereas HRR was higher for GMFCS III (37.8±4.4, p<0.05). In the moderate respectively high step rate activity level no differences in HRR were present between TD (38.2±5.4; 45.6±7.4), GMFCS I (40.3±6.9; 47.8±8.6), II (34.6±6.2; 37.7±9.8) and III (43.7±10.0; 46.7±11.1). Results suggest that step rate activity levels give an appropriate estimate of intensity of activity in children with CP, except for those at GMFCS level III. Additional analysis are required to evaluate intensity of step rate cut off levels in children with CP, especially differentiated according to motor involvement.

GROUP 19 – FAMILY 1

DO GOALS SUPPORT EMPOWERMENT? A CONTENT ANALYSIS OF GOALS IN (RE)HABILITATION PLANS

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SCIENTIFIC BACKGROUND: Goal setting is the core of (re)habilitation planning for children with CP, therefore documentation of goals as a result of family-centered and multidisciplinary collaboration is of great importance.

AIM: To explore the content of goals written in (re)habilitation plans for children and adolescents with cerebral palsy.

SUBJECTS AND METHODS: The study was a retrospective cross-sectional register study. The material consisted of randomly chosen register documents from the register of the Social Insurance Institution for 75 children and adolescents with CP in different predetermined age ranges and from different parts of Finland. The content of the goals were analyzed and linked to ICF-CY.

RESULTS AND DISCUSSION: For five children no goals were formulated in the documentation. For the remaining 70 children goals were documented by the hospital’s multidisciplinary team and/or by the local therapist. Most of the goals could be linked to the component “Body function” with the domains “Neuromusculoskeletal and movement-related functions” and “Mental functions” most frequently mentioned. In the component “Activity and Participation” the domains “Mobility” and “Self-Care” were most frequently mentioned for the younger children whereas for the older children and adolescents also the domain “Communication” was in focus. In several reports goals were mentioned as a therapeutic method. Several goals could not be linked to the ICF-CY and were coded as “not definable”.

The ICF-CY proved valuable in the classification of the content of the goals and helped to give an overview of the focus of therapeutic interventions. The content of the goals were rather general and concentrated on body function and activities. The ICF-CY could serve as a common framework for all involved in the goal-setting process as it can be used to identify the most important goals for the individual child in her/his environment and to clarify the phrasing and documentation.
"RASHOMON EFFECT": THE PROBLEM OF MULTIPLE INFORMANTS IN CARING FOR THE CHILD WITH CEREBRAL PALSY


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AIM: Kurosawa's film Rashomon depicts a plot through the widely differing accounts of four witnesses and the stories are mutually contradictory and discrepant. "Informants Discrepancies" attracted some attention in the area of children's behavior observation and the 'proxy problem' attracted even more attention in studying well being of children with disabilities, as reported by their parents and by professionals.

CONTENT_1: The experience of caregiving burden in parents of children with CP: the mediating role of marital satisfaction

SCIENTIFIC BACKGROUND: Parents of children with disabilities often experience caregiving demands, putting them at risk for role overload and caregiver burden. Thus, Paucity of data exists regarding differences between mothers and fathers of children with disabilities in their perceived sense of burden.

AIM: to examine the association between child's level of impairment, level of caregiving assistance, parental burden and the role of marital satisfaction as a moderator.

METHODS AND SUBJECTS: Forty nine parents completed the Zarit Burden Interview (ZBI) and the Evaluating and Nurturing Relationship Issues Communication and Happiness (ENRICH) Inventory, for evaluating caregiver burden and marital satisfaction, respectively. Two factors were computed out of the ZBI: Personal strain and Role strain. In addition, child's level of impairment was evaluated using the Gross Motor Functional Measure/66 (GMFM-66). The amount of assistance parents provide was evaluated by the Pediatric Evaluation Disability Inventory (PEDI) Caregiver Assistance (CGA) scale.

RESULTS AND DISCUSSION: Mothers and fathers reported higher scores on the ZBI Role strain factor compared to the Personal strain factor. Child's level of impairment, but not the level of assistance was associated with mother's burden scores. Parent's marital satisfaction was found to moderate only the association between child's level of impairment and mother's sense of burden. Although resemblance in caregiving burden of mothers and fathers of children with CP, the role of marital satisfaction was a significant moderator only for mothers sense of burden. Implications for practice include focusing on marital satisfaction as part of intervention plans.

CONTENT_2: Mothers' reports on the emotional and social problems of children with chronic conditions: Are they related to maternal emotional distress?

SCIENTIFIC BACKGROUND: According to self determination theory, autonomy is a universal basic need through development. However, this topic has received little attention in children with Cerebral Palsy (CP).

AIM: To examine the importance of child's sense of autonomy to his function level (mobility and self-care), via two informants [mothers and Health Care Professionals (HCP)].

METHODS AND SUBJECTS: The sample comprised of 73 mothers and their children with CP, aged 6-12 years. Child's function was evaluated by mothers' and HCP evaluation using The Pediatric Evaluation Disability Inventory (Caregiver Assistance: mobility and self care scales) was administered via. Impairment severity was assessed with the Gross Motor Functional Measure-66 (GMFM-66). Two independent judges evaluated child's sense of autonomy using videotaped interaction between mother and child. Correlations and multiple regressions were used for the evaluation of the associations between GMFM-66, and child sense of autonomy and for the prediction of child's functional level.

RESULTS AND DISCUSSION: Significant associations were found among child's sense of autonomy, GMFM-66 and child's function as reported by both mothers and HCP. Regression analysis showed that both GMFM-66 and child's sense of autonomy predicted mothers assessment of the child's function in self care domain. GMFM-66 alone predicted child's function in mobility domain. HCP evaluation of self-care and mobility domains was predicted by GMFM-66 only. The study sheds light upon the role of the child as informant and the importance of sense of autonomy to the child's function. Differences between parents and HCP regarding the child's basic psychological needs, should be further examined.

CONTENT_4: Practicing Family Centred Care: Perceptions of Service Providers and Parent's of Young Children with CP
SCIENTIFIC BACKGROUND: Children with cerebral palsy (CP) are thought to be best addressed by a Family-Centred Care (FCC) delivery model. The Measure of Processes of Care (MPOC) is a self-report measure of parents’ and Service Providers (SP) perceptions, regarding the extent to which core principles of FCC are actually provided.

AIMS: (1) To explore the degree to which parents’ and SP experience the service as being family-centred; (2) to examine the contributions of child's level of motor impairment- and parent's coping styles, to the experience of the service as FCC.

METHODS AND PROCEDURES: Twenty-six parents of children with CP, aged 4-8 years, and 26 SP were asked to evaluate the process of care at the child's rehabilitation pre-school. Parents and SP completed the MPOC-56 and MPOC-SP, respectively. Parents coping style was measured with the Monitor/Blunter Style Scale (MBSS). Child's level of motor impairment was evaluated using the Gross Motor Function Classification Scale (GMFCS).

RESULTS AND DISCUSSION: Parents and SP rated 'Providing General Information' domain the lowest. 'Respectful and Supportive Care' and 'Treating People Respectfully' domains were scored the highest by parents and SP, respectively. Child's GMFCS level was correlated with parents' scores on the MPOC-56, but not with SP scores on the MPOC-SP. SP scores on the general information domain was correlated to parents’ information seeking style. This study emphasizes the differences and resemblances in the way parents and SP perceive service as FCC.

CONTENT 5: Agreement between parents and clinicians in rating function in children with cerebral palsy

SCIENTIFIC BACKGROUND: Increasing interest exists in research on agreement between parents and Health Care Professionals (HCP) in assessing children with Cerebral Palsy (CP). Little is known about the extent of agreement between parents and HCP in child's functioning as assessed by the Pediatric Evaluation Disability Inventory (PEDI).

AIM: To examine: Concordance between HCP and mothers in the evaluation of child's function; whether child and mother's psychological characteristics predict concordance between HCP and mothers.

METHODS AND SUBJECTS: Mothers and an HCP evaluated seventy three children's level of function with the PEDI. Gross Motor Functional Measure/66 (GMFM-66) and mother's self report of Experiences in Close Relationships-Revised Questionnaire were administered as well. Concordance between raters was assessed using paired-t test, intraclass correlation coefficients (ICCs), multiple regressions and graphically (mountain and Youden plots).

RESULTS AND DISCUSSION: Significant differences between raters were found in two PEDI domains. ICCs were excellent for the whole sample. However, mountain plots indicated large differences between the two raters in all domains. When agreement was examined according to CP severity the ICC in the moderate severity group was low--moderate. Youden plots indicated large total systemic errors in the mild and severe groups and in the moderate severity group errors due to random factors. Lower levels of impairment reduced disagreement between mothers and HCP. Differences between the raters in perception of the child's function may cause conflicts as the treatment's regimen is based on child's function, and may impair the ability to set goals according to parents' needs and expectations.

MENTAL HEALTH OF PARENTS OF CHILDREN WITH CEREBRAL PALSY AND THE COUPLE RELATIONSHIP: REGISTRY STUDY

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SCIENTIFIC BACKGROUND: Couple relationships may be negatively affected by the demands of caring for a child with cerebral palsy, as couples may not prioritise their own wellbeing over their child’s. Furthermore, parents of children with cerebral palsy are at higher risk of depression and stress.

AIM: The study aimed to examine whether a causal link existed between psychological health and quality of the parent-couple dyad.

Subjects and Methods: Sixty-five parents of children with cerebral palsy (37 boys/28 girls, GMFCS I-V) registered on the New South Wales register (32% cross section of 2008 birth cohort) were studied. Forty-eight cases of complete data were available for analysis. Parent psychological wellbeing was screened using...
the Depression, Anxiety, Stress Scale (DASS 21). Relationship quality was assessed using the Relationship Quality Index (RQI). Results were calculated using multiple regression and independent t-tests.

RESULTS AND DISCUSSION: 83% of parents invited to participate volunteered, and for 27% both parents responded. Couple relationship quality was not predicted by depression (B=0.74 [95%CI -0.78 to 2.25], p=0.33), anxiety (B=1.44 [95%CI -2.49 to -0.39], p=0.08) or stress (B=0.79 [95%CI -0.04 to 1.63], p=0.06) as hypothesised. Moreover, parents had comparable levels of depression (p=0.99), anxiety (p=0.95), and stress (p=0.08) to the normative population. Findings suggest that in the early years, parents generally have good mental health. Other studies suggest however that mental health declines over time. Effectiveness research is therefore needed about early preventative mental health interventions designed to keep families well and intact, across the lifespan. The high response rate suggests parents do not object to disclosing their psychological wellbeing, potentially debunking the clinical belief that it is too intrusive to ask. Since these parents are at higher risk of depression and stress and readily volunteer to being measured, more systematic research using a longitudinal population approach is recommended.

DETERMINANTS OF EASE OF CAREGIVING OF YOUNG CHILDREN WITH CEREBRAL PALSY

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SCIENTIFIC BACKGROUND: Ease of caregiving refers to the level of difficulty in assisting a child to perform self-care activities and is an important outcome of family-centered services.

AIM: Knowledge of child, family, and service factors that are determinants of ease of caregiving would enable health care professionals to provide evidence-based interventions and support children and families. The purpose of this study was to determine the child, family, and service factors associated with ease of caregiving.

METHODS AND SUBJECTS: 387 pre-school aged children with cerebral palsy (CP) and their caregivers were recruited from multiple sites in Canada and the United States; their data were available for this secondary analysis. Child factors (gross motor ability, distribution of involvement, balance, quality of movement, spasticity, strength, range of motion, endurance, adaptive behavior, and health conditions) were collected at the beginning of a one-year study. Family and service factors were collected on average seven months after the study onset. Ease of caregiving was measured at the end of the study using the Child Engagement in Daily Life Measure. Sequential multiple linear regression analysis was conducted.

RESULTS AND DISCUSSION: The child factor model accounted for 55% of the variance of ease of caregiving (p<0.001). The addition of one family factor added 1% (p<0.02) and the addition of service factors added an additional 2% (p<0.01). In the final model, significant child variables were gross motor ability (standardized beta=-0.31), impact of health conditions (-0.17), and spasticity (-0.14). Family expectations (0.09), coordination of services (0.09) and needs being met (0.09) were also associated with ease of caregiving. The findings suggest that optimizing gross motor function, minimizing the impact of health conditions, and managing spasticity may enhance ease of care giving of young children with CP.

RESPITE SERVICES IMPROVE EMOTIONAL WELL-BEING OF CAREGIVERS OF CHILDREN WITH CEREBRAL PALSY

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SCIENTIFIC BACKGROUND: Respite is known to improve stress and mental health for caregivers of children with disabilities. However little specific information is available about the causes and effects of met/unmet respite needs of families of children with cerebral palsy (CP). Why some families cope and
others are in crisis is uncertain, but inadequacy of respite services is common. 

AIM: Determine relationships between caregivers’ respite needs, emotional well-being (depression, anxiety, stress, resilience and overall well-being) and child factors (age and severity of CP).

METHODS AND SUBJECTS: 71 caregivers (90.1% mothers) of children with CP (aged 0-12 years, GMFCS I=14, II=10, III=10, IV=14, V=23) completed assessments of respite needs (Respite Needs Questionnaire and Family Needs Survey) and emotional well-being (Depression Anxiety and Stress Scale, Resilience Scale and Warwick-Edinburgh Mental Well-being Scale). Relationships between respite volume, unmet needs, emotional well-being, child age and severity were assessed by correlations. Possible predictors of emotional well-being (unmet need, GMFCS and age) were examined by multiple regression.

RESULTS AND DISCUSSION: Although 55% of caregivers reported inadequate respite, actual hours of respite were not significantly related to mental health. Instead, the perception of unmet respite needs was significantly correlated with higher anxiety (p=0.001), stress (p<0.001) and depression (p=0.003) and lower resilience (p=0.002) and well-being (p=0.011). Regression analysis indicated that parent perception of unmet respite needs was a significant predictor of stress (r²=0.390, p<0.001) and resilience (r²=0.231, p=0.001) and difficulties finding appropriate respite carers was a predictor of anxiety (r²=0.259, p=0.001) and stress (r²=0.390, p=0.001). Severity of CP was a predictor of carer resilience (r²=0.231, p=0.001) and well-being (r²=0.158, p=0.017). Child age was a predictor of caregiver resilience (r²=0.231, p=0.001). Respite improves caregiver well-being when (a) services are commenced early, (b) volume is determined by individual family needs not impairment-based quotas, and (c) format and frequency is flexible.

MUSCULOSKELETAL DISORDERS IN CAREGIVERS OF CHILDREN WITH CP FOLLOWING A MULTILEVEL SURGERY

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SCIENTIFIC BACKGROUND: Persons with cerebral palsy often need assistance for activities of daily living which exposes their caregivers to different risk factors for developing musculoskeletal disorders. AIMS: This study was designed to identify the prevalence and risk factors of musculoskeletal disorders among the caregivers of children with cerebral palsy.

METHODS & SUBJECTS: A case control study where the study group comprised of 257 caregivers of children with CP who underwent multilevel surgery. The control group comprised of 117 caregivers of ambulatory children with other orthopaedic problems such as clubfoot or spina bifida. The study was conducted in a tertiary or referral rehabilitation hospital over a period of 3 years (2008-2011). The study utilised a closed ended self-administered questionnaire, which included questions regarding demographic factors such as age, gender, BMI, level of independence of the child, cooperativeness of the child, the level of sleep disturbance and mental stress measured by visual analog scale (VAS). The level of physical exertion during lifting/carrying child and fatigue were measured using Borg CR-10 scale, and the Modified Caregiver Strain Index (CSI).

RESULTS & DISCUSSION: The common musculoskeletal disorders identified were Myofascial Pain Syndrome (27.6%), Fibromyalgia Syndrome (24.5%) and Thoracic Outlet Syndrome (23%) among the study group. Prevalence of musculoskeletal discomfort at shoulder, elbow, upper back, lower back and ankle were significantly higher among the study group as compared to control group. Study further revealed that the sleeplessness (p<0.001) and level of fatigue (p<0.001) were significantly higher among the study group than the control group. Statistical comparison of CSI between two groups showed that both the groups were similarly (t-1.13 p<0.05) exposed to caregiver strain. The results indicated a significant prevalence of pain, discomfort and back pain among the caregiver of sever disability, higher BMI, non-ambulatory phase of rehabilitation children with CP.
ASSESSMENT OF THE STRUCTURAL CONNECTOME REVEALS ALTERED CONNECTIVITY IN CHILDREN WITH UNILATERAL CP

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SCIENTIFIC BACKGROUND: Using structural MRI in combination with diffusion MRI tractography, the structural network of connections (i.e. the connectome) within the brain can be studied non-invasively. AIM: Our aim was to assess the integrity of white matter pathways within the neural network of children with unilateral CP, in comparison to typically developing children (TDC). In contrast to previous tractography studies of CP, our automated approach is not limited to the analysis of a small number of tracts of interest, but assesses the entire connectome.

SUBJECTS AND METHODS: Nine children with left hemiplegia (GMFCS I/II: 8/1; MACS I/II: 3/6), 7 children with right hemiplegia (GMFCS I/II: 5/2; MACS I/II: 1/6) and 13 matched TDC were enrolled in this study. Median age in each group was 11 years. Structural and diffusion MRI were acquired using a 3T Siemens Trio. For each subject, the cerebral cortex was automatically divided into 34 regions per hemisphere and the connections between each pair of cortical regions were obtained using probabilistic tractography. The mean fractional anisotropy (FA) for each connection was calculated as a measure of tract integrity, and FA values were compared between patient and control groups using a t-test. Network-based statistics were used to correct for multiple comparisons.

RESULTS AND DISCUSSION: For children with right hemiplegia, mean FA was significantly altered compared to controls in one component of the network containing 34 connections (p = 0.0028). Connections included 12 left intra-hemispheric, 22 inter-hemispheric and no right intra-hemispheric pathways. Identified intra-hemispheric connections included primarily pathways of the motor cortex to frontal and cingulate regions. Identified inter-hemispheric pathways included motor and occipital connections. These findings highlight the neural correlates associated with motor and visual deficits in CP. For children with left hemiplegia, no significant differences in mean FA to controls were observed after correction for multiple comparisons.

SUBCORTICAL GREY MATTER MORPHOLOGY IN CONGENITAL HEMIPLEGIA

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SCIENTIFIC BACKGROUND: Cerebral Palsy manifests clinically with a range of motor deficits. Motor control in the brain is controlled primarily by cortical motor areas, and subcortical structures including the thalamus and basal ganglia.

AIM: Evaluation of the relationship between pathological changes to cortical and subcortical grey matter (GM) and motor function in congenital hemiplegia.

METHODS AND SUBJECTS: In a cross sectional study, high-resolution structural images were acquired from 28 children with congenital hemiplegia (left hemiplegia n=14: porencephaly n=4, periventricular leukomalacia n=7, grey matter injury n=2, non specific lesion n=1; right hemiplegia n=14: porencephaly n=7, periventricular white leukomalacia n=4, grey matter injury n=2, non specific lesion n=1) and 15 typically developing children using a 3T MRI scanner. Groupwise voxel based morphometry (VBM) and surface based analyses were performed. Correlations between subcortical GM nuclei volumes and Jebsen Taylor Hand Function Test scores were examined in a subset of children (n=18).

RESULTS AND DISCUSSION: VBM analysis showed significant reduction in GM within the left
precentral gyrus, caudate and lentiform nuclei in participants with right hemiplegia compared with controls. No significant reduction in GM was found in any region for the participants with left hemiplegia. There was a significant reduction in volume of the contralateral thalamus of both groups. A significant correlation was found between hand function and volume of the globus pallidus for both groups (right hemiplegia $\rho=-0.782$, $p<0.009$; left hemiplegia $\rho=-0.714$, $p<0.05$). Compared with controls, children with hemiplegia possessed numerous subcortical GM morphological changes, with minimal cortical involvement. These findings indicate more significant involvement of key subcortical GM nuclei in motor function than previously thought in CP.

**USING DIFFUSION TENSOR IMAGING TO VISUALIZE FUNCTIONAL MOTOR PATHWAYS IN CHILDREN WITH HEMIPLEGIA**

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**SCIENTIFIC BACKGROUND:** The consistency of location between the motor representation of the upper extremity (UE) and corticospinal tract (CST) origin is unknown.

**AIM:** To (a) visualize functional motor tracts using diffusion tensor imaging (DTI) in children with hemiplegic cerebral palsy (CP), and (b) determine the relationship between dexterity and integrity of the affected CST (fractional anisotropy, FA).

**METHODS AND SUBJECTS:** Nine children with hemiplegic CP participated. Motor cortex (M1) representations of the affected UE were identified using single/pulse transcranial magnetic stimulation (TMS). Electromyography was recorded during TMS in hand and arm muscles bilaterally. Using diffusion tensor imaging (DTI), CS tracts were reconstructed by seeding the tract origin in the TMS-identified motor map, using DTI Studio software. We determined the consistency of TMS-identified motor representation of the affected UE vs. DTI-reconstructed CST origin on the affected M1. FA of the affected CST was determined and dexterity was measured using the Jebsen-Taylor Test of Hand Function.

**RESULTS AND DISCUSSION:** Using TMS, we determined the laterality of the CST controlling each child’s affected hand ($n=3$ ipsilateral, $n=2$ contralateral, $n=4$ bilateral, i.e. projecting from both hemispheres). Using DTI tractography, seeded in the TMS motor map, we determined the absence or presence of visible tracts originating from the affected M1. Results demonstrated consistency between TMS and DTI in all subjects. In all TMS-identified ipsilateral subjects, no visible tracts could be reconstructed from the affected M1 using DTI. In all TMS-identified contralateral or bilateral subjects, visible tracts were reconstructed from the affected M1. A strong correlation was found between dexterity and FA in the ipsilateral ($r=0.87$, $p=0.01$) but not in the contralateral pathway ($r=-0.12$, $p=0.44$). DTI appears to be a reliable method for visualizing physiologically functional motor pathways. Better integrity of the ipsilateral pathway controlling the affected UE was indicative of poorer dexterity.

**OUTCOME OF CIMT IN RELATION TO CORTICOMOTOR PROJECTION PATTERN AND BRAIN LESION IN UNILATERAL CP**

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SCIENTIFIC BACKGROUND: It is plausible to hypothesize that the organization of corticomotor projections might influence the outcome of CIMT. The underlying brain lesion characteristics might also influence the outcome since it is known to influence motor development in a long time perspective.

AIM: To explore if hand function can be improved regardless of corticomotor projection pattern and brain lesion characteristics in children who are typically included in Constraint Induced Movement Therapy (CIMT).

METHOD AND SUBJECT: The individual data of sixteen participants (eight males, mean age 13y, SD 2.0) with unilateral CP (nine right-sided) who participated in a 2-week CIMT day camp was used for analysis. Transcranial Magnetic Stimulation (TMS) was performed to identify corticomotor organization and structural MRI was performed to describe brain lesions. Data from Jebsen-Taylor hand Function Test (JTHFT), Melbourne Assessment and Assisting Hand Assessment (AHA) collected before and after day camp was used to describe improvements on different aspects of hand function

RESULT AND DISCUSSION: To a different extent, individual improvements of speed and quality of movements were found in all types of motor projection patterns i.e. contralateral, mixed and ipsilateral. No clear relationship between clinical improvement and brain lesion characteristics was found. There was significant correlation between clinical assessment before the day camp but no significant correlation between the amount of improvements. This means that children, typically included in CIMT, can benefit from treatment irrespective of their corticomotor projection pattern and brain lesion characteristics.

THE ANTERIOR CINGULATE CORTEX IN CONGENITAL HEMIPLEGIA

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SCIENTIFIC BACKGROUND. Recent research has shown altered cognitive and social functioning in children with Cerebral Palsy (CP). The anterior cingulate cortex (ACC) is a key structure in emotional and executive function, with variable sulcal morphology. The presence of a paracingulate sulcus (PCS) has been shown to influence executive functioning ability.

AIM. Assessment of the sulcal variation and volume of the ACC in congenital hemiplegia, and association with executive function.

METHODS AND SUBJECTS. 24 children with congenital hemiplegia aged 9-16 years (porencephaly n=12, periventricular leukomalacia n=6, grey matter injury n=4, non specific lesion n=2) and 15 age and gender matched controls without brain pathology were scanned using high resolution 3T MRI. PCS was classified as present or absent in each hemisphere. Volume of the ACC was assessed using Freesurfer parcellation with manual correction. Executive function was tested using the Stroop task.

RESULTS AND DISCUSSION. The PCS occurred more frequently in the CP group. A left PCS was present in 47% of controls, 67% and 75% of children with right and left hemiplegia respectively. A right PCS was present in 40% of controls, 42% and 58% of children with right and left hemiplegia respectively. 13% of controls had bilateral PCS while 25% and 50% of children with right and left hemiplegia showed this pattern. Right ACC volume correlated with age corrected Stroop task performance in the CP group (ρ=0.60, p=0.01). There were no significant differences in ACC volume between groups, except for slightly increased right ACC volume in left hemiplegia (2-tailed t-test p<0.04).
“HABIT & LEG", A NEW INTERVENTION FOR IMPROVING BIMANUAL COORDINATION AND LOWER EXTREMITY FUNCTION

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SCIENTIFIC BACKGROUND: Hand-arm bimanual intensive training (HABIT) and constrained-induced therapy have shown evidence of efficacy for improvement in upper extremity (UE) use in children with hemiplegic cerebral palsy (HCP). However, these interventions are often administered in a static sitting position for many hours a day. Though there is a legitimate focus of intensive rehabilitation on UEs given their importance for daily activities, UE impairments in children with HCP remain stable while lower extremity (LE) function often deteriorates during development.

AIMS: to examine the efficacy of HABIT & leg, a novel bimanual intensive intervention for HCP children including systematically postural and locomotor control training.

METHODS AND SUBJECTS: Twelve children with HCP were included in a pilot study. They were tested 5 months before the training session, just before, immediately after and 3 months after the training period. The training included 90 hours of bimanual intensive training including systematically training postural and locomotor control that was introduced by using unstable supports (balls and balance boards) during games and eating for which tables were needed. Specific gross motor activities such as outside games implying upper and lower extremities, Nordic walk or climbing were also developed.

RESULTS/DISCUSSION: HABIT & leg, in combination with regular therapy, significantly improved manual dexterity measured with box and blocks (ANOVAR, p=0.002 for both hands), digital strength (ANOVAR, p≤0.001 for both hands) and manual ability (ABILHAND/Kids, ANOVAR, p<0.001). After 3 months, all improvements were maintained or increased further. LE improvements were observed in the ABILOCO/Kids, a questionnaire of locomotion ability (ANOVAR p=0.015), the 10 meter walk test (ANOVAR; p=0.002) and the 6 minutes walk test (trend). This project is the first attempt to adjunct a systematic LE component to intensive bimanual training. The proposed methodology demonstrates that this intervention can be useful for improving both upper and lower extremity function.

CHANGES IN GMFCS LEVELS MORE THAN 15 YEARS AFTER SELECTIVE DORSAL RHIZOTOMY OR ORTHOPAEDIC SURGERIES

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SCIENTIFIC BACKGROUND: There is a debate if the Gross Motor Function Classification System (GMFCS) is stable or GMFCS levels can change over time with interventions, such as Selective Dorsal Rhizotomy (SDR) and/or Orthopaedic (Orth) interventions.

AIM: To compare the GMFCS levels of patients with bilateral spasticity before and more than 15 years after ‘SDR+Orth’ or only ‘Orth’ interventions. A secondary aim was to determine if relationships existed between the change in GMFCS levels and personal characteristics.

METHODS AND SUBJECTS: Based on detailed clinical reports, pre-operative GMFCS levels were
retrospectively determined (blinded), compared, and discussed. Current GMFCS levels and personal characteristics, such as age, education, employment, marital and socio-economic status, were captured during a visit to the research unit. The study cohort consisted of 61 subjects of which 31 received ‘SDR+Orth’ (mean age: 28.7±5.5 years, range: 21-44 years) and 30 ‘Orth’ (mean age: 33.1±7.7 years, range: 19-47 years) during childhood in hospitals of Cape Town, South Africa. The mean follow-up time was 24.3±6.2 years.

RESULTS AND DISCUSSION: There was a significant difference between subjects’ GMFCS levels indicated before and more than 15 years after surgery (p< 0.001). Forty-six percent of the total study cohort improved at least one GMFCS level, while 5% deteriorated in function. The positive change was higher in the ‘SDR+Orth’ group compared to the ‘Orth’ group, with improvement seen in 58% and 33%, no change in 42% and 57%, and deterioration in 0 and 10%, respectively. The change in GMFCS levels was associated with current age, however this correlation was not very strong (r = 0.27, p=0.03). No other associations were found. In conclusion, GMFCS can change with surgical interventions such as SDR and/or orthopedic interventions over time.

DYNAMIC VS STATIC KAFO ORTHOSES IN THE TREATMENT OF KNEE FLEXION CONTRACTURES IN CHILDREN CP

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SCIENTIFIC BACKGROUND: Night time static positioning braces are recommended in the treatment of knee flexion contractures in cerebral palsy patients, but often not tolerated and quickly abandoned.

AIM: To compare the efficacy and the tolerance of static orthoses (ratchet KAFO) with dynamic orthoses (ULTRAFLEX KAFO) in the treatment of the knee flexion contracture in children with cerebral palsy.

SUBJECTS AND METHODS: This randomized, prospective, single center study included 30 children with cerebral palsy (age 11.2 years±4.2, 14 ambulant), presenting unilateral or bilateral knee flexion contracture greater or equal to 10° (in total: 48 legs, 24 dynamic & 24 static orthoses). The whole study was done without the use of botulinum toxin or serial casting.

Main assessment criteria: goniometric measurement of knee extension.

Secondary criteria: measurement of the popliteal angle, dorsiflexion of the ankle with knee extended, hamstrings and triceps surae spasticity level, orthoses’ tolerance and compliance.

Measurements were performed by the same physiotherapist for consistency at 1, 3, 6 and 8 months. The test of Student, adjusted with the method of Tukey (α'= α/√6) was used to compare groups at 6 and 8 months, with regard to inclusion.

RESULTS: Superior efficacy of the dynamic orthosis (both for ambulant and non-ambulant):
- For reduction of knee flexion contracture at 6 month (9.3° vs 2.8° ; p < 0.001), at 8 month (12.5° vs 3.5° ; p < 0.0001).
- For reduction of gastrocnemius contracture (p=0.0003) and reduction of the gastrocnemius spasticity (p=0.0003).
- Reduced hamstrings spasticity (p=0.0262).
- Orthoses tolerance (p=0.009).

DISCUSSION: The results of this study represent the first prospective comparative effectiveness evidence showing the superiority of dynamic versus static KAFO orthoses. Thus these orthoses should be a first line conservative intervention for dynamic and static hamstring and gastrocnemius contractures in children with cerebral palsy.

EFFECT OF TREADMILL GAIT TRAINING IN CEREBRAL PALSY CHILDREN

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AIM: to verify if treadmill gait training improves the gross motor function in children with cerebral palsy (CP).

METHODS and SUBJECTS: 18 children with CP were separated in two groups according to their Gross Motor Function Classification System (GMFCS) level: study 1 (GMFCS levels I/II; 9 children; mean age 9 years) and study 2 (GMFCS levels III/IV; 9 children, mean age 9 years). The studies had three phases: baseline, intervention (twice a week/25 minutes/ six consecutive weeks) and retention. At each phase, Gross Motor Function Measure (GMFM) and 10m Walk Test (WT) were applied. In the retention phase, a Satisfaction Questionnaire for parents was applied. ANOVA with repeated measures was applied (group X evaluation) to analyze the total sample of the two studies.

RESULTS and DISCUSSION: Study 1 showed positive changes in the scores of the GMFM in six participants and the WT-10m in five participants for normal speed and six for fast speed. The ANOVA indicated that there were not significant differences between the evaluations. Study 2 showed positive changes in the GMFM scores in seven participants and the WT-10m in seven participants for the normal speed and in six for the fast. The ANOVA showed no significant difference between evaluations. All the parents reported their children had improved walking. However, significant change was found in the motor function of the children with CP levels I/II and III/IV of GMFCS when the two groups were analyzed jointly.

Key Words: cerebral palsy, treadmill training, gross motor function, gait

CONCEPT FOR THE ORTHOTIC TREATMENT OF GAIT PROBLEMS IN CP WITH REGARD TO THE PATHOLOGICAL GAIT

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AIM: The presentation of a new concept for an orthotic treatment of patients with cerebral palsy. Choose the right orthosis by evaluating the patient using the Amsterdam Gait Classification. The NEURO SWING as new system ankle joint in an orthosis for CP.

CONTENT_1: For an effective orthotic treatment of patients with cerebral palsy choosing the right orthosis is essential. Since the orthosis influences the pathological gait, the latter needs to be the decisive factor in this choice. This requires a simple but adequate classification of the pathological gait of CP patients. In the development of the NEURO SWING system ankle joint that was designed, among other things, for the demands on treating CP patients, the Amsterdam Gait Classification turns out to be the optimal one.

CONTENT_2: For an effective orthotic treatment of patients with cerebral palsy choosing the right orthosis is essential. Since the orthosis influences the pathological gait, the latter needs to be the decisive factor in this choice. This requires a simple but adequate classification of the pathological gait of CP patients. In the development of the NEURO SWING system ankle joint that was designed, among other things, for the demands on treating CP patients, the Amsterdam Gait Classification turns out to be the optimal one.

CONTENT_3: For an effective orthotic treatment of patients with cerebral palsy choosing the right orthosis is essential. Since the orthosis influences the pathological gait, the latter needs to be the decisive factor in this choice. This requires a simple but adequate classification of the pathological gait of CP patients. In the development of the NEURO SWING system ankle joint that was designed, among other things, for the demands on treating CP patients, the Amsterdam Gait Classification turns out to be the optimal one.
THE IMPACT OF PAIN ON DAILY ACTIVITIES IN CHILDREN AND YOUTH WITH CEREBRAL PALSY

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Background/Aim: Children with CP experience pain that is under-diagnosed and under-treated. We aim to assess the impact of pain on restriction of daily activities. Secondary objectives include identifying common causes of pain and examining the concordance between clinician and parental reports of pain.

Methods: Children aged 3 to 19 years with CP were recruited from an ambulatory clinic in a rehabilitation facility. Caregivers were asked to complete a questionnaire regarding the presence/absence of pain and the impact of pain on activities (Health Utilities Index HUI/3 pain subset). A pediatrician documented their perception about the presence/absence of pain and the "clinical diagnosis" for pain if present. Cohen's Kappa was used to examine concordance between clinician and parental reports of pain.

Results: 204 children with CP were recruited (mean age 9.4±4.2 years, Gross Motor Functional Classification System (GMFCS) level I:24.8% II:13.4% III:19.8% IV:16.8% V:25.2%). Over 55% of parents reported their child experiencing pain in the last 2 weeks versus the clinician, who reported 41% having "clinically significant pain." 25.3% of parents reported their child experiencing pain severe enough to prevent at least some daily activities. Common causes of pain include hypertonia (9.9%), hip subluxation (7.3%) and constipation (4.2%). Amongst children with severe pain (HUI-3 IV & V), hip subluxation was the leading cause (21%). The clinician demonstrated fair agreement with parent-identified pain (K=0.44-0.45).

Discussion: There is a need for prompt identification of pain as 1 in 4 children with CP experience pain that interferes with their daily activities. Clinicians should seek parental or children’s input about pain as they are not always able to identify children experiencing pain. Hip subluxation—a preventable complication of CP—was the most common cause of severe pain. Potential causes of pain should be addressed early to reduce the negative impacts of pain on well-being and participation.

PAIN AND CP: HEALTH PROFESSIONALS’ ASSESSMENT AND TREATMENT AND THE RELATIONSHIP TO BELIEFS

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Scientific background: Studies suggest 86% of people with cerebral palsy experience chronic pain, interfering with daily living. Up-to-date knowledge about effective pain management is therefore important. Scant research exists describing the pain management practices of professionals working in cerebral palsy. Aim: This study aimed to identify cerebral palsy-specific: (1) pain assessment and management practices; (2) professionals’ knowledge about the prevalence, aetiology, severity and impact of pain; (3) knowledge of pain treatments and endorsement of what is used.

Subjects and Methods: Previous delegates of AusACPDM and International Cerebral Palsy Conference were invited to complete an anonymous, online, investigator designed survey. n=240 health professionals volunteered (n=210 female, response rate 20%). Respondents were physiotherapists (47%); occupational therapists (25%); doctors (12%); speech pathologists (8%); and others (8%). Frequency statistics were used to analyse findings.
Results and Discussion: Most professionals grossly underestimated the prevalence of pain and almost never referred patients to pain specialists (3%). Most professionals had not received training in cerebral palsy-related pain management (77%), but usually conducted pain-screening (63%) and offered pain interventions (76%). The most common pain management options recommended were: therapy (47%); anti-spasticity medications (42%); and over the counter medications (24%). Interestingly, evidence-based pain management interventions used in other populations were infrequently recommended for cerebral palsy, including: neuropathic pain medications (31%); prescription pain medications (33%); and cognitive behaviour therapy (CBT) (55%). Endorsed pain interventions included: therapy (85%); mobility exercises (78%); hydrotherapy (76%); baclofen (75%); botulinum toxin (74%); strengthening (70%); massage (69%); paracetamol (60%); heat/ice (60%); anti-inflammatories (65%); and muscle relaxants (60%). Professionals had low knowledge about pain prevalence and evidence based pain management options, yet regularly provided pain management. It is likely that the breakdown of respondents was similar to standard clinical practice and therefore it may be helpful for comprehensive evidence-based pain management information to be available to therapists.

PAIN EXPERIENCE IN CHILDREN RECEIVING BOTULINUM TOXIN A INJECTIONS FOR HYPERTONIA TREATMENT.

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Scientific background: Botulinum toxin (BoNT-A) injections in children are stressful but the extent to which they perceive pain during and after the procedure without sedation is unclear.

Aim: The purpose of this study is to describe observed and reported pain associated with BoNT-A treatment in children and youth and to explore relationships with age, cognitive status and the number of injections.

Methods and subjects: Fifty eight consecutive children (median age 9y9m, range 2y8m to 17y11m; 31males) treated for hypertonia at our tertiary level spasticity clinic were recruited in this prospective observational study. All participants received BoNT /A treatment in the outpatient clinic setting in a non-sedated fashion. The number of injected muscles ranged from 1-10 with up to 16 skin punctures per treatment session.

Pain was assessed by using the FLACC scale in all patients. The Wong Baker FACES Pain Rating Scale was used in children who were able to self-report on their pain (n=37). Relationship of age, cognitive status and number of injection with perceived pain was investigated by regression analysis. Statistical significance for all analyses was set at p ≤ 0.05.

Results and discussion: FLACC scores ranged from 0 to 10, with a median of 7. FLACC scores were statistically significantly correlated with age (p <0.05) with the younger children showing more signs of distress. The FACES scale ranged from 0-10 with median of 6. Ten out of 37 (27%) children reported their experienced pain as minimal (FACES score 0-3). FLACC and FACES scores were not statistically significant correlated with number of injections or cognitive status.

Conclusion: We found great variability in observed and reported pain in children during injections with BoNT-A without sedation independent of the number of injections. Our findings may justify non-sedated BoNT-A treatment for some subjects while other children can benefit from sedation.

CONCERNS ABOUT ASSESSMENT AND TREATMENT OF POSTOPERATIVE PAIN IN CHILDREN WITH CEREBRAL PALSY

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Scientific Background: Appropriate pain control after orthopedic surgery for children with cerebral palsy (CP) is challenging; inherent communication problems, cognitive deficits, and lack of verbal skills that are common in many of these patients make it difficult for caregivers to adequately assess pain.

Aim: The purpose of this study is to investigate the assessment of postoperative pain in children with CP undergoing orthopedic surgery. Specifically, the study will address how complete and how accurately the nursing staff documents pain scores in children with CP compared to normal controls.

Methods and Subjects: This is a retrospective review of all children with CP over ten years undergoing orthopedic surgery at a tertiary-care pediatric hospital. The primary end point of the study was the documentation of pain by use of standard pain scores at standard time points. Data was compared to an age-matched cohort of normal children undergoing orthopedic surgery for scoliosis. Chi-squared analyses were utilized to statistically compare differences between the groups (significance at p<0.05).

Results and Discussion: 169 patients with CP (mean age 11.2) were compared to an age-matched Control group. In the CP group, pain scores were completed only 60% of the time, compared to 81% in the Control group (p<0.00001). Furthermore, a disproportionate number of pain scores for the children with CP were rated as “0,” meaning that the nurses perceived no pain whatsoever. In the CP group, the % of time that the pain scores were documented as “0” was 75%, compared to 49% in the Control group (p<0.00001). Nurses adequately completed pain assessments for children with CP significantly less often than in normal controls. This data suggests the possibility of severely under/treating postoperative pain in this patient population. Additional studies are imperative to to improve our pain assessment tools and improve the care we provide these children.

MEDICAL CLOWNING IS EFFECTIVE IN REDUCING PAIN IN CHILDREN WITH CEREBRAL PALSY UNDERGOING BOTULINUM

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Scientific background: Children with cerebral palsy (CP) undergo multiple painful procedures such as Botulinum toxin (BTX) injections that are administered several times a year. While clown care reduces preoperative anxiety, its effect on painful procedures has not been assessed.

Aim: We hypothesized that medical clowning reduces pain during BTX injections.

Methods and subjects: We enrolled 32 children with CP who underwent BTX injections (mean age 6 years 8 months, SD 4 years 6 months; 23 boys). Each child was randomly assigned to receive either clown care (study) or standard care (control) intervention. Outcome measure was the Visual Analogue Scale (VAS) as reported by the child (n =17) or parent (n =15) prior and subsequent to each procedure.

Results and discussion: Whereas similar pain was anticipated prior to BTX injections, subsequently less pain was reported for children undergoing the procedure with clown care compared to standard care (p <0.001). While all children undergoing BTX with standard care reported severe pain (VAS≥4), the majority of children receiving clown care experienced lower pain levels (VAS<4, p < 0.001).

Medical clowns have the potential to alleviate pain during BTX injections and provide a non-invasive method for coping with discomfort during needle intervention in children with physical disabilities.
GROUP 23–COGNITION

PREDICTING RESPONSE TO DYSARTHRIA THERAPY BY CHILDREN WITH CEREBRAL PALSY

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Background: An intensive approach to speech therapy that focuses on breath support, phonation and speech rate has been shown to increase the speech intelligibility of children with dysarthria and cerebral palsy (CP). Aim: To investigate the possible associations between characteristics of children with CP and dysarthria and therapy outcome.

Subjects and methods: Data from two intervention studies were amalgamated for this exploratory study. 31 children with CP and severe dysarthria (M=15, F=16) received three sessions of therapy per week for six weeks. Predictor variables related to children’s engagement in therapy, age, gender, type and severity of motor disorder, pre-therapy severity of motor speech disorder and length of utterance. Therapy outcome was measured in change in percentage intelligibility one-week pre to one-week post therapy in four linguistic and listener conditions: single words (SW) and connected speech (CS) rated by familiar (FL) and unfamiliar listeners (UL). ANOVA and step-wise linear regression were used to analyse the data.

Results and Discussion: The best predictor of change in intelligibility was children’s pre-therapy intelligibility score. Children with lower pre-therapy intelligibility were found to show greater change in intelligibility (SWFL, t(26)=−4.814, p<0.001; CSFL, t(25)=−3.337, p=0.003; SWUL, t(26)=−4.246, p<0.001; CSUL, t(25)=−3.602, p=0.001). Age was inversely associated with change in intelligibility in connected speech rated by familiar listeners (t(25)=−2.065, p=0.049). Children without concomitant difficulties, e.g. language impairment, showed more change in intelligibility (e.g. for SWFL mean length utterance, t(26)=2.088, p=0.047). Findings provide tentative support the provision of early intervention where possible. It was also suggested that the processing resources available for targeted motor learning may be overtaxed in children with more severe motor involvement. Further research is required on larger cohorts of children to enable the generalisation of findings to the broader CP population and clinical context.

HIGHER-ORDER EXECUTIVE FUNCTION SKILLS AMONGST CHILDREN WITH CONGENITAL HEMIPLEGIA

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Scientific background: Early brain injury, as in congenital hemiplegia (CH), can cause deficits in higher-order cognitive tasks known as executive functions, which can disrupt normal development by impeding the child’s ability to effectively interact with their environment and acquire new skills.

Aim: The aim of this study was to investigate executive functioning in children with congenital hemiplegia.

Subjects and methods: A cross-sectional cohort of forty six children with CH (25 male; mean age 11.08 (SD 2.38), range 8-16 years, including 24 right (R), 22 left (L) CH; GMFCS I=35, II=11) and twenty typically developing children (TDC; 9 male; mean age 10.8 (SD 2.29), range 8-16 years) were included. Four domains of executive function were assessed: attentional control; cognitive flexibility; goal setting; and information processing utilising neuropsychological assessments. Between-group differences (CH vs. TDC and R vs. L) on measures of EF were examined in a series of one-way analyses of covariance. An overall composite of EF measures was created by standardising and aggregating all measures, α = .93.

Results and discussion: Children with CH performed significantly poorer on measures of executive functioning compared to TDC (aggregate executive function: F(1,63) = 31.16, p < .001, η2 = 0.33). There were no significant differences between children with left and right CH on all measures, with the exception of Inhibition/ Switching total errors, where children with left CH made fewer errors than children with right CH, F(1, 39) = 4.14, p = 0.049, η2 = 0.1. Overall, children with CH experience more executive dysfunction.
compared to TDC, irrespective of side of hemiplegia. Findings from this study support an early vulnerability model of early brain injury and are in line with recent literature documenting the detrimental effects of early brain injury on EF. This has profound implications for the planning of interventions and monitoring of child development.

LANGUAGE COMPREHENSION IN YOUNG PEOPLE WITH SEVERE CP IN RELATION TO LANGUAGE TRACTS: A DTI STUDY


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**Background:** People with severe cerebral palsy (CP) possibly have better language comprehension than their speech ability would suggest. Because of severe physical and speech impairments, assessment of language comprehension is difficult. However, early estimation of language comprehension is important for intervention of communication abilities. The arcuate fasciculus, an important language tract between Wernicke’s area and Broca’s area, is assumed to be crucial for language comprehension.

**Aim:** To visualize the arcuate fasciculus in people with severe CP.

**Methods:** In five control children (10-18 years) and in five people with severe CP (5-23 years) we visualized the arcuate fasciculus in both hemispheres with diffusion tensor imaging (DTI) at 1.5T, with 2.5mm isotropic voxels. Tractography was performed using FMRIB software library (FSL) (Smith et al., 2004). Masks of the superior temporal gyrus (Wernicke’s area) and inferior frontal gyrus (Broca’s area) were obtained from an anatomical atlas. Tracts between these masks were calculated and tract size and fractional anisotropy (FA) were measured to define strength of the tract. For comparison tractography of the pyramidal tract was performed as well.

**Results:** The arcuate fasciculus was visualized in all control children. Tract size was between 1251 and 4219 pixels, FA ranged between 0.32 and 0.41. In four people with CP, the arcuate fasciculus could be visualized. Tract size varied between 160 and 2672 pixels and FA between 0.28 and 0.47. In one child with CP with absence of language and communication abilities, the arcuate fasciculus could not be visualized.

**Conclusion:** Visualization of the arcuate fasciculus with DTI is possible, even in most people with severe CP and alleged poor language comprehension. Further research is necessary to study the value of this language tract for the development of language comprehension and communication abilities in children with severe CP.

VISUO-COGNITIVE PROFILE DISTRIBUTION IN CHILDREN WITH CP: EVIDENCE FROM THE LITERATURE


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Visual perception (VP) is one of the cognitive functions often impaired among CP children.
The aim of this systematic literature review is to assess its frequency and the relationship between visual perceptual impairment (VPI) and children characteristics. Selection of relevant information involved neuropsychologists and neuropediatricians located in three countries (France, Germany, Italy). Search of relevant papers consisted of an appropriate use of filter and MESH terms. Articles published since 1990, aimed at assessing VP according to 6 well-known neuropsychological tests, in CP children, aged 5-15 years, with an IQ≥50, were examined. Thirty eight articles were selected, only 7 were considered for analysis.

Three studies using the Developmental Test of Visual Perception reported a VPI rate ranging from 13% to 50%, among 3 Italian or Japanese preterm-born samples of 20 to 25 children with spastic diplegia. In a comparable sample, the score of the WISC-R Picture Completion task was significantly impaired. The other 3 studies recruited larger samples of 52 to 68 children, with different forms of CP, in Belgium, The Netherlands and Taiwan. The first reported a VPI rate of 40% with the visual/perceptual battery L94, the second mean IQ scores of the Raven’s Coloured Progressive Matrices of 86.6 (±20.9) and 81.4 (± 18.1) at 5 and 7 years, and the last one a mean total scale of the Test of Visual-Perceptual Skills-Revised of only 50.9 (± 26.5).

A specific link between VPI and spastic subtype was described, as well as a relationship with strabismus, visual field defect, and neuroradiological data. The influence of prematurity and seizures was controversial. Despite the heterogeneity, the lack of power and representativeness of these papers, this review shows consistent results about the presence of VPI among children with CP. Its prevalence and the role of confounding factors associated with CP need further research.

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WHICH COGNITIVE AND MOTOR AFFECT THE EARLY NUMERACY PERFORMANCE OF CHILDREN WITH CEREBRAL PALSY?

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Knowledge on the cognitive development, especially the early numeracy, of primary-school children with a cerebral palsy (CP) is remarkably limited. We aim to investigate the influence of motor and cognitive capacities on the early numeracy performance in children with a CP. Domain-general (non-verbal intelligence and working-memory) as well as more specific cognitive skills (e.g. word knowledge) will be included in the analysis to be able to compare the relative influence of these factors.

52 five/year/old children diagnosed with CP who were enrolled in special education participated. Standardized tests were administered to assess early numeracy performance, non-verbal intelligence, verbal and visual/spatial working memory, word knowledge and fine motor skills. Subitizing, which is the ability to identify the quantity of a certain amount of items that are presented in a time period that is too short to make counting possible, was assessed with an experimental task. Structural equation modeling (SEM) was used for the analysis.

Our SEM model showed that fine motor skills and non-verbal intelligence were significantly related to early numeracy capacities. The verbal and visual/spatial working memory tasks could be combined to construct a working memory factor. Working memory and subitizing were both associated with early numeracy performance. Word knowledge was, however, not related with early numeracy capacities. In general, subitizing had the strongest association with early numeracy performance.

This study shows that both motor (fine motor skills) and cognitive (non-verbal intelligence and working memory) factors are related to the early numeracy capacities of primary school children with CP. Importantly, especially subitizing was strongly associated with early numeracy performance. In sum, basic numerical capacities are necessary for more advanced arithmetic development in children with CP.
GROUP 24 – RHIZOTOMY AND ITB

MOTOR FUNCTION AFTER SELECTIVE DORSAL RHIZOTOMY, A 10-YEAR PRACTISE BASED FOLLOW-UP STUDY

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Scientific background: Selective Dorsal Rhizotomy (SDR) combined with physiotherapy has previously been shown to improve motor function in short term follow-up studies.

Aim: The aim of this study was to explore changes in motor function up to 10 years after SDR.

Subjects and method: Twenty-nine children were included, 20 males and nine females, with bilateral spastic diplegia who were consecutively operated on at a median age of 4 years and 3 months and followed until a median age of 15 years. The distribution of preoperative Gross Motor Function Classification System (GMFCS) levels was as follows: I, n=1; II, n=7; III, n=8; IV, n=12; and V, n=1. SDR was combined with goal-directed physiotherapy at local habilitation centres and regular follow-up visits at the Children’s hospital in Lund, Sweden.

Muscle tone in hip flexors, hip adductors, knee flexors, and plantar flexors was assessed with the modified Ashworth scale, passive range of motion in hip abduction, popliteal angle, maximum knee extension, and dorsiflexion of the foot was measured with a goniometer and gross motor function was assessed using the Gross Motor Function Measure (GMFM/66). The results were compared with preoperative values, taking into account age at the time of SDR.

Results and discussion: After 10 years, muscle tone was low/not increased in 19, 24, 13 and 23 participant respectively compared to preoperatively (p<0.001), mean change in passive range of motion ranged from -2.0° to 8.6°, and the mean increase in GMFM-66 score (SD, SEM) was 10.6 (11.8, 0.57). Changes in GMFM-66 scores were associated with preoperative GMFCS levels and GMFM-66 scores (p<0.05).

Ten years after SDR, combined with physiotherapy, muscle tone was normalized and mean passive range of motion was unchanged. Mean capacity of gross motor function was increased and the long-term changes in gross motor function were associated with preoperative GMFCS levels.

EFFECTIVENESS OF SELECTIVE DORSAL RHIZOTOMY IN ADOLESCENTS/YOUNG ADULTS WITH CEREBRAL PALSY

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Background/Aims: Selective dorsal rhizotomy (SDR) is a procedure performed to improve function in patients with spastic cerebral palsy (CP). Traditional indications for this procedure include borderline ambulators between the ages of 3 and 8 without rigidity, dystonia, athetosis and ataxia. Recent literature studying outcomes of SDR indicate a decline in gait and function when SDR is performed in the adolescent population. However, there is no data on pain, tone, range of motion (ROM) or quality of life. The purpose of this study is to assess whether SDR improves these outcomes in adolescents/young adults with CP.

Methods/Subjects: 18 patients with CP who underwent SDR were retrospectively identified (spastic quadriplegia n=9, spastic diplegia n=9, age range at surgery 13-27, male n=10, female n=8, GMFCS Class I n=1, GMFCS Class II n=3, Class III n=4, Class IV n=4, Class V n=6) through chart review. Patients were assessed preoperatively and postoperatively for tone (modified Ashworth scale), ROM (goniometer) and patient-based outcomes (Rehab Institute of Chicago Care and Comfort Caregiver Questionnaire, RIC-CCCQ) as part of standard of care.

Results/Discussion: To date, 14 patients have at least 1 year of follow up (range 12-37 months). Analyses show a statistically significant decrease in tone involving the hip and knee flexors and extensors, hip
adductors, and plantar flexors (p<0.05) after SDR. Nine patients (64.3%) complained of pain preoperatively, and 2 patients (14.3%) complained of pain at follow-up. Analysis of ROM and responses to the RIC-CCCQ did not show statistical significance. Initial results of adolescents/young adults undergoing SDR show a reduction in tone after one year of follow-up. In addition, SDR decreased self-reported pain in this population. Despite this procedure being performed for functional purposes in the pediatric population, initial results suggest pain and tone reduction should be an additional consideration for performing SDR in an older population.

THE RESULTS OF COLLABORATIVE STUDY MUNDYS ON ITB

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SCIENTIFIC BACKGROUND
Despite advances in neonatology, children with infantile cerebral palsy (ICP) still represent a significant burden for hospitals, physicians and caregivers. Intrathecal Baclofen Therapy (ITB) is an efficacious and safe choice for treatment of ICP. In Italy there are few centers specialized in ITB pump implantation in children and this situation reduces the availability of ITB therapy. Furthermore, many patients are evaluated with delay and consequent worse results in the control of spasticity.

AIM OF THE STUDY
Aiming to improve the access of ICP patients to ITB therapy, in 2010 the Multidisciplinary Network for Dystonia and Spasticity in Children (MUNDYS) has been organized under the leading guide of the Department of Neurosurgery of Anna Meyer Pediatric Hospital, Firenze.

MATERIALS AND METHODS
All the centers of with good expertise on ICP treatment located in Central Italy have collected and shared their own surgical experiences. The main centers partecipating to the study were: IRCCS Stella Maris Calambrone (Pisa), Policlinico Gemelli Roma, Ospedale Bambino Gesù Roma, Pediatric Rehabilitation of Ancona and Perugia Hospitals.

RESULTS
One hundred and eight ICP patients operated on for ITB pump implantation and receiving ITB therapy have been included and classified according to a standardized database. The resulting retrospective study has confirmed the efficacy of ITB therapy both for control of spasticity and pain and for parents’ satisfaction despite the surgical morbidity is still significant (about 20%).

EFFECTS OF INTRATHecal BACLOFEN ON DAILY CARE IN CHILDREN WITH SECONDARY GENERALIZED DYSTONIA

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Scientific background: Despite the fact that dystonic movements in cerebral palsy (CP) can be very disabling, treatment options are limited.
Aim: The aim of our study was to determine whether intrathecal baclofen treatment (ITB) improves activities of daily care, decreases dystonia and decreases pain in patients with dystonic CP and furthermore to determine if a more extensive study is justified.

Methods and subjects: Patients selected for ITB test treatment, aged between 4 and 18 years old, with severe generalized dystonia, Gross Motor Function Classification System level V, resulting in problems concerning daily care, were included if they, and their parents, were motivated and able to complete the whole study protocol. The design of the study was a placebo controlled case study. After not-blinded ITB test treatment, patients received randomized blinded treatment with ITB or placebo. The primary outcome measure were individual problems of daily care. Secondary outcome measures were dystonia, pain and comfort. Measurements were done at baseline, at the last day of test treatment and at the last day of blinded treatment.

Results and discussion: Four patients (mean age 12.5 year) were included. Problem scores decreased with 4.7 points and dystonia scores decreased with 72% during ITB treatment. Complications occurred in all patients (CSF leakage, infection).

Even though complications are a concern, patients and parents were still satisfied with the treatment and all continued with pump implantation. Despite the limitations of our pilot study, we think the results supports the suggestion that ITB might be effective in the treatment of generalized dystonia in CP patients. Furthermore we think the results of this study justify a more extensive study into the effects of ITB on problems of daily activities and daily care in dystonic cerebral palsy patients.
BIMANUAL SKILLS AND THE CORPUS CALLOSUM- BRAIN BEHAVIOR RELATIONSHIPS IN CHILDREN WITH EMPILEGIA

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Scientific Background:
Motor therapies have been shown to have positive effects on motor function for many but not all children with hemiplegia (CH).

Aim: Currently, little is known about brain perfusion in CH and effects of rehabilitative intervention. This work investigated relationships between hand function, perfusion and white matter (WM) integrity in children with hemiplegia before and after hand-arm bimanual intensive therapy (HABIT).

Methods:
Twelve CH (7 males, mean age 11±3 y) were included. Children underwent MRI scans performed before, after a 2-week HABIT camp and at 2-month follow-up. Three children acted as controls over the 2-week interval followed by a less intensive 6-week therapy programme. Scans were performed on a 3T GE scanner and included 3D anatomical image, diffusion tensor imaging and perfusion (3D pseudo-continuous arterial spin labeling).

Behavioural assessment included the Assisting Hand Assessment (AHA), Children's Hand Experience Questionnaire (CHEQ) and Jebsen Taylor Test of Hand Function (JTHF). Repeated measures ANOVA considered main effects of treatment.

Perfusion measurements were performed on the defined volumes of interest: primary motor area, supplementary motor area (SMA) and corpus callosum (CC). These measurements were contrasted between children who made significant progress on the AHA and those that did not.

Results:
Significant effects of treatment were seen on the AHA (p=0.02) and JTTHF (p=0.004) and a trend evident on the CHEQ (p=0.067).

Significant correlation was detected between the SMA perfusion values and AHA score at initial assessment (r=0.9, p=0.04). Children who made significant progress on the AHA were seen to have higher fractional anisotropy values across the genu (p=0.04), midbody (p=0.02) and splenium (p=0.006) of the CC than those who did not.

Discussion:
Several imaging biomarkers were detected, correlating with clinical and behavioral assessments and change in performance on the AHA. Advanced imaging methods may provide clinically relevant data for children presenting with hemiplegia.

MOTOR CORTEX REPRESENTATIONS EXPAND AFTER BIMANUAL TRAINING IN CHILDREN WITH HEMIPLEGIA

Scientific Background: The neural bases of functional improvements induced by intensive bimanual training in children with hemiplegic cerebral palsy (CP) are unknown.

Aim: To assess changes in the organization of the corticospinal system in children with hemiplegic CP after intensive bimanual training, using transcranial magnetic stimulation (TMS).

Methods and Subjects: Children (n=13, ages 6.5-14) participated in Hand-Arm Bimanual Intensive Therapy (HABIT) 6 h/day, 5 days/week, for 3 weeks. We used single-pulse TMS and EMG recordings of arm and hand muscles to map the arm and hand representation in motor cortex (M1) bilaterally before and after HABIT.

Results and Discussion: Hand function improved after HABIT and was maintained at six months (Jebsen-Taylor Test of Hand Function, p<0.001). At baseline, we determined which side of M1 controlled the impaired hand. In seven children, motor evoked potentials (MEPs) in the impaired hand were produced by TMS to ipsilateral M1, indicating that ipsilateral pathways from unaffected M1 can be important in motor control. In two children, MEPs in the impaired hand were elicited by TMS to contralateral M1, while in four children, TMS to both hemispheres elicited MEPs in the impaired hand. We examined M1 map changes after HABIT. The representation of the affected hand remained in the hemisphere(s) in which it was found before training. The size of the cortical representational area of the affected hand increased after HABIT. There was a significant increase in the digit map area (p<0.05) and area controlling both digit and wrist movement (p<0.05). Map expansions were maintained six months post-HABIT. Intensive bimanual training results in long-lasting improvements in manual skill. Like behavioral improvement, stronger motor map was maintained six months post-HABIT. These results indicate a lasting change in motor system physiology that is independent of which cortex controls movement in the impaired hand.

fMRI IMAGING AS PREDICTOR OF EFFICACY OF CONSTRAINT-INDUCED THERAPY IN HEMIPLEGIC CHILDREN

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Background. Constraint-induced movement therapy (CI MT) is a promising intervention for reducing impairment and improving the functional use of an affected upper limb in children affected by congenital and/or acquired hemiplegia.

Objective. Resting state (RS) functional MRI (fMRI) and diffusion tensor (DT) MRI were applied to evaluate the short-term structural and functional brain changes following CIMT in children with hemiplegia. We studied MRI predictors of clinical improvement after the treatment.

Methods. Brain dual-echo, DT MRI and RS fMRI sequences in 16 children with hemiplegia and 10 sex- and age-matched healthy controls were acquired at baseline, at the end of CIMT (10 weeks) and after 6 months. QUEST and BESTA clinical scale scores were obtained. From DT MRI, fractional anisotropy (FA), mean diffusivity (MD) and tensor values were measures in the lesion, in the affected and unaffected corticospinal tract (CST), and corpus callosum (CC). The sensorimotor RS network was identified using the independent component analysis and the GIFT software. Differences between groups in demographic, clinical variables and MRI variables were assessed using the Fisher exact test or the Mann Whitney U test, for categorical and continuous variables.

Results and discussion. At baseline, patients had abnormal DT MRI metrics in the symptomatic lesion, the affected CST and the CC. Reduced functional connectivity (FC) at rest was found in the bilateral
cerebellum, right precentral gyrus, and right secondary sensorimotor cortex (SII). At week 10, an improvement at QUEST and BESTA was observed, which remained stable after 6 months. The MRI predictors of clinical improvement at week 10 were baseline average lesion fractional anisotropy ($r^2=0.50$) and right SII FC ($r^2=0.10$); and at month 6 they were baseline CC axial diffusivity ($r^2=0.44$) and right SII FC ($r^2=0.58$).

DT MRI and RS fMRI offer promising and objective markers to predict clinical outcomes following CIMT in children with hemiplegia.

**RANDOMIZED TRIAL OF HOME-BASED CONSTRAINT-INDUCED MOVEMENT THERAPY COMBINED WITH INTENSIVE THERAPY**

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Scientific background:
In children with unilateral cerebral palsy (CP), evidence for modified constraint-induced movement therapy (m-CIMT) is growing, though the question rises whether the effects of m-CIMT could be enhanced by combining it with other therapy approaches.

Aim:
In this study, the effects of home-based m-CIMT with and without an intensive therapy program to promote hand function were investigated in children with unilateral CP.

Methods and subjects:
Fifty-one children (mean age 8 years 9 months) were randomized into an m-CIMT and m-CIMT + intensive therapy (IT) group. All children had to wear a constraint at the unaffected hand during one hour for five days per week over a period of 10 weeks. Children in the m-CIMT+IT group received supplementary three sessions of 45 minutes weekly of intensive therapy on distal muscle strength and hand function. The Assisting Hand Assessment (AHA) was the primary outcome measure. Secondary outcome measures were muscle tone, manual muscle strength, grip strength, Melbourne Assessment of Unilateral Upper Limb Function, Jebsen/Taylor Test and Abilhand/Kids. Assessments were administered at baseline, after intervention, and at 10 weeks follow-up.

Results:
Results showed significant between-group differences for the AHA in favour of the m-CIMT+IT group ($p=0.04$). Also a trend for more increase in the m-CIMT+IT group was found on the Jebsen-Taylor test ($p=0.07$). Both groups demonstrated comparable improvements in muscle tone ($p=0.002$), muscle strength ($p<0.0001$), grip strength ($p=0.02$), and unimanual capacity (Melbourne Assessment and Jebsen-Taylor, $p=0.0001$). Younger children and children with poorer hand function benefited from both interventions, whereas older children and children with better hand function only benefited from the combined approach.

Conclusion:
An m-CIMT programme in the home situation seems a clinically feasible and promising therapy application for improving unimanual function in children with unilateral CP. An intensive therapy program for distal hand function might additionally enhance bimanual performance.
EFFECTIVENESS OF BOOSTER CIMT-BIT FOR CHILDREN AND ADOLESCENTS WITH UNILATERAL UPPERLIMB PARESIS

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Scientific background
Modified constraint induced movement therapy combined with bimanual training (mCIMT-BIT) has proven its effectiveness; an 8 weeks-program of intensive unilateral upper extremity(UE) training (e.g. Pirate group) may not be feasible for every age group.

Aim
For adolescents with unilateral UE paresis who cope with problems performing bimanual daily activities, intensive UE training during several weeks may be no option when the school program prevails. We conducted a pilot study to evaluate whether a one-week booster session of 15 hours mCIMT combined with 25 hours BiT is effective in adolescents with unilateral Cerebral Palsy (CP) or Obstetric Plexus Brachial Lesion (OPBL).

Methods and subjects
Fourteen subjects, mean age 11.3 (8.2-17.5) years participated. All had some form of UE-training before. Twelve subjects had unilateral CP (MACS I:n=3, MACS II:n=8, MACS III:n=1) and two had OPBL. They were measured at baseline as well as one week and four months post intervention. Primary outcomes were ABILHAND-Kids and COPM. Secondary outcome measures were the children’s hand-use experience questionnaire (CHEQ) and the Box and Block test. We used t-tests to compare post-intervention results with baseline. Pre/post intervention effect sizes were calculated using Cohen’s d-value.

Results and discussion
Compared to baseline there were significant improvements on all outcome measures. Effect sizes were large, except for the Box and Block test (affected hand d=0.47). The largest effect sizes were found for the COPM-performance and COPM-satisfaction (d=3.52 and 4.18, respectively). The effect size for the ABILHAND-Kids was good (d=0.84). The first results of this pilot study indicate that a one-week booster session of 40 hours mCIMT-BiT can have beneficial effects on both qualitative and quantitative aspects of affected UE use in children and adolescents with unilateral CP or OPBL. Participants and parents were satisfied with the improved bimanual hand use in daily activities.

GROUP 26 – HIPS & SPINE 3+QoL 2

INFLUENCE OF HIP LUXATION ON HEALTH RELATED QUALITY OF LIFE (HRQOL) IN CHILDREN WITH CEREBRAL PALSY

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Scientific background: Lateralisation of the hip in children with cerebral palsy (CP) depends on motor impairment and varies from moderate impairment to severe pain and less is known from children with CP and hip lateralisation and its influence on health related quality of life (HRQL).
Aim: The aim of the present study was to evaluate the influence of hip lateralisation on HRQL in children with CP via the Caregiver Priorities and Child Health Index of Life with Disabilities (CP-CHILD) questionnaire.

Methods and subjects: We investigated 35 patients (mean age: 10.11 ± 4.94 years; w: n=18) with bilateral cerebral palsy and Gross motor function classification system (GMFCS) Level III-V. Caregivers (w=32; m=3; mean age 41.31 ± 8.07 years) were asked to rate quality of life via the CP-CHILD questionnaire. Hip lateralisation was measured by Reimers migration index (MI). According to the CP and hip surveillance program in Germany (www.cp-netz.de), patients were divided into a group with a high (MI>40%), medium (MI 25% to ≤40%) and low (MI <25%) risk to develop progressive hip lateralisation.

Results and discussion: Seven patients had GMFCS level III, n=15 level IV and n=13 level V. 57.1% of patients with GMFCS Level III had a MI >40%, 13.3% with GMFCS Level IV and 30.8% with GMFCS Level V. Two-way ANOVA revealed significant main effects of GMFCS (F[2;26]=7.361; p=0.003) and MI (F[2;26]= 5.807; p=0.008) on CP-CHILD total score but not for the interaction of both GMFCS*MI (F[4;26]=0.077; p=0.989). Post-hoc testing exposed significant differences in total scores between GMFCS level III and V (p=0.019) and GMFCS level IV and V (p=0.022) as well as between MI<25 and MI>40 (p=0.022). We demonstrated a significant influence of the lateralisation of the hip on HRQL beside the GMFCS. Our results support the need of an appropriate prevention and therapy of hip lateralisation in children with CP.

QUALITY OF LIFE IMPROVES AFTER SPINAL DEFORMITY CORRECTION IN CHILDREN WITH NEUROMUSCULAR DISEASE

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Background/Aims: The treatment of scoliosis in the patient with neuromuscular disease (NMD) is complex and fraught with conflicting considerations. Previously, patients with early onset scoliosis (EOS) needing surgical correction were treated with spinal arthrodesis. This has since been shown to worsen the progressive reduction of thoracic volume. As a result, growth-friendly constructs such as growing rods and the vertical expandable prosthetic titanium rib (VEPTR) were developed. The purpose of this study is to examine whether growth-friendly constructs correcting spinal deformity in children with neuromuscular disease improve patient quality of life and parental burden.

Subjects and Methods: The caregivers of twenty-five patients with neuromuscular disease (cerebral palsy n=5, spinal muscular atrophy n=7, neurofibromatosis n=7, muscular dystrophy n=5, Steinart’s syndrome n=1, male n=13, female n=12). The caregiver of each patient was given the EOSQ questionnaire preoperatively and before the first and second scheduled lengthening. The domains encompassed by EOSQ include General Health, Pain, Pulmonary, Transfer, Physical, Daily Living, Fatigue, Emotion, Parental, and Financial. The scores of each questionnaire were calculated and analyzed.

Results and Discussion: There were statistically significant improvements in EOSQ scores after the first lengthening for NMD patients undergoing either growing rods or VEPTR implantation in the following domains: General Health, Pulmonary, Physical, Fatigue, Emotion, Parental, and overall score. Following the second lengthening there was a statistically significant improvement in the Parental domain while all other domain scores were maintained. Our study showed that preoperative patient-based quality of life and caregiver burden is maintained or improved when neuromuscular patients are treated with growth-friendly spine constructs. This represents a beneficial change in the natural history of neuromuscular disease and provides additional evidence for the use of this treatment modality. The study is ongoing to further compare the effectiveness of different spine constructs along with other surgical and non-surgical treatments.
GAIT OUTCOMES ASSESSMENT LIST: DEVELOPING A MEANINGFUL OUTCOME MEASURE FOR AMBULATORY CEREBRAL PALSY

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Scientific Background: Ambulant children with cerebral palsy (CP) often undergo interventions for abnormal gait and associated functional limitations. The effectiveness of these interventions should be based on outcome measures that reflect their goals and expectations.

Aim: Define the priorities of children with ambulatory CP and their parents, in order to develop a comprehensive goal based outcome measure of interventions for ambulatory CP.

Participants & Methods: Qualitative interviews of 15 boys and 7 girls with CP (GMFCS I-III) & their parents, from 3 children's rehabilitation hospitals, generated 60 gait related priorities. 10 other children & their parents rated the importance of each, producing a modified list of 49 items, across 6 domains:(1) Activities of Daily Living/Independence;(2)Gait Function/Mobility;(3)Comfort/Endurance;(4)Physical Activities/Recreation;(5)Gait Appearance;(6)Body Image/Self esteem, and called the Gait Outcomes Assessment List (GOAL). Prior to a gait intervention, 12 children & their parents rated the importance of each goal in their decision to undergo an intervention.

Results: Items received a full range of importance scores (0-5) from children and parents. 27/49 items were rated > 3/5 (>fairly important) but only 12 of these were common to both. Although individual parents and children differed, there were no significant differences between overall children’s and parent’s priorities. The domains of Gait Appearance (mean 3.7 vs 3.6) & Gait Function (3.6 vs 3.3) were rated most important by children and parents respectively, greater than Comfort/Endurance; Physical Activities/Recreation; and ADLs.

Discussion: All 49 items of the GOAL are important to at least some ambulant children with CP, and their parents. Individuals' priorities vary significantly. There were no significant differences between global children's and parental priorities. A purposeful sample of international healthcare professionals & researchers across multiple disciplines have been surveyed about the GOAL for face and content validation, and further modification prior to formal psychometric testing of the GOAL Questionnaire.

OUTCOME OF SURGICAL TREATMENT IN 18 PATIENTS FOLLOWED UP AT THE UFSMIA ZONA PISANA-ASL 5.

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SCIENTIFIC BACKGROUND. Patients with Infantile Cerebral Palsy (ICP) often present with secondary abnormalities of the locomotor apparatus, caused by evolution of pathologic function amplified during growth, and orthopaedic surgery is often chosen as a therapeutic approach aimed at correcting defects or deformities, as well as at improving the functional activity of the affected segment, apparatus or system.

AIM. This study has analysed the changes in motor and postural behaviors, as well as the complications occurred in surgically treated ICP patients admitted to our Centre. Treatments included vertebral corrections (n=2), manipulation of hip musculature (adductor, ischio-crural, psoas: n=11), surgery of the knee (n=3) and/or foot (n=3) for correction of equinism, varism or valgism.

METHODS AND SUBJECTS. 18 young patients undergoing orthopaedic treatments have been studied (7 with tetraplegia, 1 with hemiplegia, 10 with diplegia). The following tests were administered before and after surgery: GMFM, GMFCS, OGA. Standardized videotaping was also employed in some instances.
THE ROLE OF ERGONOMICS IN THE CARE OF CHILDREN WITH CEREBRAL PALSY

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Aim:
The aim of this workshop is to provide the participants with hands on experience about various workplace analysis tools and methodology specific to caregivers and health care professionals in identifying the risk factors predisposing to MSD’s.

Content_1:
Introduction to Ergonomics for Caregivers/Health Care Professionals in CP
Ergonomics is the study of the relationship between the workers and the workplace. It is a developing body of knowledge whose goal is to provide and maintain a healthy “user friendly” environment. When properly applied, ergonomic principles support each person’s desire to find a zone of individual comfort. Healthcare profession deals with patients for treating, caring, comforting, shifting, and transporting. While doing so they expose to various risk factors leading to the development of musculoskeletal disorders (MSD). Some case studies also will be discussed which showed that prevalence of MSDs in physiotherapists are high and also in the informal healthcare professional such as caregivers are also prone to develop MSDs. The risk factors for MSD’s can be divided into three: physical, personal or lifestyle and psychosocial risk factors. Physical risk factors are repetition, posture, vibration, force, contact stress, duration of exposure. Personal and lifestyle factors are age, BMI, smoking, alcohol consumption, physical activities etc. All these factors need to be modified to alter the prevalence and risk of MSD among health care professionals. To prevent the health care professionals from various risk factors which lead to MSD, it is required to evaluate the workplace risks, and modify the risk factors according to the available ergonomics guidelines. The objective of this workshop is to make the participants understand various workplace analysis tools and methodologies specific to caregivers and health care professionals in identifying the risk factors predisposing to MSD’s. This workshop will discuss about various techniques for evaluating the ergonomics risk factors for healthcare professionals and prevention of MSD’s.

Content_2:
Postural Evaluation Tools and Specific Healthcare Ergonomic Workplace Analysis Tool
Postural evaluation tools such as Rapid Upper Limb Assessment (RULA), Rapid Entire Body Assessment (REBA), Quick Exposure Checklist (QEC) and Simple Model for Comprehensive Evaluation of Risks of Musculoskeletal Disorders (MODSI) provides the understanding about the postural loading and impact on the development of MSD. Recommendations can be made based on the identified postural load. Manual lifting is very common in the field of healthcare professionals. Caregivers/ healthcare professionals frequently lift heavy patients, move the patients for feeding, cleaning and transfer, leading to the development of musculoskeletal disorders. To minimise these risks, recommended lifting weight and techniques need to be identified. For identifying those risk factors special evaluations are needed. Strain Index can be used for finding out the risk factors in distal upper extremities. Revised NIOSH Lifting Equation can be used for finding out the biomechanical load of the lumbar spine in relation with recommended weight lift. Other health care ergonomics evaluation tools include Movement and Assistance of Hospital Patients (MAPO), Till Thermometer, and Patient Transfer Assessing Instrument (PTAI).

Content_3:
Injury Prevention among Physiotherapist
This session will target all previous research conducted on the topic of musculoskeletal disorders among physiotherapists, with a particular focus on studies that had examined individual, physical and psychosocial risk factors and provided suggestions or recommendations to prevent such injuries. Scientific literature published in English language was searched using electronic way. A total of 17 appropriate studies were located and examined, most of which had focused on the prevalence of musculoskeletal disorders. From the review, it was shown that major risk factors among the physiotherapist were manual therapy, repetitive movement, awkward and static posture, and physical load, lifting and transferring, treating large number of patients in a single day, working while injured and years of professional experience. The preventive
measures described in the literature were awareness of reporting of injury, use of less manual therapy, maintenance of fitness levels by proper exercise, formulation of new devices, intervention at the level of workplace, work schedule allocation, effective training, ongoing risk assessment and control.
THE BOBIVA (BOTULINUM TOXIN BIMANUAL SKILLS) STUDY IN UNILATERAL CP CHILDREN

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According to the Cochrane Update “Botulinum toxin A as an adjunct to treatment in the management of the upper limb (UL) in children with spastic CP” (Hoare BJ, 2010) there is an additional value of btA combined with OT in reducing impairment, goal achievement and improving activity level outcomes.

Aim
In 2008 the BoBiVa (Botuline toxine Bimanuele Vaardigheden) study started (http://www.controlled-trials.com/ISRCTN69541857). BoBiVa is a multicentre trial on the effect of botulinum toxin A injections and specific intensive rehabilitation therapy in children with unilateral CP on upper limb skills.

Subjects and methods
Primary outcome measures are the AHA, the ABILHAND/Kids, GAS, the COPM and a video/observation system called the Observational Skills Assessment Score (OSAS). The OSAS enables assessment of amount and quality of use of the affected hand during bimanual performance. The task specific bimanual therapy program consisted of ½ an hour physiotherapy and one hour OT 2 times a week for 12 weeks. There were two baseline measurements with 2 weeks in between and follow up sessions at 6, 12, 18 and 24 weeks after btA/start therapy. At first there were 4 study groups: btA, task specific bimanual therapy, btA and intensive therapy, and control group. Due to recruitment problems only 2 groups were left over since January 2010: btA + task specific bimanual therapy and intensive therapy alone.

Results and discussion
The inclusion stopped 31-12-2011; in total 35 children participated: 13 btA + therapy, 11 therapy alone, 5 btA, 6 control. btA has a clear effect at active thumb abduction, wrist extension, wrist/finger flexor spasticity, key grip strength and no additional effect on GAS, Abilhand-Kids and AHA. Task specific therapy has a clear effect at GAS, Abilhand-Kids and there was an improvement at the AHA in the therapy group. Also there was effect of therapy at fist grip strength and functional strength. The OSAS results are not yet analyzed.

MOTOR END PLATE TARGETED BOTULINUM TOXIN INJECTIONS IN THE PSOAS MUSCLE GIVES MUSCLE ATROPHY ON MRI

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Background: Motor end plate (MEP) targeting during BoNT-A injections brings the toxin close to its site of action and has been demonstrated to improve outcome.

Aim: The MEP zone of the psoas muscle is situated proximally in the muscle at the level of the promontorium. We will compare two injection techniques: MEP targeting versus a widely used more distal injection technique.

Methods and subjects: 7 spastic diplegic patients (age: 7 - 16y, mean 12 y) received BTX-A injections in both psoas muscles: randomly with the two different injection techniques for the left and right muscle in 5 patients, in 2 patients both muscles were injected MEP targeted. Magnetic resonance images (MRI) of the psoas were taken before, after 2 months and in 3 of 7 patients after 6 months. Muscle volume -measured with digital segmentation on the MR images- is used as primary outcome measure.
Results and discussion: Average post injection volume (in relation to pre-injection volume) for the 9 MEP targeted muscles is 79.5% (range: 63.3-90.7%) versus 107.8% (range: 99.3-120%) in the 5 distal injected psoas muscles (p=0.0033). In all 5 asymmetric injected patients the MEP targeted psoas had a larger volume reduction post-BTX-A than the more distal injected psoas muscle: average difference of the pre-post-ratio of muscle volume in both muscles is 27% (range: 9-37%). The atrophy of the MEP targeted muscle remains even 6 months after the injections (3 patients). This is the first study were a longitudinal follow-up by MRI demonstrates muscle atrophy after BTX-A-injection in children with CP. These data recommend that injections in the psoas muscle should be given in the MEP zone, this is the more proximal part, and not in the more distal area of the muscle.

EFFICACY OF A SECOND EPISODE OF BOTULINUM TOXIN-A FOR CARE/COMFORT IN CHILDREN WITH CEREBRAL PALSY

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Aim: Efficacy of repeated versus single intramuscular Botulinum Toxin A injections (BoNT-A) combined with therapy in children with marked cerebral palsy (CP) for goals of care and comfort.
Subjects: Forty-one children, mean age 7.1 (range 2.3-16) yrs, 27 males (66%); GMFCS IV=3, V=38, were randomly allocated to receive BoNT-A and therapy (n=23) or sham and therapy (n=18). Four children (n=3 surgery, n=1 safety) withdrew prior to the second cycle where all children received BoNT-A. Two episodes n=20, one episode n=17.
Method: Cycle 1, BoNT-A (max total dose 400U BOTOX®, at 12U kg/BW, ½-2U kg/muscle, dilution 100U/1ml saline) plus anaesthetic cream and intranasal fentanyl, OR sham procedure using anaesthetic cream and saline nasal spray. Cycle 2 injections 6 months from baseline. Outcomes measures: Canadian Occupational Performance Measure (COPM), Caregiver Priorities & Child Health Index (CPChild), Care and Comfort Hypertonicity Questionnaire (CCHQ) and the Pediatric Pain Profile (PPP).

Results: Data comparison: generalized estimating equations (STATA 10.0) at baseline, 4 and 10 months. Baseline: no difference between groups. COPM: both groups improved significantly with no difference between groups, performance: EMD 0.3 (95%CI -1.0,1.6) p=0.6., satisfaction: EMD 0.5 (95%CI -1.0,2.0) p=0.5. CCHQ personal care: deterioration of sham group in cycle 1 therefore only a trend towards difference, -0.9 (95% CI -1.8,0.1) p=0.07. CPChild positioning: Sham group deteriorated during cycle one with a resultant difference between 2 versus 1 episode, EMD 5.7 (95%CI 0.1, 11.4) p=0.05 (iv) CPChild (total scores): there was a trend for a benefit for 2 episodes, EMD 4.8 (-0.8, 10.4) p=0.09; and a reduction in pain (PPP) was observed for both groups.

Discussion: For children with marked CP, parents perceive improvements in satisfaction and performance in goal areas and reduction in pain for both single and repeated injections of BoNT-A. Repeated injections however showed superior outcomes for positioning. Withholding BoNT-A in a controlled study led to a deterioration in both personal care and positioning.

EXPLORING RELATIONSHIPS OF SELECTIVE MUSCLE CONTROL AND ACTIVITY-MEASURES USING ICF AS FRAMEWORK

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Scientific background: Associations between body functions and activities within the ICF framework are often assumed to demonstrate a linear relationship, an assumption which today has been questioned, but still not clearly elucidated.
Aim: To explore the relationships between body functions and activities in children with cerebral palsy (CP) before and three month after treatment with botulinumtoxin-A (BoNT-A) and goal-directed, activity-focused training.

Methods and subjects: A consecutive sample of 40 children, age 4-12 years, with spastic unilateral or bilateral CP, GMFCS I and II, referred to treatment with BoNT-A, participated. The children were examined before and three months after treatment. Assessments included three dimensional gait analyses (3D) with gait data transformed to gait deviation index (GDI), range of motion (ROM), spasticity scoring, selective muscle control of the ankle (SMC). Furthermore all children choose an activity goal which was graded using goal attainment scaling (GAS).

Results and discussion: At baseline assessment GDI and SMC demonstrated a relationship, showing children with the most favourable gait score having the best voluntary muscle control of their ankle ($r=0.39$). After three months the change in spasticity correlated to change in ankle dorsiflexion ($r=-0.55$). Furthermore a high voluntary muscle control in the ankle at baseline demonstrated a relationship to high goal attainment at the follow-up. A week correlation was also observed between high goal attainment and improvement in GDI ($r=0.35$). The results indicate interesting relationships between measures of body functions and activity within the ICF.

EVALUATING HYPERTONIA IN CEREBRAL PALSY: EARLY RESULTS FROM THE HYPE-CP STUDY

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Background: Abnormal tone in cerebral palsy (CP) is typically described according to the dominant motor pattern. Whilst it is known that different types of hypertonia can co-exist in the same child, e.g. spasticity and dystonia, little information is available on the patterns of hypertonia in CP populations.

Aim: Hypertonia Evaluation (HypE) in a population of children with CP to determine the co-existence of tone abnormalities and associations with motor function.

Subjects and Method: Children with a confirmed diagnosis of cerebral palsy attending a rehabilitation clinic in an Australian tertiary children’s hospital. Key demographic data and classifications of gross and fine motor abilities were obtained. Hypertonia was differentiated by application of the Hypertonia Assessment Tool-Discriminate (HAT-D), with measurement of severity of dystonia and spasticity using the Barry Albright Dystonia and Modified Ashworth Score scales. “Additional” movements including chorea and athetosis were recorded. Neuroimaging was reviewed for extent of abnormality and laterality.

Results and Discussion: Sixty-one children with CP were assessed (29 M; 32 F) whose median age was 11.7 years (range 2.3-18.5). Seventy-seven percent had bilateral involvement and 23% unilateral; 77% had primarily spasticity; and 23% dyskinesia. Additional movements, such as chorea, athetosis and mirror movements, were observed in 39%. In children with spastic diplegia 74% returned a positive score on the HAT-D for dystonia, presenting mostly as a combination of lower limb spasticity and dystonia, and upper limb dystonia. In children with hemiplegia, 73% had either spasticity or dystonia in the opposite limb, and bilateral neuroimaging abnormalities were frequently found. Additional movements were most commonly found in children with bilateral motor involvement. This study found that other forms of hypertonia exist behind the “dominant” motor pattern in spastic hemiplegia and diplegia. Children with a conventional diagnosis of hemiplegia may have bilateral neuroimaging and clinical findings, reinforcing the need for detailed bilateral evaluation.
GROUP 28 – PROGNOSIS

SURVIVAL IN CEREBRAL PALSY IN WESTERN SWEDEN

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Scientific background: Life expectancy in cerebral palsy (CP) is often reduced. Reports on 50-year survival or survival by CP type are scarce.
Aim: Investigate 50-year survival by CP type, motor impairment and accompanying impairments in the population-based CP register of western Sweden.
Methods and subjects: All individuals born 1959-2002 were included. Causes of death and population data were derived from national registers. CP was classified according to Hagberg and Surveillance of Cerebral Palsy in Europe. Motor impairment (unaided walker/walking with aids/non-walker and Gross Motor Function Classification System, GMFCS), cognitive level and epilepsy were documented. Kaplan-Meier survival curves were constructed. Log-rank was used to evaluate differences between groups. Comparisons with survival in the population were made.
Results and discussion: Of 1856 individuals in the database, 180 (9.7%) had died, and 1676 lived on December 31st 2009. The 50-year survival in dyskinetic CP was 63%, ataxia 83%, diplegia 89% and in hemiplegia 93%. Non-walkers had an estimated 50-year survival of 53%, compared to 94% of unaided walkers. At GMFCS level V, individuals with bilateral spastic CP had a lower survival than those with dyskinetic CP (p=0.04). Fifty-year survival with severe learning disability was 47%, 93% with normal cognitive function, and 68% in individuals with epilepsy. Respiratory failure caused 55% of the deaths in non-walkers. In hemiplegia, accidental deaths accounted for 20%. Death before 10 years of age occurred in 43% in tetraplegia, and 17-22% in other CP types. Compared with the general population, an excess death risk in the CP group appeared in all age groups and CP types, in dyskinetic CP 18.8 and in tetraplegia 75.9. Women had a greater excess risk at all ages.
Survival in CP is associated with severity of impairment, but also with subtype. An excess death risk is present in all CP types, greater in women.

HEART RATE CHARACTERISTICS ARE ASSOCIATED WITH ABNORMAL BRAIN ULTRASOUND AND MRI IN ELBW INFANTS

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Scientific background: Acute brain injury may lead to autonomic nervous system dysfunction which is reflected by abnormal heart rate characteristics (HRC). A HRC monitor was developed to analyze heart rate variability and repetitive decelerations and predict impending catastrophic illness in preterm Neonatal Intensive Care Unit (NICU) patients (HeRO monitor, Medical Predictive Sciences Corporation).
Aim: We tested the hypothesis that the HRC index (HeRO score) would be abnormally high in preterm infants with abnormal brain ultrasound and MRI findings.
Methods and subjects: We collected all available HRC monitor data on extremely low birthweight (ELBW) infants who underwent brain MRI as part of a prospective clinical trial of neurodevelopmental outcomes. Brain ultrasounds (US) were performed in the first week and as clinically indicated, and brain MRI was performed near term. US were scored as normal/mild (including grades 1-2 intraventricular hemorrhage) and moderate/severe (grades 3-4 IVH or cystic periventricular leukomalacia). MRI was scored 0-3 using an established scoring system for gray and white matter injury.
Results: 45 ELBW infants with MRI performed had HRC data available. Brain MRI was classified as 0 (normal, n=22), 1 (mild, n=14), 2 (moderate, n=5) or 3 (severely abnormal, n=4) and US as normal/mild (n=36) or moderate/severe (n=9). Average HRC index in the first 28 days after birth (aHRC28) was highly correlated with severity of abnormal brain US and MRI findings. aHRC28 for patients with normal/mild
US abnormalities was 1.37±0.48 (mean±SD) and with moderate/severe 2.53±0.69 (p<0.001). For MRI, aHRC28 for patients with class 0-3 was 1.24±0.44, 1.59±0.53, 2.49±0.68*, 2.72±0.82*, (*p<0.001 versus class 0, by ANOVA). The differences persisted after adjustment for gestational age and birthweight. Discussion: HRC monitoring may be a useful tool for assessing severity of acute brain injury in NICU patients at high risk for neurodevelopmental impairment.

“How Bad is It?” Clinical Prognostic Messages for Cerebral Palsy

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Scientific background: Parents often report that they are not provided sufficient prognostic information about their child’s cerebral palsy. Clinicians may not provide clear clinical messages about cerebral palsy as there are currently no guidelines or systematic reviews in existence.

Aim: To summarize evidence on the prevalence, prognosis and functional implications of impairments associated with cerebral palsy into succinct clinical messages.

Subjects and methods: A systematic search was conducted for observational studies published between January 1999 and January 2011 in bibliographic databases. Studies using population samples were preferentially sought; studies with greater levels of bias were only included when no higher quality observational studies were available for a particular topic area. Data regarding rates of associated impairments and functional implications was abstracted from each study. The methodological quality of each study was rated by two independent assessors.

Results and discussion: 1366 papers were identified in the search; 82 were appraised; and 49 were included in the meta-analyses. High-level evidence existed, and the data was of a high quality grade. Amongst children with cerebral palsy: 3 in 4 were in pain; 1 in 2 had an intellectual disability; 1 in 3 could not walk; 1 in 3 had a hip displacement; 1 in 4 could not talk; 1 in 4 had epilepsy; 1 in 4 had a behaviour disorder; 1 in 4 had bladder control problems; 1 in 5 had a sleep disorder; 1 in 5 needed someone to feed them; 1 in 5 dribbled; 1 in 10 were blind; and 1 in 50 were deaf. Children and adults unable to walk are more likely to experience these accompanying impairments. The risk for pain and behavioural problems occur equally at all levels of physical disability. There is insufficient evidence to be certain about rates of sleep disorders and more research is warranted.

Increased Mortality in Cerebral Palsy: A Population Based Register Study

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Background: Few population based studies on long term survival in cerebral palsy (CP) exist and even fewer with the possibility of studying the trends over decades.

Aim: Investigate trends in cerebral palsy from birth year 1950 to 2002

Methods and subjects: The Danish Cerebral Palsy Register includes children with congenital CP surviving the first year of life born in Eastern Denmark between 1950 and 2002. In total 4,111 persons with cerebral palsy were assessed on four key indicators of impairment: Subtype of CP, motor and cognitive function, and epilepsy. Information on date of birth, sex and date of emigration or death has been obtained. The mortality was analysed by Kaplan-Meier curves and Cox-regression according to birth cohort, subtype and severity of impairments. The mortality was compared to the general population by standardised mortality ratios.

Results: Mortality for CP for each subtype in birth cohorts from 1950 to 2002 are presented. Trends in mortality depended heavily on type and severity of CP. For unilateral spastic CP a uniform decline was found, whereas for bilateral spastic CP mortality decreased from birth cohort 1950 to 1975, and then increased again from 1975 to 2002. The group of dykinetic/ataxic types showed a marked increase. The indicators of severity all showed clear trends of more severe impairments leading to increased mortality.
across both birth cohorts and sex. The increase in mortality was further exacerbated looking at the standardised mortality ratios. The increasing mortality for bilateral spastic CP could only partly be explained by an increasing severity of CP for birth cohorts 1975 to 2002.

Discussion: The increasing mortality among bilateral spastic CP and dyskinetic/ataxic types is worrying. New therapeutic options starting after 1975 have to be considered as a possible cause for the increase and further studies are warranted.

SURVIVAL IN CHILDREN AND ADOLESCENTS WITH CEREBRAL PALSY - A TOTAL POPULATION STUDY

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Aims: The aims were to investigate survival of children with cerebral palsy (CP) and to search for affectable factors influencing survival in CP

Methods and subjects: The total population of children with CP in southern Sweden 2-19 years of age followed from 1994-2010. CP subtype, gross motor function classification (GMFCS) levels and co-morbidities were described. Kaplan-Meier survival curves were plotted. The factors GMFCS level (covaries with overall health), size of health care catchment area, gastrostomy feeding, and sex were investigated with Cox regression analysis.

Results and discussion: The estimated survival at 19 years was 60% in children with severe gross motor limitations (GMFCS V). Death occurred throughout childhood. All children at GMFCS levels I-II survived, and 96% of the whole CP population. Mortality risk in childhood CP was three times higher in catchment areas covering small populations than in large population areas. Gastrostomy feeding was associated with a ninefold increased risk of dying, regardless of GMFCS level and catchment area.

That health care catchment area seemed to influence survival rate indicates possible further improvement of survival in childhood CP. The different mortality rates in children with CP may be only the tip of the iceberg, indicating different quality of health care. The study does not tell exactly what to focus efforts on. For the time being, the most fragile children should be thoroughly followed by, or in close cooperation with, the most experienced multidisciplinary professional teams.

GROUP 29 – PERCEPTION & ROBOTICS

SPATIAL ORIENTATION AND GAIT CHARACTERISTICS IN CHILDREN WITH CEREBRAL PALSY

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Scientific background
The relationship between spatial orientation ability and gait characteristics in children with CP is not well established although on both practical and theoretical basis the importance to assess how postural control during gait is associated with postural control on moving platform was recommended from long time.
Aim
The aim of this study is to evaluate the rotational spatial orientation abilities in children with CP on moving platform compared with adults and age-matched subjects. Subsequently, the relationship with body rotational behavior during gait was assessed.

Subjects and methods
Thirteen children (age 8±2 years) with Cerebral Palsy (CP) stood barefoot on a platform in front of a fixed reference point; then were blindfolded and passively rotated with six velocity profiles (maximum angular velocity: 57°/s; rotation amplitudes: ±90°, ±180° and ±360°), in both hemi-space directions. After the perturbation, the blindfolded children were asked to point to the fixed reference point (Pointing Task, PT) and to step back to the initial position (Reorientation Task, RT). The results were comparatively examined with body segments rotations during standardized gait analysis (Gait Task, GT).

Results and discussion
When CP children were passively rotated towards their more affected side they overestimated the imposed angle in PT but under/reproduced it in RT. A higher variability emerged in left/hemiplegic children. Patients tended to rotate in GT towards the more affected side while in RT they showed an opposite trend. Controls showed good ability and symmetric rotations. The differences observed in children with CP evidenced some limitations of the sensory/motor system recovery. The different behaviour between RT and GT can be interpreted as a task-dependent effect. A top-down control strategy emerged during RT trials, linked to the vestibular information, while a bottom-up strategy emerged during GT evaluation mediated by the somato-sensory system and the body mechanical constrains.

fMRI CHANGES IN HEMIPLEGIC CEREBRAL PALSY CHILDREN AFTER A ROBOTIC ASSISTED REHABILITATION THERAPY

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The repetition of motor activities in facilitating conditions can induce a stimulation of gait patterns spinal and upper spinal generators, inducing a CNS neurofunctional reorganisation thanks to its neuroplasticity features and this lead to a motor learning. fMRI is a diagnostic method that can detect structural and functional changes in CNS, which has already been used in children with CP1. The first aim of this pilot study is to determine, using ankle dorsiflexion as an fMRI activation paradigm, whether changes in cortical activation occurred as a result of robot-assisted Gait Trainer (GT-I®) therapy in hemiplegic children. The second aim is to verify if these changes translate themselves in gait functional changes.

We recruited 8 children (7 males, 1 female, middle age 11y7m) with spastic hemiparesis related to the Don Calabria Centre, Verona, between October 2010-January 2011. Each patient has made a GT-training with ten 30-minute sessions treatment lasted for 2 weeks. Patients were evaluated before (T0), after (T1) and after one month (T2) of treatment using fMRI with two motor tasks (active ankle dorsiflexion of the involved ankle; finger tapping of the uninvolved hand), 6 minutes walking test (6MWT), 10 meters walking test (10MWT) and GAITRite system. Region of interest analysed in fMRI are primary motor cortex (M1), primary sensory cortex (S1), supplementary motor area (SMA), premotor cortex (PMA).

All the patients analyzed increase activation area in the hemisphere damaged at T1 at fMRI, in S1, M1, PMC and SMA. Increase in cerebral activations has been translated in all patients in a functional improvement of gait performance, with improvement in speed, cadence and resistance.
This study highlights as an intensive rheabilitative treatment with GT-I® in hemiplegic children can led to modifications in cortical activation in S1, M1, PMA and SMA associated with an improvement in gait performance.

IMPACT OF TACTILE DEFICITS ON UPPER LIMB MOTOR FUNCTION IN CHILDREN WITH UNILATERAL CEREBRAL PALSY

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Scientific background: Tactile deficits are common in children with unilateral cerebral palsy (UCP). However, due to the limited tactile assessments used, the extent to which tactile impairments impact on upper limb motor function in UCP is not known.

Aim: We aimed to determine the specific relationship between upper limb tactile and motor function in children with UCP.

Subjects and methods: Participants were 52 children with UCP aged 8-17 years (median age 12 years; 29 male; 23 left UCP; GMFCS I=34, II=18; MACS I=36, II=16). Tactile registration was assessed using Semmes Weinstein Monofilaments. Spatial tactile perception was assessed using: single point localisation, two point discrimination, double simultaneous and stereognosis. Texture perception was assessed by the AsTex®. Unimanual motor capacity was assessed using the Melbourne Unilateral Upper Limb Assessment (MUUL) and Jebsen/Taylor Test of Hand Function (JTTHF). Bimanual motor performance was assessed using the Assisting Hand Assessment (AHA). Associations between tactile function and motor function were investigated using linear regression.

Results and Discussion: Tactile registration and all tests of spatial perception were moderately/strongly related to the MUUL, JTTHF and AHA (all p<0.001). Texture perception was not related to upper limb motor function (R2=0.01/0.05; p=0.47/0.92). Stereognosis, the only tactile test involving movement, was most strongly related to upper limb motor function (MUUL: R2=0.36; AHA: R2=0.36; p<0.001). However, when removed from the model to examine the relationship between motor-free tactile function and motor function, single point localisation, a unilateral spatial perception test, contributed most strongly to unimanual capacity (explained 29% of the variance in MUUL and 26% of the variance in JTTHF), whereas double simultaneous, a bilateral spatial perception test, contributed most strongly to bimanual performance (explained 33% of variance in the AHA). Given this significant contribution, tactile testing must be emphasised prior to upper limb treatment planning for children with UCP.

IMMEDIATE EFFECT OF FUNCTIONAL ELECTRICAL STIMULATION IN CEREBRAL PALSY: A SYSTEMATIC REVIEW

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2 The University of Sydney, Sydney, Australia

Background: Functional electrical stimulation training is defined as a task-specific manner, in which a muscle is stimulated when it should be contracting during a practicing an activity, such as sitting, sit to stand, walking or reaching and manipulation.

Aim: The purpose of this systematic review is to determine the effect of functional electrical stimulation as an intervention to improve activities in children and adolescents with cerebral palsy. Activities during
functional electrical stimulation are thoroughly assessed with the use of congruent outcome measures in this review.

Methods and subjects:
The study design consisted of a systematic review of randomized trials using Cochrane Collaboration guidelines. Participants were children and adolescents with cerebral palsy less than 18 years of age. Intervention included functional electrical stimulation training that involved electrical stimulation during practicing an activity, such as sitting or walking. Outcome measures had to include a measure of activity as congruent task during functional electrical stimulation, eg, speed or Gross Motor Function Measure as general condition, and step width or foot angle as specific condition.

Results and discussion:
After being assessed against the inclusion criteria, four randomized controlled trials were included in the review. The between-group differences are reported in terms of percentage benefit. Immediate effect of functional electrical stimulation on general condition increased by 5-32% and on specific condition by 18-51% compared with no intervention.

There is limited evidence about the immediate effect of functional electrical stimulation in children with cerebral palsy. The available evidence suggests that functional electrical stimulation is minimal effective in children and adolescents with cerebral palsy who are walking independently. Future studies investigating the effect of functional electrical stimulation at different level of disability in children and adolescents with cerebral palsy may be useful to guide clinical practice.

TEMPORAL ORDER JUDGEMENT IN CHILDREN WITH UNILATERAL CEREBRAL PALSY

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6The Sansom Institute for Health Research, University of South Australia, Australia

Scientific background: Although children with unilateral cerebral palsy (UCP) are known to demonstrate deficits in tactile spatial and textural perception; temporal perception has never been examined.

Aim: To assess temporal tactile perception in children with UCP compared with typically developing children (TDC).

Subjects and methods: Forty children with UCP (median age 12 years; range 8-17 years; 24 male; 15 left UCP; MACS I=30; II=10) made temporal order judgements (TOJs) of tactile stimulus pairs, one delivered to each index finger. Stimulus order (right or left first) and stimulus onset asynchrony (SOA: 15, 30, 75, 150 or 300ms) were controlled by LabVIEW software over 200 pseudorandomised trials. In each trial, children identified whether the left or right stimulus occurred first. The 'Point of Subjective Simultaneity' (PSS), the SOA at which the two stimuli were perceived as simultaneous, and the ‘Just Noticeable Difference’ (JND), the smallest SOA at which participants made correct judgements in 75% of trials, were analysed. Potential differences between children with left UCP, right UCP and typical development were analysed using linear regression and post-estimation tests.

Results and discussion: For PSS, children with left UCP (mean -79.62 (SD= 304.45) demonstrated a more negative value than both children with right UCP (3.12(89.54)) and TDC (-2.45(44.35)), indicating that children with left UCP have a spatial bias resulting in more difficulties with identifying left leading stimuli. The JND was not different between children with left versus right UCP (mean difference 0.7 (95% CI -63.3 to 64.8ms)), however TDC performed better than both UCP groups indicating that all children with UCP demonstrate deficits in temporal tactile perception compared to TDC. Research is required to investigate the relationship between temporal perception and functional motor difficulties in this group and the potential effectiveness of treatments previously used in the adult population.
SATURDAY, 13TH OCTOBER, 2012

10.50 – 12.05 PARALLEL SESSION 11

GROUP 30 – GAIT 3 + POSTURE

MULTIDIMENSIONAL ASSESSMENT OF OUTCOME OF FUNCTIONAL ORTHOPEDIC SURGERY IN AMBULATORY CP CHILDREN

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Scientific background: Most of the studies about orthopaedic surgery on CP children reported gait-related outcomes from the body structure and function domain of ICF; only a few more recent studies explored outcomes in the ICF activity and participation domain.

Aim: The aim of this study was to verify the outcome of orthopaedic functional surgery on a diplegic CP cohort either considering physical and functional examination or applying measuring instruments dealing with activity and participation domain of ICF, such as GMFM, PODCI, FMS and FAQ and FAQ 22 higher level skills.

Methods and subjects: A total of 27 ambulatory CP diplegic patients were enrolled: mean age 12 year, SD 3,813; GMCS 1/3; 13 females and 14 males. They referred to the UDGEE of Reggio Emilia between February 2008 and October 2010 for orthopaedic functional surgery (mostly single/event multilevel surgery). A rehabilitation program was tailored for each patient. Patients were evaluated pre- and 6 to 12 months postoperatively, with a physical examination, GMFM score (dimensions dealing with standing and gait), computed gait analysis, PODCI, GMFM, FMS, FAQ and FAQ 22 higher level skills. The testing results were statistically compared.

Results and discussion: Improvements were achieved in pelvic, knee and ankle kinematics, and time-distance parameters such as in physical examination. A significant improvement was found about the increase in FAQ 22 higher level skills, GMFM and PODCI scores. Minimal average improvement was seen in FAQ and FMS.

Performing orthopaedic surgery confirms to be effective on improving activity and participation of CP patients, as measured by PODCI and GMFM, based on the improvements achieved in gait pattern. On average, little change was expected to us on FAQ and FMS, which divide patients into large and usually stable classes, as far as GMFCS.

TRICEPS SURAES STRETCHING CASTS IN CHILDREN WITH CEREBRAL PALSY

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Background: The treatment of triceps surae (TS) loss of extensibility in walking children with cerebral palsy (CP) is a topic of considerable interest and it has produced a number of publications in this regard.

Objectives: The study wants to evaluate the effectiveness of plaster casts, in progressive dorsiflexion, treatment (minimum one at maximum three) associated with a subsequent r e-education programme, defined in its progression, and use of leg-foot orthoses and / or orthotics for lengthening the triceps and improve gait in children with cerebral palsy.

Subject and methods: The study includes twenty-three children with cerebral palsy, all children were able to walk alone (10 hemiplegic and 13 diplegic). Boots casts were applied for periods of one to three weeks, a total of 30 plaster casts were performed.

The technique we used in the realization of plaster casts is that taught us by Michel Le Metayer.

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Results: Clinical results are encouraging: after plaster removing the average gain in gastrocnemius length has been of 12.6° in ankle passive dorsiflexion; 11.3° in soleus length. The medium improvement in dorsiflexion is maintained around 60% also after 20 weeks since plaster removal (respectively 6.5° soleus and 8 gastrocnemius) with significant differences depending on gestational age of children; in particular, we observe a faster loss of extensibility of TS in diplegic children born preterm (-7 soleus and -8.6 gastrocnemius) than in diplegic children born at term (-2 soleus and -2.6 gastrocnemius).

Conclusion: Stretching casts are useful to prevent ankle and foot deformities and to delay or to avoid surgery in walking children with cerebral palsy.

DYNAMIC SEAT SYSTEM VS RIGID SEAT SYSTEM IN CP: A QUANTITATIVE COMPARISON

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High-tone extensor thrust or involuntary muscle contractions experienced by many children with Cerebral Palsy with severe dystonia, can cause a lot of problems for the patient relating to the seating system. From the 80’s, the concept of a dynamic seat especially in a backrest component was suggested as potential solution for patient with dyskinetic or dystonic syndrome. However no quantitative evaluations on this kind of seat system exist.

The main objective of this study is to make a quantitative comparison of a dynamic seat system versus a rigid seat system in dystonic patient with CP, using quantitative analysis of movement (3D kinematics and pressure distribution).

Material and Methods: We evaluated 10 patients affected by CP (range:6-19 years), in particular with spastic and dystonic quadriplegia of type V according to Palisano’s Classification (GMFCS). The patients were evaluated using an optoelectronic system with passive markers (ELITE) for kinematic acquisition, a synchronic Video system and a sensor for acquisition of pressure distribution placed on a seatback (Tekscan). The acquisitions were performed with the patient sit on the seating system in two sessions: before with the seat system in the dynamic configuration and then in the rigid configuration.

Results: The data demonstrate that the seating system in the dynamic configuration is able to reduce the forces experienced by the patients, limiting the rolling down of the trunk and slipping forward of the pelvis and showing a better upper limb smoothness during the extensor thrust.

These results demonstrate that instrumental data and data processing procedures used in the present study appear to provide an useful tool for better understanding how the concept of a dynamic back in a seat system may affect and influence the position and the stability of the subject with dystonia on the seat system.

THE EFFECT OF TARGETED TRAINING ON THE GROSS MOTOR FUNCTION OF CHILDREN WITH CEREBRAL PALSY

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Scientific Background: Targeted Training (TT) is an innovative treatment for training postural control in children with Cerebral Palsy (CP).

Aim: TT has been practised for 15 years with promising clinical results. This pilot study aimed to investigate the gross motor outcome of the training using a randomised control design.
Methods and subjects: 14 children (age 6.6 SD 4.2 years, 4 female, 8 GMFCS V, 1 GMFCS IV, 5 GMFCS III) were randomised (stratified for GMFCS and age) to training as usual (TAU) or TT groups. GMFM-IS was measured at baseline, following a six month intervention period and follow-up six months post-intervention. Scoring was blinded.

Results and discussion: Three children from the control group did not complete the study; one control withdrew directly after randomising, the other two underwent surgery during the study.

During the intervention period, the median change in GMFM in the TT group (n=7) was 2.7 (range -3.2 to 6.1, five increased), in the TAU group (n=5) was -0.5 (range -2.7 to 6.6, two increased).

During follow-up the median change in GMFM in the TT group (n=7) was -1.5 (range -4.0 to 3.4, one increased), in the TAU group (n=4) was 0.9 (range -5.3 to 4.2, two increased).

The Wilcoxon signed ranks tests for change in GMFM pre/post training were non-significant for both intervention and follow-up periods (Intervention TT P=0.128, TAU P=0.684, follow-up TT P=0.173, TAU P=1).

The groups in this study were very small and the outcome measure's sensitivity low in relation to this group of children with CP; the results are therefore tentative. It does however appear that there may be a greater effect of TT than TAU on gross motor function in these children. To more accurately determine the effect of TT and avoid a possible type II error, the design should be repeated with a greater number of participants.

ASSESSMENT AND TREATMENT OF POSTURAL CONTROL IN CHILDREN WITH MOTOR IMPAIRMENT

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Aim:
Postural control problems will be explored through the theory of open and closed chains; the segmental assessment of trunk control (satco) will be introduced. This synthesis will enable a new perspective on the treatment of postural control difficulties.

Content_1: Introduction and background
The course concept will be described as providing clinicians working with children with developmental neurological conditions with an overview of means of precise analysis of the child’s control problems and to offer some suggestions for specific treatment options. The introduction will continue with an overview of the clinical challenge and a description of the common postures used by children with cerebral palsy / moderate to severe motor deficits. This information will then be placed in the context of the gross motor development curves and the gross motor classification system. Attention will be drawn to the issues and difficulties in treating trunk control problems and promoting trunk control particularly in the more severely disabled child using currently available strategies.

This workshop is relevant to clinicians treating children with moderate-to-severe motor deficits in the clinical setting (particularly, but not exclusively gmfc iii, iv, v), to those conducting research focusing on treatment outcomes and to those interested in assessing function, activity and participation in children with moderate-to-severe motor impairment.

Content_2: Open and closed chains: a means of identifying and addressing control problems.
This section will begin with an introduction to the concept of open and closed chains using a biomechanical perspective and their value in assessment and treatment. Differentiation will be made between this terminological use of the open and closed chain approach for neurological rehabilitation and that used in the field of sports therapy. The closed chain will be defined with illustration of 3, 4 and 5 bar chains during everyday functional tasks in both typically developing and motor impaired individuals. The neuromuscular control requirements of the closed chain will be explored, together with the functional aspects of closed chain postures. This will be followed by, and contrasted with, open chain postures and the open chain clearly defined again using examples in both typically developing and motor impaired individuals. A specific focus will be made on open and closed chains within the trunk during functional activity. the therapeutic value of the unsupported or open chain approach will be explored particularly in promoting...
trunk control and the situation when it is appropriate to use a closed chain.

**Content 3:**
Satco: a new clinical tool for documenting specific motor deficits in trunk stability.
In this section, workshop participants will be introduced to the segmental assessment of trunk control (satco), a new clinical tool for documenting specific motor deficits in trunk stability. The rationale for the satco will be reviewed and details given of the reliability and validity of this clinical tool. Workshop participants will be informed of the test requirements and given an overview of the administration and scoring procedure to evaluate static, active and reactive control. An introduction will be given to common tester errors when conducting the satco and to compensatory strategies used by children when control is compromised. Both of these influence test scoring. This will be followed by a brief practice session for both administering and scoring the satco.

**Content 4:**
Treatment strategies
The workshop concludes with a synthesis of the previous sections and suggestions of ways in which to bring them together to formulate treatment strategies. Participants will be introduced to the concept of segmental treatment approaches and their use particularly in promoting trunk control. Emphasis will be placed on the use of open chains in clinical settings but with awareness of the closed chain and its place in management. Finally, workshop participants will be introduced to targeted training, a therapy option that has been developed using these concepts.

**GROUP 31 – GROWTH**

**ENERGY REQUIREMENTS IN PRESCHOOL-AGED CHILDREN WITH CEREBRAL PALSY**

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²Queensland Cerebral Palsy and Rehabilitation Research Centre - Royal Children’s Hospital – Brisbane – Queensland – Australia.

Scientific Background: There is a paucity of data concerning the energy requirements (ER) of young children with cerebral palsy (CP), knowledge of which is essential for early nutritional management.

Aim: To determine ER for children with CP in relation to Gross Motor Function Classification System (GMFCS), motor type and distribution, and compared to typically developing children (TDC).

Methods and subjects: Thirty-two children with CP (63% male) GMFCS I/II (n=16); GMFCS III/IV/V (n=16), motor types (spastic n=26, dystonia n=2, athetosis n=3, hypotonia n=1) and distributions (hemiplegia n=11, diplegia n=7, triplegia n=4, quadriplegia n=10) and 16 TDC (63% male), mean age 3.7 (±0.5) years participated. Energy requirements were determined using doubly labelled water. Data were compared using ANOVAs and independent t-tests.

Results: There was no statistical difference in ER between children of GMFCS I/II and TDC. Children with reduced function (GMFCS III/IV/V) had a lower mean ER (±SD) than GMFCS I/II and TDC (4339±1029kJ vs 6091±898kJ and 6408±755kJ; MD=1752kJ p=0.0005, and MD=2068kJ p=0.000). ER of children with hemiplegia was not statistically different from those with diplegia, however was higher than those with triplegia or quadriplegia (6088±765kJ vs 4428±1197 and 4370±1052kJ, MD=1660kJ, p=0.007; MD=1717kJ, p<0.0005). Motor type did not statistically influence ER.

Discussion: This study is the first to investigate the energy requirements of preschool-aged children across the range of functional abilities, motor types and distributions. Our data highlighted that ambulatory children (GMFCS I and II) have similar ER to TDC. Conversely the children with reduced function (GMFCS III, IV and V) have significantly lower ER, decreased on average by 31% when compared to ambulatory children and TDC. Both functional ability and distribution are important factors in determining ER, whereas motor type had minimal impact. Clinicians now have known ER targets to prevent overfeeding and associated negative health consequences.
VALIDATION OF A THREE-DAY WEIGHED FOOD RECORD IN PRESCHOOL-AGED CHILDREN WITH CEREBRAL PALSY

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Scientific Background: Accurate determination of energy intake in preschool-aged children with cerebral palsy (CP) is critical for nutritional management, however no valid measures exist.

Aim: Validation of a modified three-day weighed food record for measuring energy intake in preschool-aged children with CP.

Methods and subjects: Thirty-two children with CP (63% male) including Gross Motor Function Classification System (GMFCS) I=14, II=2, III=5, IV=3, V=8 (spasticity n=26, dystonia n=2, athetosis n=3, hypotonia n=1) and 15 typically developing children (TDC) (63% male), mean age 3.7 (±0.5) years participated. Energy intake was measured via a three-day weighed food record and compared to gold standard total energy expenditure (TEE) measurements (doubly-labelled water technique). Children were grouped by functional ability (Group A:GMFCS I/II, n=16; Group B:GMFCS III/IV/V, n=16). Comparisons were via paired t-tests and Bland and Altman analyses.

Results: Children with reduced function (Group B) had no statistical difference in energy intake and TEE values. Energy intake values were significantly less than TEE values in TDC and Group A (mean difference (MD)=1083±722kJ, 95% CI=/1483kJ to /683kJ, p=0.005; MD=/1060±1111kJ, 95% CI=/1652kJ to /468kJ, p=0.002 respectively), however these differences are minimal. Both represent typical within-subject variability in day-to-day energy intake in young children’s diets.

Discussion: Our validation study confirmed a modified three-day weighed food record accurately measures energy intake in preschool-aged children with CP. A previous study suggested food record use led to substantial overestimation in energy intake, potentially misleading clinicians when assessing the nutritional adequacy of a child’s diet. Accurate reporting in the present study could be attributed to increased awareness of parents on dietary intake in young children susceptible to nutritional concerns. A modified three-day weighed food record can now be widely used in clinical practice and future research to accurately determine energy intake in this population.

BONE MINERAL DENSITY AND VITAMIN D STATUS IN CHILDREN WITH CEREBRAL PALSY. A CROSS-SECTIONAL STUDY.

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Scientific background: Non-ambulatory children with cerebral palsy (CP) have high risk of osteoporosis and fractures of the long bones mainly due to lack of weight bearing.

Aim: To examine bone mineral density (BMD) and its relation to vitamin D status in children with CP.

Methods/subjects: Twenty-five children with CP were recruited from St. Olav’s University Hospital, Trondheim, Norway. BMD was measured at the lumbar spine and distal femur bilaterally using dual X-ray absorptiometry (DXA). Exposure variables were the ability or inability to walk as well as vitamin D status assessed by measurement of 25-hydroxy/vitamin D (25-OHD).

Results and discussion: In the femur the BMD z-score ranged from /1.5 to /2.5. Children unable to walk had significantly lower z-scores (range: -2.9 to -4.7) than walkers (range: -0.6 to -1.4). Mean 25-OHD in the total population was 42 nmo/L (SD: 14); lower in children able to walk (mean: 35 nmol/L; SD: 5) than in those unable (mean: 53; SD: 19; p = 0.039). Seventeen (82%) children had 25-OHD levels below 50 nmol/L, suggesting insufficient status, and four of these were vitamin D deficient (i.e. 25-OHD <30 nmol/L). Among children able to walk 25-OHD levels correlated with BMD at the lumbar spine (r = 0.68; p = 0.021) and the cortical bone region of the femur (right femur r = 0.64; p =0.033; left femur: 0.60; p =
0.053. Our study confirms that children with CP unable to walk have very low BMD in the distal femur. However, a surprisingly high proportion of the children had insufficient vitamin D status, which adversely affected BMD in walkers. Taken together, our results suggest suboptimal supplementation of vitamin D in all children with CP, and that more attention is needed to ensure adequate vitamin D supplementation.

NUTRITIONAL STATUS OF CHILDREN WITH CEREBRAL PALSY IN A POOR PERI-URBAN AFRICAN COMMUNITY SETTING

Saloojee G.
University of the Witwatersrand.

Background: The extent of malnutrition in children with cerebral palsy in a disadvantaged African setting has not previously been described.

Aim: To compare the nutritional status of children with cerebral palsy with that of their siblings and able-bodied neighbours living in a poor informal settlement near Soweto, South Africa.

Method and subjects: A community based study was undertaken and snowball sampling used. Two controls, an able-bodied sibling nearest in age and an able-bodied neighbour of the same sex and similar age were recruited for each child. Anthropometrics were measured by trained field workers. Tibial length and halfspan were used to predict height in children unable to stand.

Results and discussion: 77 children with CP across all five Gross Motor Function Classification System levels; 52 siblings and 72 neighbours were enrolled. The table below presents the pertinent data.

<table>
<thead>
<tr>
<th></th>
<th>No.</th>
<th>Age (months)</th>
<th>Underweight (weight for age &lt; -2SD) %</th>
<th>Stunted (height for age &lt; -2SD) %</th>
<th>Wasted (weight for height &lt; -2SD) %</th>
<th>Obese (BMI &gt; +2SD [age ref]) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child with CP</td>
<td>77</td>
<td>105</td>
<td>31.2</td>
<td>54.5</td>
<td>15.5</td>
<td>1.3</td>
</tr>
<tr>
<td>Sibling</td>
<td>52</td>
<td>83</td>
<td>1.9</td>
<td>13.9</td>
<td>6.2</td>
<td>5.6</td>
</tr>
<tr>
<td>Neighbour</td>
<td>72</td>
<td>105</td>
<td>1.4</td>
<td>19.3</td>
<td>2.7</td>
<td>6.9</td>
</tr>
</tbody>
</table>

Children with CP were statistically significantly more likely to be underweight (p=0.00, p=0.00), stunted (p=0.00; p=0.00) and wasted compared to the respective controls and less likely to be obese (p=0.00; p=0.00). Stunting and obesity rates in controls were similar to national data, while underweight rates were much lower (national=9%). Although half the children with CP were unable to feed themselves, 73% of carers were unconcerned about their child’s feeding abilities whilst 43% expressed concern regarding the child’s weight. Children with CP in this low-resourced setting were at high risk for malnutrition compared to siblings and neighbours, underlying the importance of a regular review of their nutritional and feeding practices.

STRUCTURAL PROPERTIES OF QUALITY IN THE CEREBRAL PALSY FOLLOW-UP PROGRAM IN DENMARK (CPUP)

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Scientific background: CPUP is a quality register and follow-up program for children with cerebral palsy, to monitor and improve the quality of healthcare and to minimize secondary consequences of CP, but the structural properties of quality has not been described.

Aim: To describe the structural properties of quality of the follow-up and interventions for children with CP in Denmark and to discuss the need for development of indicators of structural properties of quality.

Methods and subjects: CPUP is a population-based, prospective longitudinal follow-up program and quality register.
The aim of the follow-up program is to prevent or minimize the secondary consequences of CP, such as hip dislocation and server contractures and to provide a standardized and predictable follow-up for the families and healthcare professionals. CPUP consist of standardized protocols and uses process and outcome indicators to describe the quality of the follow-up and interventions for children with CP. The CPUP in Denmark have included 197 children born after year 2002 and 160 children were followed throughout year 2011. In year 2011 four hospital units and 20 municipalities have assessed the included children according to the four protocols. The results have been analyzed with descriptive statistics.

Results and discussion: In year 2011 the children were followed by 8 pediatric neurologists, 3 pediatric orthopedic surgeons, 76 physiotherapists and 34 occupational therapists. Each of the four protocols was fulfilled on 56-128 children. Each healthcare professional fulfilled at least one protocol on 1 to 60 children. The pediatric neurologists and pediatric orthopedic surgeons fulfilled a protocol on an average of 15 and 41 children, while the physiotherapists and occupational therapists fulfilled a protocol on an average of 1.6 children.

The results show a pronounced need for the development of indicators for the structural properties of quality of follow-up and interventions for children with CP.

**TOWARDS THE DEVELOPMENT OF THE ICF-CY CORE SETS FOR CHILDREN AND YOUTH WITH CP: GLOBAL EXPERT SURVEY**

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Scientific background: The goal of the International Classification of Functioning (ICF-CY) is to create a framework for defining and classifying the health and function of children around the world. To facilitate the application of the ICF-CY in practice, ICF based-tools like the “ICF core sets” are being developed.

Aims: Our objective was to identify the most relevant areas of body function (b) and structure (s), activity & participation (a&p), environmental (e) and personal factors (pf) important to children with Cerebral Palsy (CP) from the expert perspective using the ICF-CY coding system.

Methods and subjects: We conducted an international survey of professional experts. The questionnaire consisted of 5 open-ended questions covering each component of the ICF-CY. 423 professionals from the six World Health Organization (WHO) regions offered to participate. A sample of 247 experts was selected. Expert’s answers were linked to the ICF-CY by 2 professionals.

Results and discussion: 193 experts completed the survey (response rate 78%). Median years of experience were 20(5-44 ys). 9,706 ICF-CY categories were linked. The most frequent “s” and “b” ICF-CY categories were related to structures (65%) and functions (65%) of movement. In “a&p”, the most frequent answers covered areas of recreation-leisure (43%), mobility (37%), and self-care (35%). The most frequent “e” and “pf” were immediate family support (48%) and experience/patterns of behaviors (38%) respectively. Answers varied by children’s age group and professional background.

This is the first international expert survey using the WHO methodology for ICF core sets development. While some of these findings are predictable, experts suggest a more comprehensive profile of functioning in particular in areas of personal capacity and social participation. The results of this survey will be used as one source of information to create the ICF-CY core sets for children and youth with CP.
GROUP 32 – REMOTE

A LONG WAY AWAY: PROFILE OF CEREBRAL PALSY IN THE REMOTE NORTHERN TERRITORY, AUSTRALIA

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Background: Little is known about the profile of children with cerebral palsy in The Northern Territory, one of the most remote regions of the western world.

Aim: To describe the profile of cerebral palsy and access to rehabilitation services among indigenous and non-indigenous children with CP living in the Northern Territory.

Method and subjects: Children resident in the Northern Territory with a confirmed diagnosis of cerebral palsy referred to a rehabilitation clinic. Each child was assessed for motor function, hip status and access to rehabilitation services in the region.

Results and Discussion: One hundred children with cerebral palsy were assessed whose median age was 8.8 years (range 1.7-18.8); 47% were indigenous. Sixty-seven percent had bilateral involvement with 33% unilateral; 86% were primarily of the spastic type; 11% were dyskinetic; 2% ataxic and 1% hypotonic. Distribution by Gross Motor Function Classification System (GMFCS) levels was (Level) I - 26%; II - 26%; III - 7%; IV - 13%; V - 28%. Bimanual function of children over four years was classified using the Manual Ability Classification System: (Level) 1/ 27%, 2/ 25%; 3 / 13%; 4 / 12%; 5 / 23%. Fifty/six percent of the clinical population was enrolled in a hip surveillance program; 39% had previously received Botulinum toxin injections; 28% had received single- or multi-level orthopaedic surgery and 47% wore ankle-foot orthoses. There were no significant differences between indigenous and non-indigenous children in motor topography or tone pattern, or frequency of hip subluxation. Indigenous children were less likely to have received rehabilitation interventions including prescription of orthoses, treatment with botulinum toxin or orthopaedic surgery. This unique study describes the clinical profile of a large group of children with cerebral palsy living in remote Australia. Despite a lack of total population estimate, distribution by motor topography and tone pattern is similar to other Australian state CP populations.

A SHORT INTENSE THERAPEUTIC STRATEGY SIGNIFICANTLY IMPROVES OUTCOMES FOR POOR RURAL CHILDREN WITH CP

Saloojee G.
University of the Witwatersrand

Background: Addressing the largely unmet therapy needs of children with cerebral palsy (CP) living in poorly-resourced settings is a challenge requiring creative strategies.

Aim: To investigate the effects of a focused once-off intervention model on the functional performance of children with CP with limited access to regular therapy living in a poor,deeply rural South African district.

Study participants: Twenty children with moderate to severe CP received the intervention at one hospital. They were matched for age and Gross Motor Function Classification System (GMFCS) level with 19 children who continued their usual 45-minute, once-monthly therapy sessions at a second hospital in the same district.

Method: The intervention comprised: (i) five consecutive days of Bobath-based neurodevelopmental therapy; (ii) provision of appropriate equipment; and (iii) caregiver training. Children were assessed at baseline, immediately post-intervention and eight weeks later. Child and caregiver related outcomes were measured using validated tools.

Results and discussion: There was a statistically significant improvement in Gross Motor Function Measure-66 (GMFM-66) and Pediatric Evaluation Disability Inventory (PEDI) scores for the intervention group from baseline to follow-up (GMFM-66 mean change=3.41, 95% Confidence Interval (CI) = 1.10-5.07, p=0.004; PEDI mean change=3.10, 95%CI = 0.72-5.47; p=0.01). Caregiver outcomes as
measured by the Family Support (FSS) and Mental Health Scales (MHS) also improved significantly (FSS mean change=3.20, 95%CI = 0.87-5.52, p=0.01; MHS mean change=10.00; 95%CI = 8.79-19.12; p=0.03). No changes were seen in the control group for any of the outcomes. This study offers the first evidence that in poorly resourced settings where access to regular therapy is limited, a brief, intensive, once-off intervention can significantly improve children’s functional performance and caregivers’ wellbeing, at least in the short-term. Further exploration of this innovative approach to address the massive unmet needs of children with CP living in disadvantaged settings globally appears warranted.

CULTURAL VALIDATION OF MEASURES RELATED TO FAMILIES OF CHILDREN WITH CEREBRAL PALSY IN JORDAN

Almasri N., Saleh M.
University of Jordan.

Scientific background: Knowledge about family resources and sources of support of families of children with Cerebral Palsy (CP) helps providing family-centered care which leads to better child and family outcomes.

Aims: to culturally validate the Family Resources scale (FRS) and Family Support Scale (FSS), and to describe and identify variables that influence family resources and support of families of children with CP.

Subjects and methods: A cross-sectional study design. Participants were 99 children and youth with CP and their caregivers who are receiving services at different settings in Jordan. Participants children aged 4.3±4.5 years, 52 % were males. Children varied across Gross Motor Functional Classification System (GMFCS). Caregivers were mostly mothers (74.7%), with at least high school education (78.2%). Most of the participating families were of low income status (82.6%). Participants were interviewed using the validated Arabic-version of FSS and FRS. Criterion-tested assessors determined the GMFCS of children.

Results and Discussion: Internal consistencies of translated measures were examined and Cronbach’s alphas are 0.83 and 0.62 for FRS and FSS scales, respectively. Participants reported a moderate level of resources (mean= 66.4 out of 90), with the lowest scores in resources related to growth and support and child care domains. The child GMFCS age, mothers’ age, and educational level are significantly related to family resources. Spouse and professional helpers were rated as the most helpful source of support of (mean 1.6 out of 3; SD 0.5) while programs and organizations are the least helpful (mean 0.4 out of 3; SD 0.4) for participant families. Child GMFCS, health, parents’ age and educational level were significantly related to scores of support.

Discussion: Family resources and support assessments are critical in implementing family-centered practices for children with CP. Certain child and caregivers characteristics need to be considered to better identify resources and empower families of children with CP.

RETROSPECTIVE STUDY: CLASSIFICATION,CAPABILITIES AND CO-MORBIDITIES OF THAI CHILDREN WITH CP

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Background: Classification of children with cerebral palsy (CP) using 5-level Gross Motor Function Classification Systems (GMFCS) has been widely used. Topographical classification is also used to classify the type of CP. The use of GMFCS in Thai children with CP was reported in the research but it is not known whether it was used in clinic. Classification of CP, capabilities and co-morbidities of these children recorded on the medical charts would reflect the actual situation of Thai children with CP.
Aim: To explore the presentation of Thai children with CP and investigate their capabilities and co-morbidities as reported on their charts.

Method and subjects: Retrospective chart audit of children aged 0-14 years, admitted in hospitals between 2007 and 2009, in 4 hospitals and 2 schools in central region of Thailand was conducted (n=264).

Results and discussion: Specific classification for CP type was reported in 70% of charts, mostly with diplegia (48.17%) and quadriplegia (18.85%) with only 3 charts recording GMFCS. Type was altered from the initial diagnosis in 46 charts while the final diagnosis remained the same in 150 charts. Capability in sitting and walking were reported on 144 and 240 charts, respectively. Of 144 charts, 50 (43.86%): could not sit, 43 (29.86%): could sit stable while in 240 reports, 100 (41.67%): could not walk, 38 (15.83%): could walk independently. Intelligence Quotient (IQ) was reported in 43 charts. Almost half of these children (n=22) demonstrated mild to moderate mental retardation (IQ=35-69). Co-morbidities recorded included seizure (n=82), speech impairment (n=103), hearing impairments (n=54), feeding problems (n=53), and visual impairment (n=51). Other co-morbidities were constipation, hip dislocation, pneumonia, scoliosis, and gastro-oesophageal reflux.

Classifying GMFCS level using recorded sitting and walking capability implied that these children with CP in Thailand were mostly non-ambulatory (Level III-V).

STUDY OF THE PATTERN OF CEREBRAL PALSY AMONG CHILDREN IN ALEXANDRIA, EGYPT

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Cerebral palsy (cp) is the commonest neuro-motor impairment in childhood. In recent years, there has been mounting changes in cp pattern. Despite of its importance, the problem is largely ignored in developing countries including Egypt.

The aim of our study was arranged for: giving a recent comprehensive study about cp patterns among cp infants and children attending Alexandria University Children's Hospital over a period of one year (2010-2011)

Subjects: 286 cerebral palsy patients attending the pediatric neurology clinic at aucih over a period of one year.

Methods: data was collected from parents or near relatives, from clinical examination and from medical files and records of the neurology clinic. The patients were then classified according to the following: clinical types (spastic, ataxic, dyskinetic and mixed), topographic classification, associated classification, aetiological classification, and severity classification (mild, moderate, severe).

Results and discussion: most of our cases are males (60%). Spastic cp is the commonest (82.5%) and most of them are tetraplegic (4 limbs affection, 51.6%) and followed by hemiplegic type and the least was triplegic type. 42% of cases were suffered from epilepsy and their EEG is mainly of focal changes with secondary generalization. Feeding problems were reported in 74%. As regard etiological factors, most of our cases were due to prenatal causes (48%) mainly due to prematurity then bleeding during early gestations, pre-eclampsia and placental insufficiency. Idiopathic cp was diagnose in 13% of our cases.

Conclusion: cerebral palsy is a common health problem in alexandria and nearby governorates and much more attention needs to be paid to its magnitude. Early diagnosis of cp is important to allow fully integrated early intervention and to ensure a favorable outcome. Risk factors are: prematurity, gestational hypertension and pre-eclampsia, placental insufficiency (small gestational age), intrauterine bleeding and the need of neonatal intensive care.
POPULATION-BASED STUDY OF REHABILITATION SERVICES PROVIDED FOR CHILDREN WITH CEREBRAL PALSY

Almasri N., Saleh M.
University of Jordan.

Scientific background: In Jordan, knowledge about accessibility, coordination, and focus of rehabilitation services provided for children with cerebral Palsy (CP) is very limited.

Aims: To describe rehabilitation services provided for children with CP in terms of type, accessibility, focus of therapy, and caregivers’ satisfaction, and to describe differences among services based on children Gross Motor Function Classification System (GMFCS).

Methods and subjects: Parents of 101 children with CP participated in a population-based descriptive study across Jordan. Children aged 4.8±4.4 years, 53% were males. Children varied across the GMFCS levels. 75% of the parents were mothers, of which 77% have at least high school education. 83% of participating families were of low income. Participants completed self-report questionnaires related to services, family, and child characteristics. The level of GMFCS of children was determined by reliable research assistants.

Results and discussion: 95% of parents expressed needs for rehabilitation services and 70.3% for primary health care; however, only 2% expressed needs for mental health services, and 6% for community services. Parents reported access to most of the services they needed for their children, and were mostly satisfied with these services. During therapy sessions, the focus of therapy was on impairments more than participation as reported by parents. Parents of children in levels I&II GMFCS reported better access to services than children in level IV&V.

In Jordan, the majority of services for children with CP are provided by medical and rehabilitation teams, while community and educational systems have limited role in providing services. Jordanian parents tend to report high satisfaction with services mainly due to feeling obliged to service providers. Service providers should be informed regarding the effectiveness of participation and functional-based models of service and the importance of considering the GMFCS of children when providing services for children with CP to better meet their needs and improve their access to services.
SAFETY OF A SECOND EPISODE OF BOTULINUM TOXIN-A FOR CARE/COMFORT IN CHILDREN WITH CEREBRAL PALSY.

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²Queensland Cerebral Palsy and Rehabilitation Research Centre, School of Medicine, The University of Queensland, Australia

Aim: To determine safety of repeated versus single intramuscular Botulinum Toxin A injections (BoNT-A) plus therapy in children with marked cerebral palsy (CP) for goals of care and comfort.

Subjects: Forty-one children, mean age 7.1 (range 2.3-16) yrs, 27 males (66%); GMFCS IV=3, V=38, were randomly allocated to receive BoNT-A and therapy (n=23) or sham and therapy (n=18). Four children (n=3 surgery, n=1 safety) withdrew prior to the second cycle where all children received BoNT-A. Two episodes n=20, one episode n=17.

Method: Cycle 1, BoNT-A (max total dose 400U BOTOX®, at 12U kg/BW, ½-2U kg/muscle, dilution 100U/1ml saline) plus anaesthetic cream and intranasal fentanyl, OR sham procedure using anaesthetic cream and saline nasal spray. Cycle 2 injections 6 months from baseline. Adverse events (AE) were collected at 2, 4 and 16 wks post injections by a physician masked to group allocation. Adverse events were rated according to severity, likely relationship to BoNT-A and system/organ classification.

Results: Rates of adverse events were compared between groups using Poisson regression. No difference in co/morbidities or outcome measures between groups at baseline. 10/17(59%) children from SHAM+1BoNTA group and 11/20(55%) from 2BoNT-A group had a moderate/serious event. The median (range) of moderate/serious events for 1BoNTA and 2BoNTA groups was 1(0-3) and 1(0-4) respectively; incidence rate ratio(IRR)=0.85, 95%CI=0.45-1.61; P=0.62. 14(82%) children from 1BoNTA group and 18(90%) from 2BoNT/A group had any adverse event. The median (range) of all events for the 1BoNTA and 2BoNTA groups was 2(0-4) and 2(0-7) respectively; IRR=1.29, 95%CI=0.81-2.03; P=0.27. The safety review found there was no pattern of children having repeated serious or moderate events attributed to the BoNT-A or the anaesthesia. Mild events were repeated and related to the BoNT-A.

Discussion: Repetition of BoNTA did not significantly increase the likelihood of having an adverse event in this patient group with complex co-morbidities.

PRESENTATION OF FRENCH “COHORT OF CHILDREN WITH SEVERE FORMS OF CEREBRAL PALSY”

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Children with severe forms of cerebral palsy (CP) are high risk of hip joint displacement and scoliosis. We do not know exactly how these complications are linked together and which one will provoke pain and when pain will occurs. Results about this question in the scientific literature are discordant.

Aim: The purpose of this French cohort is first to establish the incidence of orthopedic complications (scoliosis and hip joint) and their sequences with time and secondary to explore related pain and impact of nutrition, surgery, asymmetric postures and environmental factors.

Methods and subjects: Longitudinal study during 10 years of 385 patients aged from 4 to 10, with severe cerebral palsy according to one visit per year. Patients are recruited over three years (end of recruitment period: December 2012), in 42 sites located all over France. Currently, 177 children have been included.
We use the Gross Motor Function Classification System (GMFCS) to determine abilities and limitations in gross motor function, we consider hip joint displacement if it was more than 30%.

Results and discussion: We present the results of the first 160 patients. Mean age is 6.9 years; 59.4% of boys and 40.6% of girls. 30.0% are GMFCS IV and 69.4% GMFCS V. 26.9% of children have scoliosis, and 37.7% have hip displacement, 25.6% of patients have been reported as painful. We can affirm that pain and orthopedics complications are still a problem today for these patients who do not walk.

Knowledge given by this study would permit to improve medical follow-up and quality of life of these patients, by putting in place preventive actions and adapted treatments. Surgery indications for scoliosis and hip joint displacement would be precise as well as postural equipment.

**DAY AND NIGHT BODY POSITION AND MOVEMENT IN CHILDREN WITH SEVERE CEREBRAL PALSY**

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Scientific background: Most children with severe cerebral palsy (CP) are not able to move freely or turn over by themselves; therefore, they might spend a long time in one position if they do not receive help from a caregiver.

Aim: To investigate differences in position and movement in daily life between children with severe CP and children with typical development (TD) using wearable devices.

Methods and subjects: Fifteen children with severe CP living at home (7 males, 8 females; mean age 8.3 ± 4.4 years) and 15 children with TD (6 males, 9 females; mean age 8.6 ± 4.8 years) participated. Body position (upright, supine, right- and left-side lying, prone) and movements (active or inactive) were recorded for 24 hours using wearable devices worn by each child. The period of time spent in one position and inactive periods during daytime and nighttime sleep were computed and analyzed for group differences.

Results and Discussion: The children with disabilities showed the longest mean time spent in one position and the longest mean inactive period compared to the children with TD during nighttime sleep (5.7 ± 3.4 hrs vs. 3.4 ± 1.3 hrs for time spent in one position, 1.4 ± 0.8 hrs vs. 0.7 ± 0.3 hrs for inactive period, p < 0.05). No significant difference was found between the two groups during the daytime. These results indicate that in children with severe disabilities, position changes and body movements are extremely sparse during nighttime sleep. This suggests that more attention should be paid to nighttime sleep in children with CP, to prevent immobility-related problems such as pressure ulcers and deformity.


**THE MORGAN PALEG HYPOTONIA SCALE**

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Scientific background: Hypotonia has always been described as a "decrease in the resistance to passive movement, but there is currently no tool to measure hypotonia objectively.

Aim: To develop a screening tool to identify infants and young children with hypotonia that require either monitoring, therapeutic or medical evaluation.

Methods and subjects: Thirty objective clinical measurements related to hypotonia were gathered from the systematic review of the literature. These potential test items were then discussed during three focus groups of 25-30 pediatric PTs and OTs. Ten items were consistently identified by the participants. This 10-item screening tool was then presented to and discussed with 7 focus groups consisting of 25-30 pediatric PTs and OTs. From these 10 items, six items were identified by the majority of the participants as reliable
indicators of hypotonia. This final version of 6 items (MPH-6) was presented and discussed at an additional four focus groups consisting of 25-50 pediatric PTs and OTs and finally shared and discussed with 5 expert physicians. Modifications were made, and the final version of the MPH-6 was then tested by 40 pediatric PTs who work in early intervention for validation.

Results and discussion: A score of 0-.4 on the MPH-6 indicated the child was not hypotonic, and was not in need of additional evaluation or intervention. Children with mild/moderate hypotonia had a score of .5-1.2 suggesting that they either needed to be monitored closely or referred for an assessment by an early intervention team for consideration of intervention services. A score of 1.3-2 indicated more severe hypotonia, suggesting that a referral to a qualified physician (developmental pediatrician, neurologist, physiatrist, etc) for a diagnostic evaluation was indicated. The MPH-6 provides an objective measurement of hypotonia to assist the clinician in determining which children require monitoring, assessment and intervention, or a full diagnostic evaluation by a physician.

RESULTS OF A 2 YEAR STUDY INVESTIGATING THE INFLUENCE OF HOME BASED THERAPY ON CEREBRAL PALSY

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Background: severely affected cerebral palsy (cp) patients (gmfc 4 and 5) struggle to benefit from conventional non-invasive rehabilitation platforms.

Aim: the feasibility of a high frequency home-based therapy that utilizes parents as the primary caregiver was explored.

Methods and subjects: a total of 274 american and south american cerebral palsy patients participated. An inclusion criterion further limited patients to gmfc type 4 and 5. Exclusion criteria restricted use of patients having undergone limb surgery or botulinum toxin a treatments 6 months prior to or over the course of the study leaving 60 relevant candidates. parents of cp patients were instructed by an experienced physical therapist a home based therapy. specific stimulation guidelines (pressure magnitude and frequency) were instructed and were monitored using a custom force gauge integrated into the therapy. Therapy was encouraged for at least 30 minutes 5 times a week. Cpchild questionnaires were completed and collected before treatment and consecutively every 6 months by the parent. Therapy and study directives respect ethical norms. non-parametric wilcoxon tests were utilized to perform post-hoc analyses.

Results and discussion: baseline cpchild scores agreed with published mean values. to date, gmfc type 4 patients improved their cpchild scores by 5 points (8%, p=0.2), 9 points (18%, p=0.3), and 6 points (12%, p>0.5) over initial measures after 6, 12, and 18 months of home therapy respectively. correspondingly, gmfc type 5 patients improved their cpchild scores by 3 points (5%, p= 0.4), negligible variation, and 9 points (19%, p=0.1) after 6, 12, and 18 months. Although further data is required to achieve statistical significance, preliminary trends in results suggest home based therapy using high frequency manual stimulation is a feasible platform for the improved health and wellbeing of severely affected cerebral palsy patients.

GROUP 34 – FAMILY 2

THE UNMET FAMILY NEEDS AND PERCEIVED STRESS IN PARENTS WITH CHILDREN WITH CEREBRAL PALSY

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Background: The parents of children with disabilities, including children with cerebral palsy (CP), experience a higher level of stress than the parents of children without a disability. Studies have shown that
perceived stress of parents might be affected by various factors, including the amount and type of family needs expressed by family members of children with CP.

Objective: To explore whether there is a connection between perceived stress and the amount and type of family needs in parents of pre-school children with cerebral palsy.

Material and Methods: 30 parents (27 mothers, 3 fathers) of children (mean age 4.5 SD 2.1 years) diagnosed with cerebral palsy participated in the study. Families received health services in three out-patient centres in Riga. The family needs were estimated using a translated and adapted version of Family Needs Survey (Bailey & Simeonsson, 1988). The measure includes 41 items grouped into six areas of needs: Information, Support, Explaining to Others, Community Services, Financial Needs and Family Functioning. The perceived stress level of parents was measured with translated version of Perceived Stress Scale - PSS 14 (Cohen et al, 1983).

Results and discussion: The results reveal that a lower stress level was associated with fewer family needs related to Support (r=0.77, p<0.01), Finances (r=0.74 p<0.01) and Family Functioning (r = 0.67, p<0.01). There were some association with family needs related to Explaining to others (r=0.61, p<0.01), Needs for Information (r=0.61, p<0.01) and Community resources (r=0.57, p<0.01). In general fewer family needs were recognized in parents with lower perceived stress (r=0.87, p<0.01).

The data supports previous evidence that there is a connection between perceived stress and the amount and type of family needs in parents of children with cerebral palsy. However, due to the small and selected sample, the results need to be interpreted with caution. Future work with larger sample size and more detailed analysis is planned.

PARENTS EXPECTATIONS REGARDING CHILDREN WITH CEREBRAL PALSY'S FUTURE

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Scientific background: Parent's expectations regarding their child's future are important as parental expectations guide behavior and relationships. However, the topic of parental expectations has received little attention in children with cerebral palsy (CP) literature.

Aim: To evaluate: 1) the reliability and validity of parents' expectations questionnaire of their child with CP (PEQ-CP), 2) associations between PEQ-CP and child's impairment and activity levels.

Methods and subjects: The sample comprised of 49 mothers, fathers and children with CP. Parental expectations questionnaire was developed for the current study for evaluating child's future including: independence in daily life activities, raising a family, livelihood and happiness. Activity was assessed with the Pediatric Evaluation Disability Inventory (PEDI) Functional Skills (FS) and Care-giver assistance (CA) scales. Internal consistency and overall reliability of the PEQ-CP were assessed via Cronbach's alpha and intraclass correlation coefficient (ICC). Discriminative validity was assessed using collapsed strata of the Gross Motor Function Classification Measure-66 (GMFM-66). PEQ-CP mean difference between mother's and father's was investigated via paired t-test.

Results and discussion: Children's mean age was 8.8 ± 2.1. The reliability of the questionnaire was good-to-excellent. The PEQ-CP was able to distinguish between children with various levels of impairment severity. No significant differences were found between mother's and father's expectations. Total score of the PEQ-CP was related to all PEDI domains. Individual items, but for "happiness" item, were associated with both FS and CA sub-domains. Mother's and father's PEQ-CP was also associated with GMFM-66.

Conclusion: The PEQ-CP has good psychometric properties when administered by mothers and fathers. Parent's expectations regarding the child's future is congruent with the child's impairment level and abilities. It appears that the PEQ-CP 'happiness' item relates to different aspects of life than the other items.
“OUR CHILD’S SIGNIFICANT DISABILITY SHAPES OUR LIVES”: EXPERIENCES OF FAMILY SOCIAL PARTICIPATION

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Children and youth who are severely physically disabled rely on extensive family support for their daily care needs and activity engagement, and consequently they and their families are at risk of restricted participation in activities that support their wellbeing, social relationships, and family cohesion.

This study aimed to understand parents’ view of their family social participation: the enabling and restricting factors families faced; strategies they used to reduce barriers to their participation; and supports they perceived would further assist them.

Based on narrative inquiry as the research methodology, the experiences of ten parents of children and youth (10/18 years) with severe physical disabilities identified as GMFCS & MACS Levels IV or V were explored using The Occupational Performance History Interview (OPHI/II). Each interview was audio-recorded and transcribed verbatim. A core story, constructed from each interview, identified key participation issues using narrative analysis. Thematic analysis compared themes across participant’s stories.

Parents used highly structured routines and required substantial resources, particularly adult assistance and financial means to facilitate family social participation. Their needs were greater when their child had more severe impairments, was heavier, incontinent, or had fragile health. Past experiences and parents’ perceptions of their disabled child’s enjoyment and benefit from participation influenced parents’ motivation to continue to explore ways their family could participate. Together these factors affected parents’ choices of family activities, parents’ ability to assume other roles they valued, parents’ belief in their ability to influence the quality of family experiences and family enjoyment and satisfaction. These families’ social participation relied on additional resources and flexible service delivery tailored to their needs and preferences. Clinicians, policy makers and service providers need to provide varied resource options from which parents can select services that enable their family to participate socially in ways that they value and enjoy.

THE INFLUENCE OF PARENTING STYLE IN THE EVOLUTION OF CHILD WITH CEREBRAL PALSY (CP)

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Background and aims: This paper aims to present parenting styles seen in children with cerebral palsy admitted to our clinic and how they influence the evolution of these children.

Our aims are: Determination of the caregivers’ parenting styles in our center. Assessing the influence of parenting styles on the evolution of children with cerebral palsy.

Methods: Our studied group includes 100 parents who completed the parenting styles questionnaire (excessive protector, balanced, indifferent, authoritarian, inconsistent styles) and their children aged 10-18 years diagnosed with CP, receiving "Who am I" test and then “Family” test for correlation with parenting style.

Results: It is obvious that excessive protector parenting style is dominant in our study followed by indifferent, inconsistent, balanced, authoritative styles. Children from families with excessive protector parenting style have difficulty acquiring basic skills, relating with others, they are lack of initiative and self-esteem, avoid or have a distorted contact with reality.

Conclusions: Detection of parenting style is required for the evolution of children with CP; approach of optimal style leads to harmonious development, preparing children for life.
PARENT PERCEPTIONS OF FAMILY-CENTERED PRACTICE FOR CHILDREN WITH CEREBRAL PALSY IN JORDAN

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Scientific background: The Measure of Process of Care-20 items set (MPOC-20) is a valid and reliable self-report measure of parents' perceptions of the extent to which health services are family-centered.

Aims: To culturally validate the MPOC-20, and to describe and identify variables that influence parents' perceptions of family-centered practice (FCP) in Amman, Jordan.

Subjects and methods: A cross-sectional study design. Participants were 98 families of children and youth with cerebral palsy who are receiving services at different settings in Amman, Jordan. Participating children aged 4.3±4.5 years, 52% were males. Children varied across Gross Motor Functional Classification System (GMFCS). Parents were mostly mothers (74.5%), with at least high school education (77.3%). Most of the participating families were of low income status (83.5%). Participants completed the validated Arabic version of MPOC-20. Criterion-tested assessors determined the GMFCS level of children.

Results and discussion: Generally parents' rating of the family-centered behaviors of staff who work with their children ranged between "to fairly great extent" and "to moderate extent". Respectful and supportive care received the highest rating, while providing information (general and specific) received the lowest. There were significant differences in scores of three scales of the MPOC-20 between families of children at level I and IV on the GMFCS. General child health also affected scores in areas of coordinated and comprehensive care (p=0.34) and providing general information (p=0.023). Parents generally rated the family-centered behaviors of staff as positive in Jordan, with some gaps that needs improvement. Further research is needed to examine parents' perception of FCP for children with other disabilities.

GROUP 35 – PHYSICAL THERAPY 2+GAIT 4

WALKING STRIDE RATES PATTERNS CHILDREN WITH CEREBRAL PALSY

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Scientific Background: Ambulatory adolescents with cerebral palsy (CP) have been documented to have lower daily walking activity levels and patterns of habitual walking activity than typically developing youth (TDY).

Aim: Describe daily walking stride rate patterns of young children and youth with CP and compare to a TDY cohort.

Methods and Subjects: A cross sectional comparison cohort study examined walking stride rate curves developed from 5 days of StepWatch accelerometer (SW) data for 209 children with ambulatory CP, Gross Motor Function Classification System (GMFCS) levels I/III ages 2-13 years. Participants were compared to a sample of and 368 TDY.

Results and Discussion: For all youth with CP, non-walking activity levels significantly varied with age (p = .005) and were lowest at 8-9 years. Time spent at low intensity walking (1-39 stride/min) significantly increased with age (p=.004) and boys spent significantly more time at 40-60 strides/min (moderate intensity) than girls (p=.006). All children with CP walk less time per day than the TDY cohort regardless of GMFCS level (p<.001). Peak strides/min rates attained by TDY and participants at GMFCS levels I, II and III were 73, 70, 69 and 60 strides/min respectively (p<.001). Total number of strides and minutes spent at low and moderate stride intensities were significantly lower for all GMFCS levels compared to TDY (p <.007). Time spent at low intensity stride rates was not significantly different between GMFCS levels I and II for this sample. These results suggest that children and youth with CP demonstrate similar levels of walking activity relative to age and gender.
ad TDY. This information has potential to inform and focus the intensity and dosing of intervention protocols aimed at enhancing habitual walking activity levels and participation in daily life.

INFLUENCE OF PELVIC KINEMATICS ON LOWER LIMB ROTATIONAL DEVIATIONS DURING GAIT

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Scientific background: Lack of normalization of foot progression angle after correction of lower limb torsional troubles raised the question about the influence of pelvic rotation on lower limb rotation during gait.

Aim: To explore the influence of pelvic kinematics on foot progression angle deviations.

Methods and subjects: We retrospectively reviewed kinematic data of 188 children with spastic diplegia without any previous surgery. Data, recorded at mid stance, were: pelvic rotation, hip rotation, ankle rotation and foot progression angle.

Results and discussion: Abnormal pelvic rotation was noticed in 255 of 376 lower limbs (68%). Among 231 patients with internal foot progression angle, internal pelvic rotation was associated to other transverse plan kinematic deviations in 98 cases (42 %). For 78 patients who showed external foot progression angle, external pelvic rotation represented a combined cause in 22 cases (28%).

Pelvic rotation is difficult to analyse by means of observational gait analysis alone. This kinematic parameter can represent an isolated cause of abnormal foot progression angle but it is often combined with other transverse plan deviations. A detailed kinematic analysis of interaction between planes is an essential step when making surgical planning, particularly when foot progression angle has to be corrected.

MUSCLE STRENGTH IS RELATED TO THE ONE-MINUTE WALK TEST IN YOUNG CHILDREN WITH CEREBRAL PALSY

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Scientific Background Understanding the role of muscle strength in relation to walking performance in children with cerebral palsy (CP) is essential in treatment planning.

Aim: To assess the relationship between muscle strength and walking performance in children with CP.

Subjects and Method: 18 ambulatory children aged 3-11 years (mean=6.5 years, SD=2.0, range 3.7-10.7) with unilateral (n=9) and bilateral (n=9) spastic CP, GMFCS I (n=11) and II (n=7) were assessed on two test occasions. At each test occasion isometric strength of the hip abductors (ABD), knee extensors (KE), ankle plantar flexors with knees flexed (SOL) and extended (GSTR) of the most impaired limb were measured three times using a handheld dynamometer. Torque (Nm) was calculated by multiplying force (N) by the length (m) of the lever arm. The 1 minute walk test (1MWT) was performed once each test occasion. The average of the two test occasions and repetitions (of strength measurements) was used for further analysis. Regression analyses were performed. A correction was made for the possible confounder height when necessary.

Results and Discussion There was a strong association between isometric muscle strength (GSTR R²=75%, ABD R²=74%, SOL R²=71%, KE R²=59%) and the 1MWT. Height was a confounder for the relationship between the 1MWT and ABD or SOL.

This may suggest that strength training can improve walking performance in the 1MWT. Although strength training is more commonly used in children with CP, increases in strength are not always accompanied by improvements in walking. Application of motor learning and task-oriented exercises might
be needed to transfer the increase in strength achieved in the training to functional activities such as walking.

HOW ACTIVE ARE THEY? HABITUAL PHYSICAL ACTIVITY AND MOTOR FUNCTION IN TODDLERS WITH CEREBRAL PALSY

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Scientific background: Habitual physical activity (HPA) is an established determinant for healthy growth and development. Accelerometers are considered to be the most promising measure of free-living activity in toddlers.

Aim: To describe the cross-sectional relationship between HPA and gross motor function in toddlers with cerebral palsy (CP).

Methods and subjects: Sixty-five children (45 boys) with CP, mean±SD age 2yrs 3mo±6mo with Gross Motor Function Classification (GMFCS): I=32; II=6; III=14; IV=3; and V=10. Mean Gross Motor Function Measure (GMFM-66) score was 51 (±19; range: 13.5-89.7). Motor type distribution was: unilateral spasticity=23; bilateral spasticity=30; hypotonia=7; athetosis=3; ataxia=1; and dystonia=1. Children wore an Actigraph® accelerometer at the centre of their lower back during waking hours for three days (mean±SD 542±73 min/day) while parents kept an activity log. HPA was calculated as mean activity counts per minute (cpm) reflecting magnitude of acceleration in the vertical axis.

Results and discussion: GMFM score explained 39% of the variance in HPA after controlling for age, gender and motor type (Multiple Linear Regression, p<0.001). Only GMFM score was statistically significant in the final model (β=0.7, 95%CI=5.8-9.6, p<0.001). HPA was significantly different (ANOVA Games/Howell post/hoc test, p≤0.004) between all groups; GMFCS I/II (451±132cpm; range: 197/756cpm), III (283±142cpm; range: 114/547cpm) and IV/V (69±45cpm; range: 8/146cpm). This demonstrates a reduction of HPA with increasing functional impairment but also shows children classified as GMFCS I, II and III have high within/group variability in HPA levels. Despite having capacity for higher activity levels, some of these children have HPA levels similar to those classified as GMFCS IV and V. The use of a quantitative measure of HPA enables identification of children at risk of developing conditions such as chronic pain, fatigue and low bone mineral density secondary to low levels of HPA, and the assessment of the efficacy of prescribed interventions.

HEART RATE VARIABILITY IN CHILDREN WITH CEREBRAL PALSY AND ACQUIRED BRAIN INJURY

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Scientific background: Children with cerebral palsy (CP) may demonstrate cardiac autonomic function (CAF) disturbance. As CAF may be associated with motor function it is important to assess this association in children with CP in comparison to children with acquired brain injury (ABI) and typically-developed (TDC).

Aims: 1) to evaluate CAF during rest and exercise in children with CP, ABI and TDC; and 2) to assess the association of CAF with mobility.

Subjects and Methods: Fourteen children with CP, nine with ABI, and seven TDC participated. CAF was established via heart rate variability (HRV) with a Polar watch and assessed via the following measures: mean R-R intervals, standard deviation of the average R-R intervals, root mean square-standard deviation and high and low frequencies. HRV was assessed during rest and aerobic and isometric exercise. Isometric
exercise (children with CP only) consisted of graviton machine pushup. Aerobic exercise consisted of the six minutes walk test (6MWT). Mobility level was established via the distance walked in the 6MWT and gait speed in 10 meters. One way ANOVA examined differences between the groups in HRV. t-test compared rest and exercise HRV. Associations established with Pearson correlations.

Results and Discussion: Compares to TDC, at rest, children with CP and ABI demonstrated lower HRV. HRV at rest of children with CP were lower than those of children with ABI. HRV changed significantly during aerobic exercise only among the TDC. Similarly, HRV of children with CP during isometric exercise and rest was not significantly different. The decrease in HRV in children with CP and ABI were related to mobility level. In conclusion, compares to TDC, the cardiac autonomic mechanism of children with CP and ABI is less efficient at rest, less adaptive to exercise and related to mobility. However, children with CP exhibited greater CAF disturbance.

GROUP 36 – MENTAL HEALTH

PSYCHOLOGICAL PROBLEMS IN ADOLESCENTS WITH CEREBRAL PALSY: A EUROPEAN LONGITUDINAL STUDY

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Scientific background: Children with cerebral palsy (CP) are at increased risk of psychological problems compared to typically developing children, yet little known about the extent to which these problems are stable or where opportunities might lie for prevention.

Aim: (1) To describe the prevalence and stability of emotional symptoms, conduct disorder, hyperactivity, peer and prosocial problems in adolescents with CP. (2) To study the determinants of psychological problems including child impairments and potentially modifiable factors.

Methods and subjects: Randomly sampled children with CP in nine European regions were interviewed at age 8-12 years (T1; n=818) and 73% (n=594) again at age 13-17 years (T2) as part of SPARCLE. The Strengths & Difficulties Questionnaire (SDQ1, parent form) was used to identify psychological problems. Predictors of psychological problems were studied using multivariable logistic regression.

Results: Adolescents with CP have a rate of clinically significant psychological problems twice that of typically developing children. However, hyperactivity decreased over time (p<0.001) but peer problems increased (p=0.002) making this the most common problem affecting 39% of the sample. Considerable stability in all domains of the SDQ was apparent. Age and sex predicted emotional symptoms, sex also predicted hyperactivity, parent qualifications predicted peer problems and intellectual impairment prosocial problems. Each domain of the SDQ at T2 was significantly predicted by their corresponding domain at T1 and accounted for the most variation in psychological outcome by adolescence.

Discussion: While children with CP grow into and grow out of some problems, by adolescence their psychological well-being in middle childhood remains the most significant predictor of their well-being four years later. The identification of high risk groups and the treatment of psychological problems earlier in childhood could improve outcomes by adolescence although few other potentially modifiable risk factors were identified.

SOCIAL SUPPORT SERVICES MEDIATE EMOTIONAL WELL-BEING OF CAREGIVERS OF CHILDREN WITH CEREBRAL PALSY

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Scientific Background: Although social and information support services are considered to have a major impact on stress, depression, anxiety, emotional well-being and resilience of caregivers of children with disabilities, little is known about specific benefits for caregivers of children with cerebral palsy (CP).

Aim: Determine associations between met/unmet support needs (information, support groups, parenting programs and counselling), caregiver well-being (depression, anxiety, stress, resilience and well-being) and child factors (age and severity of CP).

Methods and Subjects: 71 caregivers of children with CP (90% mothers; mean age 38.5 years; child’s age mean 7.26, range 1.5-12.75 years) completed assessments of support needs (Caregiver Social Support Needs Questionnaire and the Family Needs Survey) and emotional wellbeing (Depression Anxiety and Stress Scale (DASS-21), Resilience Scale and Warwick-Edinburgh Mental Well-being Scale). Associations between support needs and well-being were assessed by correlations. Comparison of well-being between caregivers with met versus unmet support needs were assessed by t-tests. Effects of age (0-4years, 4-8years and 8-12years) on caregiver support needs and well-being were examined by a multivariate ANOVA.

Results and Discussion: Caregivers reported higher stress, depression and anxiety compared to the general population, however comparable resilience and overall well-being. Those with perceived adequate social support did not have higher resilience or emotional well-being than those with perceived unmet support needs, however they did report significantly lower stress (p=0.008), depression (p=0.03) and anxiety (p<0.001). Caregivers of children <4 years reported more unmet support needs (p=0.004), higher depression (p=0.04) and anxiety (p=0.013), but also higher resilience (p=0.004) than caregivers of children >4 years. Stress, anxiety and depression in caregivers of children with CP is related to their child’s age and family access to adequate social and information support services. Services introduced early in a child’s life and tailored to caregivers’ perceived needs are most beneficial in enhancing emotional well-being.

SELF-REPORTED MENTAL HEALTH IN CHILDREN WITH CEREBRAL PALSY 8-18 YEARS OLD

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Scientific background: Mental health problems often accompany the motor disorder in cerebral palsy (CP). Aim: To explore self-reported mental health in paediatric CP.

Methods and subjects: 81 participants (40 males), median age 15.6 years, were assessed with clinical examination, interview and questionnaires. GMFCS levels were I 43 %, II 41 %, III 12% and IV-V 4 %. Six children used an anti-epileptic drug, and 55 children (67 %) had recurrent musculoskeletal pain (RMP). The children and their mothers reported child mental health problems on the Strengths and Difficulties Questionnaire (SDQ), mothers in addition reported socio-economic status and own mental health on the General Health Questionnaire (GHQ). The SDQ consists of four symptom scales yielding a “total difficulties score” (TDS). An additional prosocial subscale measures the ability to act prosocially, independent of the difficulties measured by the other subscales. Responses from boys and girls were analysed separately and compared to gender-specific self-report from the Norwegian general population (TDY) 10-19 years old and to mother’s report.

Results and discussion: Boys and girls were similar regarding GMFCS levels, epilepsy, RMP, socio-economic factors and maternal GHQ score. Compared to TDY, both genders reported similar amount of peer problems and more prosocial behaviour (p<0.01). In addition, boys reported less conduct and hyperactivity problems (p<0.01), more emotional problems (p<0.05) and lower TDS (p<0.05). Girls reported less conduct and hyperactivity problems (p<0.05) and similar TDS. Compared to mothers, both genders reported less peer problems (<0.01) and girls reported more prosocial behaviour (p<0.05). Boys reported less hyperactivity problems (p<0.01) and lower TDS (p<0.01).
As expected from studies of other chronic health conditions, children reported less mental health problems than mothers proxy-reported, but the difference reached statistical significance only for boys. Child and maternal different view on peer problems may indicate different view on child societal participation as well.

**SYSTEMATIC REVIEW OF SELF-CONCEPT MEASURES FOR PRIMARY SCHOOL AGED CHILDREN WITH CEREBRAL PALSY**

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Scientific background: Self-concept is broadly defined as an individual’s perception of oneself. Although self-concept is thought to be negatively affected by having cerebral palsy (CP), there is limited research about self-concept development, difficulties or interventions in this population. A major barrier may be lack of measurement instruments with suitable psychometric data.

Aim: This systematic review aimed to identify self-concept measures suitable for children aged 8-12 with CP.

Methods and subject: Six electronic databases (PubMed, MEDLINE, CINAHL, PsycINFO, PsycARTICLES and Web of Science) were searched from the earliest possible date (1966) to January 2012 to identify assessment tools: (i) that measured self-concept, (ii) in children aged 8-12 years (iii) with CP; and (iv) that had psychometric data available for CP. To identify all possible assessments and psychometric information, secondary searching included: reference lists of identified articles, citation tracking of included articles, and electronic searches of included test titles and authors’ names.

Results and discussion: Searches yielded 264 articles, of which 25 met the criteria for the review. These articles included 10 different self-concept assessments used with children with CP, however only four had any psychometric data for the target population. The Self-Perception Profile for Children (SPPC) was most commonly used. Children with CP showed good/excellent test-retest reliability on the typically developing version and good internal consistency using a modified version for children with CP in the Netherlands. The Self-Description Questionnaire/I (SDQ/I) was less popular, however a study of 103 children with CP reported good-excellent internal consistency and emerging construct validity. The Rosenberg Self-Esteem Index (RSE) showed excellent internal consistency for children with CP. At this stage no self-concept instrument published in English has sufficient psychometric data for children with CP. The SPPC and the SDQ/I are promising options, however they vary in the characteristics used to estimate the self-concept construct.

**HOW SCHOOL READY ARE PRE-SCHOOL AGED CHILDREN WITH CEREBRAL PALSY?**

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Scientific Background: Cross-sectional population-based, cohort study

Aim: To examine the attainment of motor performance, self-care skills and social function in preschool age children with Cerebral Palsy (CP) compared to typically developing children (TDC) prior to school entry.

Subjects and Methods: Participants were entered from a population-based cohort of 329 children diagnosed with CP. Children were included if they attended 48 or 60 month appointments (n=139). Children were classified as GMFCS I=71(51%), II=20(14%), III=13(9%), IV=18(13%) and V=17(12%) with predominant motor type unilateral spasticity (n=63,45%), bilateral spasticity (n=59,42%), dystonia/ataxia (n=8,6%), hypotonia (n=2,1%) or athetosis (n=6,4%).

Children were assessed for motor performance (PEIDI mobility SS), self-care (PEIDI Self-care SS) and social function (PEIDI SF SS) at 48-60 months (c.a) and compared to TDC (n=51). Logistic regression was used to compare children with GMFCS I-III vs IV-V.
Results and Discussion: Children with cerebral palsy at 48-60 months had lower PEDI scores in all domains compared with TDC (mean(SD)=50(10)). Self-care scores were 0.5–>4 SDs below those of TDC with mean(SD) scores for GMFCS I=34.3(14.7), II=24.8(14.1), III=19.0(9.6), IV=10.5(1.7) and V≤10(0). Motor performance was 2–>4 SD below TDC with mean(SD) scores for GMFCS I=27.8(16.2), II=16.0(11.2), III=10(0), IV=10.2(1.1) and V≤10(0). Social function was 0.5–>4 SD below TDC with mean(SD) scores for GMFCS I=41.8(17.0), I=29.2(14.0), III=28.1(12.1), IV=20.3(15.4) and V=11.6(5.1). Children with GMFCS IV-V scored significantly lower on the PEDI than GMFCS I-III. The mean(95% CI) difference for self care was 17.4(10.1/24.8) (p<0.01), mobility 15.9(8.5/23.3) (p<0.01) and social function 23.9(14.7/33.0) (p<0.01).

Physical needs are a primary focus for preschool age children with CP as they demonstrate mobility 2 to 4 SD below their peers. Of potentially greater importance for school readiness is their reduced self-care abilities and poorer social function. Broader emphasis needs to be placed on multi-modal intervention to prepare children for school entry.

SOCIAL FACTORS DETERMINING PHYSICALLY ACTIVITY IN ADOLESCENTS WITH CEREBRAL PALSY

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Scientific background:
To engage and maintain adolescents’ participation in physical activity it is important to fully understand the factors that influence their physical activity behaviours.

Aim:
The aim of this qualitative study was to determine how social environments motivate or discourage participation in physical activity for youth with cerebral palsy (cp).

Methods and subjects:
A qualitative research method (phenomenological approach) was chosen to allow adolescents to voice their own opinions. Nine ambulatory and non-ambulatory adolescents with cp (mean age 14 yrs, ranging 10-21 years; self reported gross motor function classification system (gmfc) distribution: n=2 level i, n=2 level iii, n=3 level iv, n=2 level v) and 11 parents of adolescents with cp participated in one of the 8 focus groups or an individual interview. Digital audio recordings were made and all discussions were transcribed and analyzed using qsr nvivo 9 software. Text was reviewed independently by 3 members of the study team (bg, l5, and dj).

Results and discussion:
Thematic analysis revealed social factors at the youth, family and community levels. Youths’ personal preferences and attitudes were key determinants in the types of activities they chose to pursue. Social relationships with family members, peers, and other adults either motivated or discouraged youth from engaging in physical activity. Some specific challenges of youth with cp included keeping up with same-age peers, having a disability that was less visible, and relying on parents for advocacy and support. This study helped us gain insight and understanding of the participants’ experiences and perspectives in physical activity, which can be of great importance when planning programs aimed at helping youth become and/or stay physically active.
IS THE PREVALENCE OF CEREBRAL PALSY RELATED TO PERINATAL CARE QUALITY?

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Scientific background: The prevalence rate of cerebral palsy (CP) has often been used as an indicator of perinatal care quality.

Aim: To monitor trends in the prevalence of cerebral palsy and quantify their association with perinatal risk factors.

Subjects and methods: Data from a French morbidity register on severe neurodevelopmental disabilities were analysed for trends in CP, in children born between 1982 and 2002 and residing in their eighth year of life in a geographically restricted area.

Results and discussion: 577 cases (56.8% boys) with CP were registered with an average annual prevalence rate of 1.9/10,000 (95% CI: 1.7-2.0), among which 56% with the bilateral spastic, 29.7% the unilateral spastic, 5.9% the ataxic and 1.9% the dyskinetic form. The prevalence of CP rose from 1982 till 1993 (p<0.001), after which it decreased significantly (p<0.0001), primarily due to decreased prevalence of bilateral spastic cases (p<0.0001). The proportion of intellectually retarded children also decreased significantly (p=0.02) from 46% in the period 1982-1984, to 25% in the period 2000-2002. The aetiology was unknown in 26 to 45% of the cases, depending on the period. Of the known aetiologies, the part explained by perinatal causes tended to increase (p=0.078) from the period 1988-1991 to 2000-2002, relative to the pre- and postnatal causes which remained stable.

The proportion of CP born prematurely and highly prematurely (between 32/36 and below 32 weeks of gestation, respectively) increased over the period 1989/2002 (p=0.01), but the prevalence of CP among both categories decreased significantly (p=0.005 and 0.004, respectively). The proportion of preterm children with an intellectual disability and epilepsy was 2-4 times lower than among those born at term and was stable across periods.

Despite increasing proportions of preterm births the prevalence of CP is decreasing which may partly be explained by progress in prenatal diagnosis and preterm care.

ETIOLOGICAL FACTORS OF CEREBRAL PALSY OF CHILDREN BORN IN THE UNIVERSITY TEACHING HOSPITAL IN MOSTAR

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Aim: The aim of the paper is to analyze the frequency of prenatal and perinatal risk factors in children with cerebral palsy rehabilitated at the Department of Physiotherapy and Department of Psychophysiological and speech difficulties in University Teaching Hospital in Mostar and two private institutions for the rehabilitation of persons with special needs: The Holy Family in Mostar and the Holy Family in Siroki Brijeg.

Subjects: The study included all children with cerebral palsy on the rehabilitation in the abovementioned institutions, from 1 January 1997 to 1 January 2005. The number of patients is 55. The survey included 55 children with cerebral palsy, 28 of whom were male and 27 female children, which shows that cerebral palsy occurs equally in male and female children.
CITOMEGALOVIRUS AND CEREBRAL PALSY: A POPULATION BASED COHORT STUDY FROM ACPR

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Intrauterine (congenital) cytomegalovirus infection (CMV) can result in poor neurological outcomes including cerebral palsy (CP). Aims: To describe the incidence of CP attributed to congenital CMV reported to the Australian CP Register (ACPR) and to profile this series of children. Methods and subjects: Cases (birth years 1993-2003) were drawn from three state CP registers (South Australia, Victoria, and Western Australia) with population level ascertainment for CP (a rate of at least 1.5 per 1000 live births). The CMV Group comprised CP cases with a field entry for confirmed cause listed as congenital CMV. Clinical and demographic data were extracted. The CMV Group was compared with all those without CMV as a confirmed diagnosis (Other/Unknown Cause Group). Results: A total of n=36 cases, or 1.6% of CP cases were attributed to congenital CMV for this period, a rate of 3.1 per 100,000 live births. When compared with the Other/Unknown Cause Group, the CMV Group had proportionally more cases of spastic quadriplegia (n=24, 75% v 22%, spastic quadriplegia vs other topographies, Odds Ratio (OR): 8.9 (95% CI: 4.1-19.5)) and were significantly more likely to require wheeled mobility (GMFCS IV-V v I-III, OR: 7.94 (95% CI: 2.8-21.9)). The CMV Group had proportionally more cases of epilepsy (n=23, 64% v 27.8%), hearing impairment (n=20, 56% v 11%), vision impairment (n=21, 66% v 34%) and severe communication impairment (n=23, 64% v 21%). Discussion: CMV is an important, potentially preventable causal pathway to CP. The true burden of CP due to CMV remains unclear. The rate of CMV in this study, was in keeping with a recent South Australian retrospective case control study, but lower than that identified by prospective studies of congenital CMV elsewhere. Children in the CMV Group had more severe and multiple disabilities compared with those in the Other/Unknown Cause Group.

ETIOLOGY DOES NOT PLAY A ROLE IN THE EXTENT OF PSYCHOPATHOLOGY IN CHILDREN WITH CEREBRAL PALSY

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Aim: Children with cerebral palsy are at a higher risk of developing psychopathology as compared to normative population. The aim of our study was to examine the psychopathological profile characteristic of cerebral palsy, quality of life and to observe potential differences in these parameters between the two major etiology groups: Periventricular leukomalacia (prematurity) and asphyxia causing hypoxic ischemic encephalopathy (term infants).

Method: 23 children with cerebral palsy (9 premature, 14 term asphyxia) and 20 of their healthy siblings were assessed using parent forms of the Child Behavior Checklist , Disruptive Behavior Disorder Rating Scale and Pediatric Quality of Life Inventory.

Results: Children with cerebral palsy showed more emotional and behavioral abnormalities than their siblings and their quality of life as reported by their parents was lower. No differences were found between the children born prematurely and those who suffered asphyxia.

Interpretation: Children with cerebral palsy show abnormal emotional and behavioral symptoms and have poorer quality of life than their siblings. The pathopsychological profile of preterm and children with asphyxia at term is similar.
CEREBRAL PALSY ATTRIBUTED TO INJURY OR POSTNEONATAL INFECTION, METROPOLITAN ATLANTA, 1991 - 2008

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Scientific background: Cerebral palsy (CP) attributed to an event during infancy or early childhood may be preventable through public health interventions such as vaccinations and injury prevention measures.

Aim: This study estimated the prevalence of CP attributed to injury or postneonatal infection in metropolitan Atlanta from 1991-2008.

Methods and subjects: We used data from the Metropolitan Atlanta Developmental Disabilities Surveillance Program (MADDSP), a population-based, records-based surveillance system that monitors CP prevalence among 8-year-old children. We examined the prevalence of CP attributed to an injury occurring at any time after birth, or an infection at least 29 days after birth, up to 8 years of age. Children with documented prenatal or perinatal conditions were excluded. Prevalence rates per 10,000 8-year-old children were calculated for all children and by sex, race (Black non-Hispanic, White non-Hispanic), and time period (1991-1996, 2000-2008).

Results and discussion: From 1991-2008 there were 1338 CP cases; 93 (7.0%) were attributed to injury (n=67) or infection (n=26; meningitis, n=21). The prevalence of CP attributed to injury or postneonatal infection was 2.4 per 10,000 8-year-old children and decreased significantly from 1991-1996 (3.1/10,000) to 2000-2006 (1.9/10,000); the proportion of all CP cases attributed to injury or postneonatal infection declined from 9.4% (1991-1996) to 5.3% (2000-2008). Most notably, the prevalence of CP attributed to postneonatal infection declined from 1.0/10,000 (1991-1996) to 0.4/10,000 (2000-2008; p=0.02). Boys had a higher CP prevalence than girls (prevalence ratio (PR)=1.5), particularly for CP attributed to injury (PR=1.6). Black children had a higher CP prevalence than white children (PR=1.8), particularly for CP attributed to infection (PR=4.5). CP attributed to injury or postneonatal infection declined significantly between 1991 and 2008, primarily resulting from fewer cases attributed to postneonatal infection. Black children had a significantly higher prevalence than White children, particularly for CP attributed to postneonatal infection; further research to understand these disparities is needed.

AUTISM SPECTRUM DISORDER AMONG CHILDREN WITH CEREBRAL PALSY, METROPOLITAN ATLANTA, 2006 - 2008

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Scientific background: Previous studies have suggested that the frequency of autism spectrum disorders (ASD) among children with cerebral palsy is higher than the general population prevalence of ASD, but information from population-based studies is limited.

Aim: The goal of this study was to examine the frequency of ASD among children with CP identified from a population-based surveillance program.

Methods and subjects: We used data from the 2006 and 2008 surveillance years of the Metropolitan Atlanta Developmental Disabilities Surveillance Program (MADDSP). Children were included if they resided in the five-county surveillance area during the surveillance year, were born 8 years prior to the surveillance year, and met the MADDSP case definition for CP. Determination of ASD case status was made using MADDSP methodology. Frequency tables using chi-square statistics were used to examine differences in the frequency of ASD by sex, race/ethnicity, CP subtype, co-occurring ID, co-occurring epilepsy, and walking ability.

Results and discussion: A total of 358 children met the MADDSP case definition for CP; of these, 27 (7.5%) also met the case definition for ASD. The frequency of ASD among children with CP did not differ significantly by sex, race/ethnicity, CP subtype, or co-occurring epilepsy, but was higher among children with intellectual disability compared to those without (10.6% vs 5.1%, p=0.05). Among 241 children with CP with available data on walking ability, ASD frequency was higher among those who could walk independently compared to those with limited or no walking ability (11.1% vs 2.3%, p = 0.01). The lower
frequency of ASD among children with severe motor impairment suggests that clinicians should be alert to the possibility of ASD among these children with CP to ensure that they receive appropriate treatment and support. Diagnostic tests for ASD should accommodate children with physical disabilities. Common risk factors or etiologies might explain the elevated frequency of ASD among children with CP.

EARLY HAND FUNCTION IN UNILATERAL CEREBRAL PALSY: CORRELATION WITH CORTICOMOTOR REORGANIZATION


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Scientific background: Over the past decade the use of Transcranial Magnetic Stimulation (TMS) has greatly improved our understanding of the mechanisms underlying functional reorganization in patients with early cerebral lesions; however, its use in toddlers and very young children is still limited.

Aim: To find early clinical signs in early hand function assessment of children with unilateral cerebral palsy (UCP) which could be associated to different patterns of corticomotor reorganization.

Methods and subjects: 11 children with UCP (5 left-sided hemiplegia; GMFCS I, MACS I/II) were assessed by means of a structured protocol (Besta Scale) evaluating hand function both on request (grip) and spontaneously (bimanual activities) at a mean age of 25 months (range 16-28). They also underwent TMS and frameless stereotactic neuronavigation of the First Dorsal Interosseus (FDI) and Opponens Pollicis (OP) at a mean age of 14 years 8 months (range 12y1m-18y3m). Amplitude of Motor Evoked Potentials, Total and Central Motor Cortical Times were related to Besta Scale scores by means of non parametric Mann-Whitney Test.

Results and discussion: 6 of the 11 children had ipsilesional (contralateral) and 5 contralesional (2 ipsilateral, 3 bilateral) corticospinal projections to the affected hand. The 2 children with cortical-subcortical arterial ischemic infarctions showed ipsilateral corticospinal projections; the remaining 9 children with periventricular leukomalacia and/or basal ganglia damage had either a contralateral or a bilateral corticospinal reorganization. The 5 children with contralesional reorganization showed significant lower grip and bimanual scores on the Besta Scale (p<0.01). They all had a shift of the FDI and OP cortical motor representations on the affected hemisphere in comparison to the unaffected. We found a significant correlation between early hand function assessment during the first years of life and different patterns of corticomotor reorganization. This study systematically investigating the relationship between neuroimaging, neurophysiological data and early hand functional impairment has not only prognostic but also therapeutic implications.

STRUCTURAL AND DEVELOPMENTAL CORRELATES OF FIDGETY MOVEMENTS IN HIGH RISK PREMATURE INFANTS

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The quality of infant general movements, specifically fidgety movements (FMs), may be a marker of early brain impairment and may reflect the integrity of corticospinal or reticulospinal pathways. Diffusion tensor imaging (DTI) has shown disrupted thalamocortical connectivity and abnormalities of descending corticospinal tracts in young children with cerebral palsy. DTI has not yet been used to compare structural white matter tract integrity with the FMs and neuromotor status of high-risk, premature infants. Our objective was to describe the relationship of the presence (FM+) or absence (FM-) of FMs among high risk premature infants at 10-15 weeks post term, their performance on the Test of Infant Motor Performance (TIMP), and MRI measures of grey matter, cerebellum and white matter tract structure as measured by DTI at term age equivalent (TAE). Video recordings were assessed by experienced testers using Prechtl’s methodology. Tracts of internal capsule, posterior thalamic radiations and corona radiate were graded by an experienced pediatric neuroradiologist masked to neurodevelopmental status and compared with FMs. Nine infants, <32 weeks gestation with birthweights between 575G and 1300G received TAE DTI; Three had BPD, two Nec and IVH grade 3 or 4, one had PVL, and one severe ROP. Five were FM-, four FM+; and two had abnormal TIMP scores. In three cases of FM+ all white matter tracts were normal. In three cases, FMs were graded as FM- and tracts of the internal capsule, posterior thalamic radiations and corona radiate were abnormal. In two children white matter tracts were normal with FM- at 10 weeks. One child had FM+ and mildly abnormal white matter tracts.

FM+ may be related to both sensory and motor pathways and may provide a valuable early developmental biomarker for understanding difficulties in both early motor skills as well as their adaptive correlates. Further investigations are needed.

NEONATAL NEURAL AND PHYSIOLOGICAL CORRELATES OF EARLY MOTOR DEVELOPMENT IN PRETERM CHILDREN

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Scientific background: The incidence of cerebral palsy (CP) is relatively high in preterm children. This ongoing prospective study investigates neonatal brain structure on MRI-DTI, perinatal risk factors, and neurodevelopment in preterm children. Aim: To develop a neonatal prognostic index for upper and lower limb motor function in preterm children. Methods and subjects: 102 VLBW infants (<1500g BW; <32weeks GA) admitted to the NICU were recruited prior to routine near-term brain-MRI between 1/10-12/31/11, 68 infants (42 females/26 males) had DTI scans (GA at scan 36.7±1.8 weeks). To date, 29 infants returned for follow-up evaluation at 18-20 months corrected-age, 17 with near-term DTI. Brain MRI scans performed on 3T MRI(GE-Discovery MR750,GE 8-Channel HD head coil) included T1, T2-weighted scans and diffusion-weighted scans. DTI was processed using an infant atlas and DiffeoMap(www.mristudio.org) for calculations of mean diffusivity (MD) in white matter motor tracts including posterior/thalamic radiation (PTR), retrolenticular capsule (RLC), and corpus callosum (CC). Perinatal risk factors included average total serum/bilirubin within two/weeks of birth (TB) and bronchopulmonary dysplasia (BPD). Gross and fine motor development at 18-20 months corrected-age was assessed on Bayley Scales of Infant Development II (BSID-II).

Results and discussion: Mean BW was 1092±276 g, GA was 28.7±2.4 weeks. Rate of BPD was 40% and was associated with lower gross-motor BSID-III (p=.025). Mean TB (5.4±1.3 mg/dl, 2.9-10.0) correlated to higher MD in left/right RLC (rho=.475, p=.000; rho=.444, p=.000). Fine-motor development correlated to lower MD in left/right PTR (rho=-.560, p=.010; rho=-.591, p=.006) and CC (rho=-.436, p=.040; rho=-.417, p=.048). Gross-motor development correlated to lower MD in left/right PTR (rho=-.775, p=.000; rho=-.437, p=.040) and left CC (rho=-.592, p=.006). Preliminary analysis of this ongoing research may provide neonatal clues to later motor deficits that may ultimately guide early intervention to improve motor control and quality of life for preterm children.
AN AUTOMATIC GENERAL MOVEMENT DISCRIMINATION SYSTEM BASED ON REAL–TIME VIDEO ANALYSIS

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Scientific background: General movements (GMs) strongly reflect the nervous system integrity of fetuses and newborns, and Prechtl's method for qualitative assessment of GMs has been proven effective in the evaluation of infant neurology.

Aim: The purpose of this study was to enable automatic discrimination of GMs inspired by Prechtl's method using video images taken in real time with a single video camera. To this end, we developed a novel tool that can be used to automatically analyze and discriminate GMs in video images without the need to place markers on infants.

Methods and subjects: To verify the validity of the proposed method, we focused on four types of GMs: writhing movements, fidgety movements, cramped-synchronized movements and poor-repertoire movements. First, we implemented analysis of these four types in video images extracted from the DVD “Spontaneous motor activity as a diagnostic tool - Japanese edition”. The movements of a full-term Japanese infant in a non-crying, non-sleeping state were also monitored and analyzed from birth to 15 weeks of age. For comparison, the infant's movements were assessed by a physical therapist using Prechtl's method at the same time.

Results and discussion: The four GM types extracted from the DVD were discriminated with high accuracy (average discrimination rate: 100%). For the full-term infant's movements, the evaluation results from the proposed system were similar to those of the therapist, indicating writhing or fidgety movements. These results led us to conclude that the system may support automatic discrimination of GMs in young infants using measured video images only.

MRI AND MOTOR IMPAIRMENT IN CEREBRAL PALSY: WHICH PREDICTIVE FACTORS?

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Scientific background: The imaging study play a central role in diagnosis and evaluation of brain injury, but his utility to predict the outcomes and severity of cerebral palsy has not been fully clarify. Moreover, the best predictor is not yet defined: white matter, posterior limb of the internal capsule, cortex, basal ganglia-thalamic lesions.

Aim: In this retrospective study we evaluated the correlation between brain MRI features and clinical severity in children with cerebral palsy, to assess the white matter and cortex lesions as predictive factors for the motor impairment.

Subjects and methods: Our cohort consists of 69 patients with Cerebral Palsy classified into spastic diplegia (N=22) and spastic quadriplegia (N=47), who were referred to our Operative Unit between January 2006 and January 2011. Motor severity was classified by the Gross Motor Function Classification System (GMFCS).

According to the Grading of MRI findings (Modified Mc. Ardle, G. Cioni et al., Brain & Development, 1997), the following MRI parameters were scored: size of lateral ventricles, extension of white matter abnormal signal intensity and of white matter reduction, thinning of corpus callosum, presence and size of cystic areas, dimension of subarachnoid spaces and presence of cortical abnormalities.

Result and discussion: The severity of motor impairment resulted strongly associated with the size of lateral ventricles (P< 0,001), white matter abnormal signal intensity (P= 0,0015),extension of white matter reduction (P= 0,001), thinning of corpus callosum (P< 0,001), enlargement of subarachnoid spaces (P< 0,001). No significant associations were found with the cortical abnormalities and the cysts.

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In agreement with other studies, our data show that the brain MRI grading, evaluating white matter and cortex lesions, correlates with motor impairment severity and confirm the utility of neuroimaging to predict the motor outcomes. However, further studies are needed to assess also the basal ganglia and parasagittal damage as predictive factors in term infants.

**DYSKINETIC CEREBRAL PALSY IN ASPHYXIATED TERM NEONATES – THE CHALLENGE TO IDENTIFY MILD LESIONS**

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Scientific background: Dyskinetic CP is rare (7% of total CP), but typically caused by hypoxic lesions of thalami and basal ganglia in term asphyxiated neonates.

Aims: This study illustrates the importance of good neuroimaging in dyskinetic cerebral palsy (CP) following asphyxia on example of two term born boys.

Methods and subjects: The first boy was born with Apgar scores 1/5 and resuscitated. Motor development was delayed, but intellectual functions near normal. Communications problems occurred due to orofacial dyskinesia. The second boy suffered severe intrapartal asphyxia, caused by placental abruption and ruptured uterus, with Apgar score 1/3, resuscitated. His motor milestones were markedly delayed, while intellectual development was normal. His school performance was disturbed by severe dysarthria. Both children, assessed at age of 15 years, were diagnosed as dyskinetic CP, using Surveillance of Cerebral Palsy (SCPE) functional classification: Patient 1, GMFCS 2, BFMC 3b; Patient 2, GMFCS 5, BMFM 5 with accompanying impairments of epilepsy and communications problems (Viking Speech Scale, 2010, level 3).

Results and discussion: In both children brain MRI, performed at the age of 15 years (1.5 Tesla), revealed mild but typical bilateral deep grey matter lesions involving the ventrolateral thalamus (Patient 1,2) and posterior putamen (Patient 2) best seen on T2 w and Flair images.

Both children were term born with clear signs of asphyxia and hypoxic-ischemic encephalopathy and then developed dyskinetic CP with severe communication problems but near normal intellectual functions. Brain MRI of both children illustrated mild but bilateral lesions in thalami and in putamen (Patient 2).

In cases of asphyxiated neonates developing dyskinetic CP, MRI of good quality is an important diagnostic step. Lesions although small but in strategic domains can cause severe motor impairment, but may be overlooked.

**CEREBRAL PALSY IN VERY PRETERM CHILDREN: RESULTS OF THE POPULATION-BASED ACTION STUDY**

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Background: Despite improvements in obstetrical and neonatological care, cerebral palsy (CP) remains a major long-term adverse outcome of very preterm birth.

Aim: To describe the prevalence, type and severity of CP in 22-31 weeks’ gestational age infants at 2 years of age corrected for prematurity.

Methods and subject: ACTION 2 was a prospective, population-based cohort study carried out in five Italian regions (Friuli Venezia-Giulia, Toscana, Marche, Lazio and Calabria). All infants born at 22-31 weeks’ gestational age in these regions in 2003-05 and discharged alive from neonatal intensive care were invited for a follow-up pediatric examination at 2 years corrected age. General health, neuro-sensorial status, cognitive and communicative development, gross- and fine motor-functioning were investigated. The presence of CP was assessed independently from motor functioning. The assessment was carried out for each limb separately, using a functional severity scoring (from 0 to 5).

We studied the prevalence of CP by gestational age and other infant’s characteristics, and its association with other impairments.

Results and discussion: Out of 1407 eligible children, information on CP was available for 1191 (follow-up rate 85%). One hundred twenty-one children (10.1%, 95%CI 8.5/12.0%) had CP. The prevalence of CP decreased with increasing gestational age: from 16.1% (95%CI 8.8/25.9%) at 22 to 25 weeks to 7.7% (95%CI 5.7-10.1%) at 30-31 (test for trend p<0.001): Spastic CP was predominant (78.5%) followed by hypotonic (9.1%) and dyskinetic types (3.3%). 54/121 children (44.6%) had functional limitation in one or two limbs while 65 (53.7%) in three or four limbs.

Sixty-one percent of CP children had severe motor disability, 8 (6.6%) had severe visual and 4 (3.3%) severe hearing impairments; 23 (19.0%) could only pronounce sounds or syllables. Almost half of them (45.5%) were using tutors.

CP is still a major consequence of very preterm birth, particularly at the earlier gestational ages.

3 Cognition, Vision, Perception, Communication and speech

WRITTEN LANGUAGE ACQUISITION IN HEMIPLEGIC CHILDREN WITH CONGENITAL UNILATERAL FOCAL BRAIN LESIONS

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Scientific background: While the early developmental trajectories of oral language after congenital brain insult have been documented by some studies the long-term effects of early lesions on written language have not been reported.

Aim: There is, to the best of our knowledge, no study addressing the incidence of written language deficits in hemiplegic children with focal brain lesions and the factors that can eventually put these children at greater risk of developing academic difficulties. The aim of the present study was two-fold: on the one hand, assessing the incidence of written language deficits after congenital focal lesions to the left or to the right hemisphere, and secondly to estimate the effects on written language abilities of lesion-related factors such as, timing and extension, and of presence/absence of epilepsy and/or EEG abnormalities.

Subjects and methods: 28 children (15 M 13 F) with mean age (at the time of written language evaluation) 9 yr 27 mo (range 7-13 yrs) with congenital unilateral focal brain lesions (16 LH and 12 RH) were selected among children referred to the centre for cerebral palsy of our hospital. Children were considered for participation if they had undergone MRI and EEG; intelligence and oral and written language testing results were available; PIQ or VIQ were in the normal or borderline range (> 70); no child presented treatment-resistant epilepsy and sensory or psychiatric disorders.

Results and discussion: As a group, the children presented written language deficits with a greater incidence than the normal population. RL show significantly worse performances than LH, despite homogeneous cognitive abilities and age of testing in the two groups. The presence of epilepsy was the significant contributing factor in determining poorer performance in written language tasks, especially in text comprehension.
A FUNCTIONAL CLASSIFICATION SYSTEM OF EATING AND DRINKING ABILITY FOR INDIVIDUALS WITH CP

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Scientific Background: Disorders of movement and posture associated with cerebral palsy often lead to difficulties with feeding, eating, drinking and swallowing; compromised eating and drinking skills can lead to respiratory disease, because of food and fluid entering the lungs, and poor growth and health, because of insufficient nutritional intake.

Aim: The aim is to develop a valid and reliable classification system of the functional eating and drinking abilities of individuals with cerebral palsy, in the context of other functional classification systems such as the GMFCS and MACS.

DOES MOTOR IMPAIRMENT SEVERITY SIGNIFICANTLY PREDICT VOLUME OF SLT CONTACT IN CHILDREN WITH CP?

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This research, carried out in specialised clinic for children with Cerebral Palsy, addresses speech and language therapy service provision in children with CP. The aim of the research was to investigate whether the severity of a child's CP predict their need for speech and language therapy intervention i.e. do the children with more severe CP receive more intervention than those with a milder form of CP.

RELIABILITY OF THE NORDIC OROFACIAL TEST – SCREENING IN CHILDREN AND YOUTH WITH CEREBRAL PALSY

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Scientific background
Cerebral palsy (CP) is often associated with orofacial dysfunction; therefore validated screening tools can identify areas for further evaluation to effectively customize interventions to improve daily life for persons with CP.

Aim
To evaluate interrater and intrarater agreement of the Nordic Orofacial Test - Screening (NOT-S) examination applied to children and youth with CP.

Methods and subjects
Two speech-language pathologists independently rated the NOT-S examination from video-recordings of 48 subjects with CP (5-22 y) whereof 31 subjects were re-rated. The samples covered subjects with all CP-subdiagnoses, levels of GMFCS, and levels of MACS.

The NOT-S examination consists of 17 items in the domains 1-Face at rest, 2-Nose breathing, 3-Facial expression, 4-Masticatory muscle and jaw function, 5-Oral motor function, and 6-Speech, which are rated in a 'Yes' (dysfunction observed in domain)/'No' format, generating a score from 0 to 6. This study includes 15 items.

Results and discussion
Interrater agreement. The intra-class correlation coefficient of the NOT-S examination score was 0.87 (95% CI 0.70-0.94). Five out of 6 domains and 12 out of 15 items showed acceptable Cohen unweighted kappa
values ($\kappa$.0.41-1.00). The lowest kappa was found for domain 4 (item 4B; $\kappa$=-0.04), though it had high intrarater agreement (92%). Kappa for item 1A was 0.09 and for item 5B 0.35. No significant differences were found between the raters using the Exact binomial test ($p'>0.05$).

Intrarater agreement. The kappa values of the domains ranged from 0.81 to 1.00 and from 0.43 to 0.89 for the two raters, respectively. The kappa values of the items ranged from 0.53 to 1.00 and from 0.43 to 1.00 for the two raters, respectively.

We conclude that the NOT-S examination shows acceptable interrater and intrarater agreement with video-recordings of children and youth with CP. Together with the NOT-S interview, the full NOT-S constitutes a comprehensive screening of orofacial dysfunction.

THE PREVALENCE OF MALOCCLUSION AND HABITS IN CHILDREN WITH CEREBRAL PALSY

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Scientific background: Malocclusion and oral habits are common in children with cerebral palsy.

Aim: This study sets out to examine the prevalence of malocclusion and habits in a group of children with cerebral palsy and to compare it with a control group of healthy children.

Methods and subjects: The presence of anterior open bite was statistically significantly higher in the cerebral palsy group. The presence of posterior crossbite was not significantly different between the examined groups just as for lingual crossbite. The occurrence of visceral swallowing, incompetent lips and oral respiration was significantly higher in the cerebral palsy group.

Results and discussion: The current study cannot satisfactorily sustain the issue of higher prevalence of posterior and lingual crossbite in children with cerebral palsy because of no significant differences between groups, but it certainly can for anterior openbite. The present study also adds to the evidence that there is an increased prevalence of oral breathing, visceral swallowing and lip incompetence in children with cerebral palsy.

EFFECTS OF MULTI – SENSORY INTEGRATION TRAINING IN CHILDREN WITH CEREBRAL PALSY

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Scientific background: Well timed and coordinated movements are crucial for successful interaction with the environment; thus, interventions targeting these aspects of sensory-motor-control could prove beneficial for children with cerebral palsy (CP).

Aim: To investigate possible individual short- and long-term effects of multi-sensory integration training on upper-limb kinematics during goal-directed movements in children with CP.

Subject and methods: Five children diagnosed with CP of different subtypes and severity participated in 4 weeks individually customised timing-training (Interactive Metronome, IM). IM is a multi-sensory integration training method based on activation of movements in synchronization with a tone. Accuracy feedback is provided via auditory and visual cues. To establish short- and long-term effects, goal-directed upper-limb movements were recorded by the use of a 6-camera optoelectronic system (ProReflex) pre- and at two post-training occasions. Further, children’s experiences of possible training effects in their daily life were assessed by questionnaire.
Results and discussion: Kinematic analyses comparing pre- and post-testing outcomes revealed shorter durations, reduced segmentation and increased velocity of movements for most children. The strongest effects were located to the affected side in the children with hemiplegic CP. Most of the participants showed sustainment of the identified spatio-temporal changes at 6-months post-completed training. Two of the participants, those with the severest forms of CP where only one hand/arm were functionally viable, reported noticeable effects on arm/hand function on tasks related to daily activities. As children with hemiplegic CP typically use their affected hand less and more ineffectively, subjective effects in daily activities may be undetectable despite the effects seen in the kinematics. Our conclusion is that timing training appears to be a feasible training complement for improving aspects of sensory-motor control in CP. Further studies with larger samples utilizing methods that enable explorations of specific effects pertaining to planning and biomechanics are called for.

PERCEPTION OF ACTION IN CHILDREN DIAGNOSED WITH SPASTIC CEREBRAL PALSY

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Scientific background: Producing meaningful goal-directed movements requires awareness and agency (ownership) of movements which occurs as a result of integration of intention, motor commands and sensory feedback. Cerebral Palsy (CP) is commonly described as a disorder of normal sensory-motor development, but new research has emphasized that CP also involves alteration of cognitive abilities which may interfere with agency.

Aim: We investigate whether children with CP have altered sense of agency, whether intensive sensory-motor training may improve the sense of agency and finally which neural networks are responsible for generating sense of agency.

Methods and subjects: CP children, healthy children and healthy adults were asked to move an object on a computer screen using a (hidden) tablet. Occasionally the computer deviated the object from the intended goal. Subjects were then asked to evaluate whether they or the computer were responsible for the movement. Electroencephalography (EEG) was used to determine cortical neural activity associated to the reported sense of agency and transcranial magnetic stimulation (TMS) was used to probe the involvement of specific cortical areas in the generation of the sense of agency.

Results and discussion: CP children were found to have an altered ability to correctly determine the proper agent of a movement compared to healthy children. Reduced movement control combined with poorer integration of sensory information probably contributes to this. 20 weeks of daily visual perception motor training normalized the sense of agency for CP children. The responsible neural networks are being determined by ongoing EEG and TMS experiments as better understanding of the neural circuits involved in generating the sense of agency and the role of lesion of these networks for impaired motor control and cognition in CP and other patients with brain lesion is important in order to facilitate rehabilitation in the future.

MOTOR AND PROCESSING SKILLS PERFORMANCE EVALUATION IN PEOPLE WITH CEREBRAL PALSY

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Scientific background: The Cerebral Palsy (CP) is not just a motor disability. There are many motor impairments described which affect the functional activity. However, it is less known what other deficits interfere with functional performance.

Aims: Knowing which motor and processing skills are affected in adults with CP, and knowing their self-perception of their performance in activities of daily living.
Methods and subjects: 11 observations for adults with CP have been completed during two activities of daily living. Motor and processing skills have been scored and they have also been asked about their performance perception using the Canadian Occupational Performance Measure (COMP).

Results: The different skills “Aligns”, “Positions” and “Walks”, are affected in the whole sample. The best motor skills results are found in “Manipulates” and “Grips”. “Searches/locates” is the only not-affected skill. “Uses”, “Chooses”, “Inquires”, “Continues” and “Sequences” are the processing most penalized skills. The average values for the COMP are: 8 for “Performance”, 8.1 for “Importance” and 8.8 for “Satisfaction”.

Conclusions: People with CP show more difficulties at motor skills, but they also have the processing skills affected, specifically, those related to “Knowledge” and “Temporal organization”. Nevertheless, their performance perception and satisfaction are very well scored. These results question if people with CP would undergo a treatment to improve their motor and processing skills.

Culla ©, an environment for enhancing the experience of children with cerebral palsy: a case study

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Background: At the current time, children with motor development disorders can pass as much as 4 or 5 hours a day immobile and therefore they learn to not use their body. The Culla (cot) was designed and built to improve early stage experience in children with motor development disorder. This pioneering device takes the baby through very slow oscillations of 1 degree per second.

Purpose: To verify efficacy in the promotion of postural development, over a 2 - 3 year period, the Culla will be used by ten or so children with motor development disorder (cerebral palsy, motor retardation in patients with genetic disorders).

Methods and subjects: One of the children who used the Culla is a little girl with bilateral cerebral palsy (GMFCS: 5°), as a consequence of a cerebral birth trauma at term. The study of the little girl’s evolution was conducted using the research on a single subject method, primarily using the Postural Adjustment Measurement (PAM), an as yet non-standardised quantitative scale.

Results and discussion: There was a very promising initial phase (after one month of using the Culla, the PAM score had undergone a significant increase, with a steeper gradient of the overall development line than at baseline). During this period, the coefficient of development improved from 0.2 to 0.6. The Culla is therefore proving an environment rich in experience opportunities for children with motor development disorders: the observations currently in our possession suggest that it improves, above all, primary variability. However, the child must be in satisfactory conditions of health to use the Culla regularly.

Intensive mental training, intrathecal baclofen and OMT may lead to development of visual functions

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Scientific background: Intrathecally administered baclofen (ITB) is used in managing severe spasticity but affects also sensory functions.

Aim: We report effects of ITB on motor functions and awareness of visual space, navigation in space, visual memory, visual imagination, visual field, depth perception and perception of environment in 3D. Case study.

Methods and subject: The patient was 19 years old and had severe spasticity and joint rigidity, constricted lower visual fields, practically no concept of visual space, directions, distance or depth, no visual memory related to environment and no motor memory, no virtual visual space or imagination. Memories were
carried by language, except for face recognition and interpretation of facial expressions and elementary recognition of environment. ITB was started in January 2004. Treatment included orthopedic manual physiotherapy, strength training, acupuncture for pain management, occupational therapy, and intensive mental visual training using videos even if they could not be remembered and thinking of objects and spaces with emerging visual imagination.

Results and Discussion: The development 2004 to 2012 can be roughly divided into three stages:
I: Immediately after the operation there was an expected drop in spasticity and slow increase of body image: toes were the first body part felt a few hours after the operation.
II: Multiple processes improved parallel: development of the awareness visual space; visual fields increased to nearly normal by October 2006; virtual visual space started to emerged in 2007.
III: Body awareness developed fast in 2008 but is not yet completed. Imaging line directions remained difficult and thus imagined balls burst until March 2012. Development of social cognition has occurred parallel to improved facial mimicry, improved speech and joy of vision and visual imagination.
Mental training can improve rudimentary visual functions to nearly normal. This possibility should be tried as a part of therapies for cerebral palsy.

DIFFERENCE IN FUNCTIONAL ACTIVITY, SELF – CARE IN CHILDREN WITH CP AND CVI AND CHILDREN WITH JUST CP

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Aim: This study aims to compare the scores in functional activity and self-care between a group children with CP and CVI, and a group children with just CP.

Methods: A retrospective study was done based on the medical records and scores of GMFM-88 and PEDI-NL of forty/six children, including twenty/three children with CP and CVI, and twenty/three children matched pairs with CP but without CVI, were compared. The mean age of the participants was 6.4 years (range: 3.10-8.10 years).

Results: The group of children with CP and CVI scored on the GMFM-88 statistically significantly lower ($p < .05$) for each area of motor function ($pA = .000$, $pB = .000$, $pc = .000$, $pD = .009$, $pE = .002$ en $pTotal = .000$) and on the PEDI-NL for self-care (Functional abilities and Care assistance) $p = .000$, mobility (Functional abilities and Care assistance) $p = .000$, social function (Functional abilities and Care assistance) $p = .000$ compared to children with just CP.

Conclusion: Functional activity and self-care are significantly lower ($p < .05$) scored for the group children with CP and CVI, compared to children with CP without CVI, using the scores of GMFM-88 and PEDI-NL.

USING A VIRTUAL REALITY – BASED THERAPY SYSTEM TO CHILDREN WITH CEREBRAL PALSY

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Aim: In this study we used a glove-based virtual reality (VR) system, called YouGrabber® (YouRehab, Zurich, Switzerland), which is designed to improve upper limb motor function via bimanual training reaching and grasping.

Methods: Six children (4 females, age 8.8±1.4y) with congenital motor deficits participated in the study. A 4-week individualized VR training program (3-4 sessions/week [N=2] and 1 session/week [N=4] was applied. No additional arm and hand training or any exercises to improve visual attention were provided during the duration of the study.

Results: Only the BBT showed improvements in all subjects (at least in one hand). The YouGrabber Analysis Tool revealed that in all subjects the difficulty of the games could be increased after each training.
session while the efficiency of scoring (points per object) remained the same or increased, indicating improved performance. Also the interval and the speed of arriving objects could be increased in all subjects, revealing that the training intensity increased, measured in numbers of arm-hand movements performed in one training session.

Conclusions: Preliminary results showed improvements in motor behavior, measured with the BBT. Further, gaze pattern analysis indicates higher visual attention and optimized focus on relevant game events, indicating higher visual concentration during the therapy session. We suggest that the VR-based motor rehabilitation system not only improves motor behavior but also visual attention. More detailed individual analysis on the assessed Tobii eye tracking data are required to understand the visual behavior in children with CP.

PERCEPTION OF GRASPING BIOLOGICAL MOVEMENT IN CHILDREN WITH CEREBRAL PALSY

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Biological motion selectively activates a region in the posterior superior temporal sulcus (STS), an area frequently affected in subjects with periventricular leukomalacia (PVL), a congenital lesion of the white matter, often inducing specific neuromotor disorders of the lower limbs and, less frequently, the upper limbs.

This study investigates how efficiently children with PVL and cerebral palsy (diplegia and tetraplegia) can derive the shape of the object by observing in egocentric and allocentric perspectives a grasping biological motion sequence (see Campanella F. et al., 2011), and correlates the results with both the extent of the lesion and the motor involvement of the upper limbs.

We recorded real reach-and-grasp actions in three-dimensional space towards objects of different shape (a cylinder and a cube) to produce two-dimensional ‘point-light displays’ of a hand reaching for an invisible object in egocentric and allocentric perspectives. Subjects were required to discriminate the shape of the object. Twelve children with PVL and diplegia or tetraplegia (normal Verbal Intelligence Quotient) were tested and compared to normative data from typical aged- and sex-matched children.

The results show that PVL children perform significantly worse than controls, and have no systematic preference for egocentric compared with allocentric perspective, as observed in controls. The impairment was equally strong for children with upper or lower limb motor impairment, indicating that the perception of grasping biological motion is not correlated with the subject’s motor performance. The same subjects also showed reduced sensitivity to flow-motion discrimination. Taken together these data indicate that in children with PVL, the STS cortex representing biological and flow motion may be compromised.

NEUROPSYCHOLOGICAL PROFILES AT THE NEPSY-II IN CHILDREN WITH CONGENITAL HEMIPLEGIA AND DIPLEGIA: PRELIMINARY FINDINGS

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The literature is convergent in reporting milder deficits in cognitive functions such as language, memory, executive functions and attention in children with congenital lesions with respect to adult onset lesions, comparable in localization. Studies have generally focused on single functions, assessed with different instruments, making it difficult to directly compare results across studies. Furthermore, few studies (Kolk et al., 2011; Korkman et al., 2012) have assessed a broad range of cognitive functions in the same child allowing for hypotheses to be advanced on the degree of vulnerability in the face of early unilateral or
bilateral damage and on the neurobiological underpinnings underlying plasticity. This 'methodological gap' could be filled by the NEPSY-II (Developmental Neuropsychological Assessment, NEPSY-II, Korkman et al., 2007; Italian standardization, Urgesi and Fabbro, 2011). This comprehensive battery comprising 33 tests measures attention/executive functions, language, memory, sensory-motor skills, visuo-spatial processing and social perception.

Aim of this preliminary study is to analyze the cognitive profile at the NEPSY-II of children with diplegia and with congenital hemiplegia and subsequently to correlate the neuropsychological findings with neuroradiological data. Thirteen children aged 6 to 14 years participated in the study: 8 children with diplegia and periventricular leukomalacia and 5 with left hemisphere lesions due to perinatal strokes localized in cortico-subcortical or periventricular regions, have been selected from patients with cerebral palsy referred to our tertiary care hospital. Inclusion criteria were: recent brain MRI, absence of drug-resistant epilepsy, psychiatric disorders or severe sensory deficits, IQ> 85 in either Verbal or Performance domains.

The preliminary results suggest that children with diplegia have impaired performance in several areas of the visual/spatial domain and significant difficulties in rapid information processing tasks. Children with congenital left hemisphere lesions do not show a clear neuropsychological pattern with no significant differences between the verbal and visuo-spatial domains. The number of left lesion patients is too small to allow inferences to be made on the neuropsychological data which needs to be analyzed in terms of lesion characteristics.

4 Soft tissues surgery, Botulinum toxin

BTX-A INJECTIONS SUPPORTING SYSTEM – THE BTX-A ELECTRONIC CARD ON TRANGO24 E-HEALTH PLATFORM

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Scientific background: The Botulinum toxin (BTX) is a widely used medicine in the comprehensive management of spasticity in children with cerebral palsy (CP) there is a need for simple method of preparation of treatment protocols and doses calculation according to the current international recommendations.

Aim: To develop and test a software which would assist clinician in calculating proper dosage per muscle and per injection session in children with cerebral palsy and store injection data for post-hoc analyses.

Subjects and methods: First we designed a pilot version of the injection protocol using Microsoft Excel spreadsheet. The design was tested during over 1000 injections and introduced improvements according to the needs of injecting clinicians were introduced. Finally the BTX-A- Electronic Card on Trango24 E-Health platform was developed and tested for its utility during 500 injection sessions.

Results and discussion: The BTX-A- Electronic Card supports clinicians in preparation of the BTX treatment protocol. It presents a list of muscles for each extremity in a transparent way and the recommended dose range per muscle according to the 2010 consensus statement. It displays warnings if the maximal dose per muscle, per extremity or per injection session has been exceeded. It enables printing out the injection protocol, export of the injection protocol as a pdf or Excel file, storing the injection data in a database, easy access to the treatment history and preparation of drug accountability log. The software was proved to have clinical utility in over 500 injection sessions. It supports patients’ safety and clinicians’ adherence to the international consensus statement.
ASSOCIATED REACTIONS AT DIFFERENT LEVELS OF FORCE IN CEREBRAL PALSY

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Background and purpose: Associated reactions (ARs) may be a significant clinical problem if increased levels of muscle contraction in cerebral palsy are found to be triggers of ARs.

Aim: The aim here was to provide measures of ARs at varying force levels in people with hemiplegic and quadriplegic cerebral palsy compared with people with normal development.

Methods and subjects: People with hemiplegic (H: n= 23, mean age: 21.7y) and quadriplegic cerebral palsy (Q: n=15, mean age: 20.9y), and with normal development (N: n=22, mean age: 21.2y) were recruited. The participants were required to follow step changes in a visual target with a response cursor via elbow flexor isometric contractions at a range of forces (15-90% of maximal voluntary contraction [MVC]). ARs were recorded when muscle activity of the non/tracking limb exceeded 5% MVC. A repeated measures ANOVA was employed to examine three factors: participant group, limb and force level.

Results and discussion: All groups had a higher frequency of occurrence of ARs as the level of force increased (F5,285 = 50.1, p < 0.01). More than half the participants presented ARs when the force level was above 15% MVC in the Q, above 30% MVC in the H and above 60% MVC in the N group. These results reveal that the incidence, duration and force of ARs increased as the physical demands were increased in all groups. The H group only had ARs at high level of physical demand, but not the Q group. In order to avoid excessive associated reactions, it is advised to give exercise workloads of not more than 30% of MVC for people with hemiplegic cerebral palsy and give functional activities for quadriplegic cerebral palsy.

IMPACT ON QoL OF PATIENTS WITH CP AND SPASTICITY RELATED PAIN OF A BTX-A TREATMENT

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Aim: To determine the impact of treatment with BTX-A on the quality of life (QoL) of patients with cerebral palsy (CP) who have musculoskeletal pain associated with spasticity, and their primary caregivers.

Patients and methods: A sample of 24 patients with CP was evaluated. The indication of BTX-A was the pain associated with spasticity (mainly hip), with impact on perineal hygiene. Interviews were conducted before and after BTX-A treatment to patients of different ages (mean 31.0 years [SD 9.81], range 12.4 to 51.6) with spastic CP high involvement (GMFCS IV-V 95.8%), and/or their caregivers. The pre-treatment (baseline) data were obtained in the same query to face interview, and post-treatment data in a telephone interview after 1-2 months. We used two analog scales, a general health and a pain (with a visual gradient 0 to 10), a hygiene index, and four domains of the SF-36 Spanish version.

Results and conclusions: A total of 24 completed interviews were obtained at a mean interval of 43.7 (range 35 to 63) days between the pre and post-treatment with BTX-A. The analog scale health and general pain have shown no-difference post-treatment. However, the hygiene index (p <0.001) and the domain "Pain" of the SF-36 (p <0.001) show very significant differences in the t-test analysis. These results suggest the effectiveness of the BTX-A in the treatment of pain associated with spasticity in patients with CP, and its efficacy in improving hygiene tasks of the main caregiver, which results in an improvement quality of life.
OUTCOMES OF SINGLE AND MULTIPLE SESSION OPERATIVE SOFT TISSUE PROCEDURES IN CEREBRAL PALSY

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Scientific background: Cerebral palsy is a challenging problem of developing world. One of the main questions about this entity is the timing and extend of orthopaedic procedures.

Aim: We compared the functional results of two different patient groups: patients that are applied multiple procedures in one operation and the patients that are applied one procedure in one operation. We aimed to show the superiority of combined operative procedures in one session over multiple sessions.

Methods and subjects: We evaluated 46 patients with spastic cerebral palsy retrospectively. Soft tissue releasing and lengthening procedures were applied to all of the patients. Combined procedures (hip, knee, ankle) were applied to 26 of the patients in one session. The remaining 20 patients were operated in multiple sessions. Pre- and post-operative range of motion, degree of contractures were noted for each joint of lower extremity. Gross motor function test, pediatric functional independence scale and Ashword scale were used for functional assessment.

Results and discussion: Remarkable improvement was obtained in both groups. There was no significant difference between one or multiple session operations. The rates of major or minor complications were similar in both groups. Since we could not show any significant difference in both groups, we advocate single session operations because of shorter hospital stays, costs and facility of rehabilitation.

THE APPLICATION OF MYOFASCIAL TRIGGER POINT THERAPY TO MUSCLES WITH SPASTICITY

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Therapy ACT

Objective: This paper presents the protocol for a randomised controlled trial in treatment of spasticity in lower limbs. Current intervention for children with Cerebral Palsy (CP) primarily involves regular stretching and strengthening programs, botox injections followed by serial casting and in some cases surgery. This project aims to investigate the use of Myofascial Trigger Point therapy (MTrP) as a means of increasing calf muscle range in muscles with spasticity, thereby reducing the need for more extreme interventions, by addressing the tightness in the fascia, the muscle and the underlying joint. It is hypothesised that this therapy will assist with maintaining and/or increasing calf muscle length, ultimately improving function; reduce the need for frequent intervention; and empower the individual by giving them skills to manage their condition.

Design: Prospective randomised controlled trial with a cross over design.

Method: 20 participants aged between 6 and 12 years, with a diagnosis of CP and GMFCS level 1, 2 or 3. Each group will undergo two 9-week blocks of treatment. One block consists of routine therapy of regular stretching and strengthening. The other block will consist of routine therapy as well as Myofascial Trigger Point therapy (MTrP) to the calf muscles. Pre and post assessments will include a QOL assessment, components of the Movement ABC, goniometer and photographic measures of gastrocnemius and soleus muscle length.

Results: An alpha of 0.05 and power of 80% was used. This study has been registered (ACTRN1261100120976). QOL results are positive. Goniometric measures being calibrated.

Conclusion: There is no current evidence available on the application of Myofascial Trigger Point therapy to spastic muscles. We are addressing two important areas in the physio-therapeutic role; reintroduction of massage in management of spasticity, and empowering the child and family in self management with improved participation options. (ICF) model.

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EFFECT OF AN INTENSIVE AND SEQUENCED REHABILITATION IN THE FUNCTIONAL OUTCOME AFTER SEMLS IN CP

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SCIENTIFIC BACKGROUND: The functional results of Single Event Multilevel Surgery (SEMLS) for Cerebral Palsy are closely dependent on the quality of post surgical rehabilitation. However, there is no consensus or standardisation of the intensity, type, duration or sequence of rehabilitation modalities used.

AIM: The aim of the study was to find out the effect of intensity, type and sequence of postsurgical rehabilitation on the functional outcome of multilevel surgery for cerebral palsy.

MATERIALS & METHODS: This was a case control study with 20 subjects (9 females and 11 males) with mean age of 8±2.89 years (range 5-15) were enrolled in the study group, while 21 subjects (15 females and 8 males) with mean age of 9.57±3 years (range 4-16) constituted the control group. All the subjects received same surgical procedures by a single Orthopedic Surgeon, which included Orthopedic Selective Spasticity Control Surgery and simultaneous restoration of lever arm dysfunctions. The study group received protocol based, sequenced multidisciplinary rehabilitation for an average of 3 hours per day. The control group received conventional physiotherapy for an average of 45 minutes per day. The chief outcome measures used in the study were Manual Ability Classification System (MACS) and Functional Mobility Scale Version 2 (FMS), before the surgery and at the last follow up after 2 years.

RESULTS: There were no significant differences between the two groups before the start of rehabilitation: GMFCS (t/0.91, p>0.05), FMS (t/0.019, p>0.05), MACS (p>0.05). The results revealed significant functional improvement among both the groups after the rehabilitation: GMFCS (study: t/4.29, p<0.001; control: t/2.17, p<0.02), FMS (study: t/4.29, p<0.001; control: t/3.44, p<0.001), MACS (study: p<0.001; control: p<0.001). While the GMFCS level of study group had improved significantly compared to the control group after rehabilitation (t/2.88, p<0.001). The study recommended a structured intensive and sequenced rehabilitation protocol for greater functional improvement after SEMLS for cerebral palsy.

RESULTS OF 12 YEARS OF EXPERIENCE IN THE USE OF BOTULINUM TOXIN IN SPASTIC CHILDREN IN OUR CENTER

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Background and aims:
Botulinum toxin is an amazing molecule because its paralyzing effect may become a bacteriological weapon and a remarkable treatment in muscular spasticity reduction in order to improve nursing, daily self care, taking on shoes, vertical and standing position, gait depending on case. Main aim of improving quality of life in spastic children is obtained by using botulinum toxin focused on muscles which are responsible of difficult situations.

Methods:
The paper expresses the results of botulinum toxin using in our center, on 761 patients for 12 years, 650 patients with CP (85,41%), 85 with TBI (11,16%), 6 with brain tumor ablation sequels (0,78%), 9 with meningitis and encephalitis sequels (1,18%), 8 with brachial plexus paresis (1,05%), 3 with arthrogriposis (0,39%). Patients were recorded on video tapes and examined with ASHWORTH SCALE.

Results:
We had two non responsive patients in our studied group, one diagnosed cu cerebral palsy and the other with TBI (vegetative state). 470 children received only one shot, 140 two and 151 more than three doses.

Conclusions:
Harmonization of botulinum toxin intervention with recovery algorithm offers amazing results in spastic child evolution.

COMPLICATIONS FOLLOWING SINGLE EVENT MULTILEVEL SURGERY REHABILITATION IN CEREBRAL PALSY

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SCIENTIFIC BACKGROUND: The functional results of Single Event Multilevel Surgery (SEMLS) for Cerebral Palsy (CP) are closely dependent on the quality of post-surgical rehabilitation.

AIM: This study was conducted to find out the prevalence and types of complications encountered during rehabilitation following SEMLS.

METHODS & SUBJECTS: 463 subjects diagnosed with CP participated in this prevalence study. The distribution of patients were Spastic Diplegia (59%), Spastic Quadriplegia (33%), Spastic Athetoid Quadriplegia (6%) and Spastic Hemiplegia (4%). The present study analysed the complications during post-surgical rehabilitation following SEMLS during a period of 12 years (2000-2012). The mean age at the time of surgery was 8±4 years. All 463 children underwent SEMLS followed by a post-operative plaster immobilization period which varied between 2 weeks (upper limbs) to 6-10 weeks (lower limbs) and was followed by physical therapy for at least 6 months.

RESULTS & DISCUSSION: The complications were Myofascial Pain Syndrome (149, 32.60%), Prolonged Articular Stiffness beyond 4 weeks (111, 24.23%), Patellofemoral Pain Syndrome (38, 8.13%), Osteopenia (36, 7.88%), Meralgia Paresthetica (26, 5.69%), Pressure Ulcers (19, 4.10%), Hypertrophic Scar (18, 3.94%), Low Energy Fractures (19, 4.06%), Superficial Pin Tract Infection (12, 2.56%), Wound Dehiscence (9, 1.92%), Patellar Tendinitis (8, 1.71%), Myositis Ossificans (7, 1.51%), Complex Regional Pain Syndrome (5, 1.07%), Rickets (3, 0.6%), Osteomyelitis (2, 0.43%), Transient Common Peroneal Nerve Palsy (2, 0.43%), Transient Axillary Nerve Palsy (2, 0.43%), Skin Hypersensitivity (1, 0.21%), and IT Band Friction Syndrome (1, 0.21%). There was a significant association between the anatomical distribution of abnormality and osteopenia (χ²/8.01, p<0.05). A preoperative GMFCS level IV and V was associated with a higher prevalence of complications like Osteopenia, Low Energy Fractures and Myositis Ossificans. However, none of the complications were life threatening, permanent or affecting the long term outcome of surgery. To minimise the rate of complications we recommend a structured rehabilitation protocol carried out by an experienced multidisciplinary medical team.

FUNCTIONAL OUTCOME OF A NEW SURGICAL APPROACH IN SEVERE CEREBRAL PALSY (GMFCS IV AND V)

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SCIENTIFIC BACKGROUND: Cerebral Palsy children with GMFCS IV and V are non-ambulatory and at a greater risk of complications.

AIMS: The purpose of the study was to find out the outcome of Single Event Multilevel Lever Arm Restoration and Anti Spasticity Surgery (SEMLS) in CP with GMFCS levels IV and V.

MATERIALS & METHODS: In this study 170 children with GMFCS V&IV were participated. Mean age of the participants was 9.68±4.77. The surgical procedures were performed by a single Orthopedic Surgeon which included Intramuscular Release and Controlled Tendon Lengthening using the principles of Orthopedic Selective Spasticity Control Surgery and simultaneous restoration of lever arm dysfunctions and
was followed by protocol based, sequenced multidisciplinary rehabilitation for average of 6 months. The outcome measures such as GMFM-88, Functional Mobility Scale (FMS), Physicians Rating Scale (PRS), Manual Ability Classification System (MACS) were used to compare the functional status which followed by the rehabilitation.

RESULTS & DISCUSSION: The results showed a significant improvement in all GMFM-88 components and the values were Lying and Rolling (A); GMFM V: t=9.77 (P<0.001), GMFM IV t=8.56 (P<0.001), Sitting (B); GMFM V: t=20.01 (P<0.001), GMFM IV: t=12.61 (P<0.001), Crawling and Kneeling (C); GMFM V: t=22.26 (P<0.001), GMFM IV: t=21.01 (P<0.001); Standing (D); GMFM V: t=20.01 (P<0.001), GMFM IV t=15.65 (P<0.001), and total GMFM-88; GMFM V t=31.55 (P<0.001), GMFM IV t=32.86 (P<0.001), respectively. The result of Pre-Post PRS evaluation showed a significant improvement for both sides (Right: t=8.60, (P<0.001); Left: t=9.21, (P<0.001). The improvement in the MACS (Right: t=4.05 (P<0.001); Left: t=5.74 (P<0.001) and FMS (t=5.46 (P<0.001) were also significant among both GMFCS V and IV. A well-planned and executed SEMLS, followed by intensive rehabilitation, provides the person with GMFCS levels IV and V a significant functional improvement.

OUTCOME OF SINGLE EVENT MULTILEVEL LEVER ARM RESTORATION AND ANTI SPASTICITY SURGERY FOR CP

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SCIENTIFIC BACKGROUND: In Cerebral Palsy (CP), lever arm dysfunction and spasticity of non-antigravity or the body propelling muscles are the major factors which restrict gait and motor function.

AIMS: The aims of the study to find out the functional outcome of single event multiple lever arm restoration and anti-spasticity surgery (SEMLARASS).

METHODS&SUBJECTS: The study design was pre-post experimental design. 314 children with different types of cerebral palsies participated in this study. Mean age of the participants was 9.7±4.8 years. Distributions of children were spastic diplegia (58%), spastic quadriplegia (35%) and spastic-athetoid quadriplegia (7%). The surgical procedures were performed by a single Orthopedic Surgeon which included Intramuscular Release and Controlled Tendon Lengthening using the principles of Orthopedic Selective Spasticity Control Surgery and simultaneous restoration of lever arm dysfunctions and was followed protocol based, sequenced multidisciplinary rehabilitation for an average of 6 months. Outcome measures such as Functional Mobility Scale (FMS), Manual Ability Classification System (MACS), Pediatric Quality of Life (PQOL) were used to measure the functional status of the children following post operative rehabilitation.

RESULTS & DISCUSSION: The results showed a significant improvement after a 1 year post -surgical rehabilitation. Correlation studies showed median value of FMS of 3 before surgery and 5 after surgery. Before surgery the median value of Gross Motor Functional Classification System (GMFCS) was level 4 and after surgery it was level 2. Before surgery the mean value of PQOL was 39.64± 17.49; after surgery the mean value was 23.11 ±14.02. Before surgery median value of MACS was 3 and after surgery it was 1. A well-planned and executed SEMLARASS, followed by intensive protocol based, sequenced multidisciplinary rehabilitation provides the person with CP an excellent functional improvement.
WHAT IS THE DOSE OF THERAPY NEEDED FOR FUNCTIONAL BENEFIT POST SEMLS IN CHILDREN WITH CP?

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Scientific background:
Children with cerebral palsy (CP) require intensive rehabilitation after surgical procedures aimed at altering the natural history of the disorder in order to recover function, but the level of intensity and duration of therapy required has not been systematically quantified.

Aim:
The aim was to identify consecutive CP patients undergoing multidisciplinary rehabilitation following orthopaedic surgical procedures and determine their demographic characteristics, the nature of the presenting problem, dose of orthopaedic surgery, duration of participation in the program, number of occasions of service (dose of therapy provision), and changes in the principle outcome measure, the Canadian Outcome Performance Measure (COPM).

Methods and Subjects:
Retrospective case audit of consecutive children having single event multilevel orthopaedic surgery at our tertiary centre in 2011.

Results and Discussion:
12 patients (age range 2-18yrs, mean 11.5; gender 9M 3 F) utilized the service over 15 day-patient admissions.
38% of patients resided in rural and remote areas.
Surgical interventions included spinal instrumentation, hip surgery (psoas; VDRO, DRO, adductor lengthening), knee level surgery (HS transfer) and distal surgery (Strayer lengthening, split tib post transfer, triple arthrodesis)
Patients received a total of 581 occasions of service over 15 day-patient admission episodes, for an average of 38.7 occasions of service per patient rehabilitation episode.
Patients showed clinically significant mean improvement in COPM scores (2.80) when rating performance of goal related activities (Mean admission COPM 2.53 and mean discharge COPM 5.34).
A strongly positive correlation (r) =0.604 was demonstrated between the number of episodes of care and change in COPM performance scores (p= 0.017).
No adverse events were reported.
The ambulatory rehabilitation service delivery model is effective, well accepted by patients, and safe. A reduction in inpatient care costs and reduction in risks associated with inpatient admission are additional benefits.

MASSIVE HETEROTOPIC OSSIFICATION AFTER ILIOPSOAS TENDON LENGTHENING: A CASE REPORT

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Heterotopic ossification is a post-surgery complication occasionally observed in patients with infantile cerebral palsy.
A case of bilateral heterotopic ossification complicating iliopsoas tendon lengthening in a tetraplegic 7-year-old child is presented.
The child underwent iliopsoas and adductors release because of symptomatic bilateral hip subluxation.
The patient presented pain at the mobilization of the hips, one month after surgery. Clinical and radiographic examination showed the appearance of extensive bilateral heterotopic ossification of the iliopsoas. After extracorporeal shockwaves the pain disappeared while a certain stiffness remaining. Symptoms and radiography are not changed 2 years later.
Reviewing our case series and literature, we suppose that massive heterotypic ossification could be due to: child's dystonia, non-implementation of drainage after surgery, tenotomy of the iliopsoas at the lesser trochanter.

6 Posture, Non-ambulatory children management

POSTURAL APPROACH IN PATIENTS WITH CEREBRAL PALSY

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Background: The Cerebral Palsy is condition caused by damage to one or more areas of the brain, that affects control coordination of body movement and posture, conditioning the development of severe musculoskeletal deformities (5). Methods and Subjects: We conducted an study with 24 patients ages 2 to 26 years old with the diagnosis of PCI using the methodology of Chailey Approach to Postural England Center made medical history, physical examination before and after the intervention, assessment Skill Level Development, radiographic studies of thoracolumbar spine and pelvis before and after the study, 44 were prescribed later addition postural measures were taken of each patient, manufacturing, testing, delivery and monitoring team every month for 4 years. For radiographic evaluation of Hips were used Reimer Migration Index and Acetabular Angle. For assessment of the spine was used Cobb method with the following Results. there was improvement in 100% with flexible kyphosis and these didn't progress to fixed, 80% of patients with scoliosis remained progression-free and 20% of patients had scoliosis structured. Reimer index decreased in 21% of patients remained at 43% and increased at 36% of cases. The Acetabular angle decreased in 57% of cases remained at 29% and increased by14% of cases Approach Conclusion. Postural the preventive and corrective posture is a method to improve the quality of life of patients with physical disabilities.

POSTURAL CONTROL DURING REACHING IN CHILDREN WITH CEREBRAL PALSY: AN ELECTROMYOGRAPHIC ANALYSIS

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Background: Children with cerebral palsy (CP) have difficulty maintaining balance due to poor postural control. Previous studies have suggested an inability to adjust the degree of postural muscle contraction. However, the characteristics of postural control in children with severe CP have not been clearly established.

Aim: The characteristics of postural muscle contraction in children with mild to severe CP was investigated using electromyography during reaching activities and compared to that of developing healthy children and adults.

Methods and subjects: Healthy 9 children (age: 9.5 ± 2.0 years) and 10 adults (age: 26.1 ± 5.8 years) and 11 children with CP participated in the study (age: 12.6 ± 3.9 years, Gross Motor Function Classification: II, n = 2; III, n = 2; IV, n = 5; V, n = 2). Subjects sat in an adjustable chair reclined at different angles corresponding to three different sitting conditions. They reached for an object. Electromyographic data was collected from the neck flexors, neck extensors, trunk flexors, and trunk extensors before and during reaching. Onset time of muscle activity in each muscle was determined and comparisons made between onset times in the extensors and flexors of the neck and trunk. The amplitude of muscle activity in the trunk.

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Flexors was measured in three sitting conditions. Changes in amplitude corresponding to the conditions were identified.

Results: Flexor muscles in healthy children and adults activated earlier than extensor muscles. However, muscle activation patterns varied in children with severe CP. In all healthy adults and most healthy children increased amplitude in the flexors during reaching corresponded to the reclining angle of the chair. Changes in amplitude were not observed in all children with CP in all conditions.

Conclusion: In this study, direction-specificity during reaching was not always evident in children with CP compared with healthy developing children and adults. Moreover, children with CP had difficulty fine-tuning, especially those with severe CP who had difficulty maintaining a sitting position.

WEB BASED HOME REHABILITATION GAMING SYSTEM FOR BALANCE TRAINING. PRELIMINARY STUDY.

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Background: Recent experimental evidence suggests that virtual reality technologies have great potential in neurological rehabilitation of patients with movement and balance disorders. To emotionally engage patients in balance training and move rehabilitation process to home setting the Web Based Home Rehabilitation Gaming System has been developed. It does not require expensive equipment and is available for free use in Internet (http://game.reha.lviv.ua).

Aim: Preliminary evaluation of Web Based Home Rehabilitation Gaming System for balance training in patients with Cerebral Palsy.

Subjects and methods: Under study were 6 patients with Cerebral Palsy, spastic forms, aged 5 to 11 years. They have daily training sessions for two weeks (12 sessions) with 30 minutes duration. Four of them were at GMFCS level I, one at II and one at III level. Outcome assessment was performed using Stabilometry data and Pediatric Balance Scale. “Stabilometry” is a special diagnostic tool that has been included to the System to evaluate balance. The patient stays still on the balance board for 15 seconds. Average velocity and area of center of pressure (CoP) displacement are calculated.

Results and discussion: The score of Pediatric Balance Scale improved for one or two points in 5 cases, only in one case it was unchanged. Stabilometry data indicates marked reduction of both average CoP velocity and area in 5 cases. Only in one case a slight decline of stabilometry parameters was noted, but the balance scale performance improved from 48 to 50 points. After the treatment all parents and children were satisfied and interested in the continuation of training. This study has several weak points: small number of patients, no control group, evaluation done by non “blinded” therapist. Preliminary results show improvement of balance in patients with Cerebral Palsy after home training course. Further studies are needed.

IMMEDIATE EFFECT OF PHYSIOTHERAPY ON SIT-TO-STAND MOVEMENT IN CHILDREN WITH SPASTIC DIPLEGIA

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3Kanazawa University, Japan

Scientific background: In recent years, several research studies on motion analysis of sit-to-stand (STS) movement in children with cerebral palsy have been reported; however, the effect of physiotherapy (PT) on STS movement in children with cerebral palsy has not been fully clarified.

Aim: Therefore, the aim of this study was to assess STS movement of children with spastic diplegia (SD) before and after PT. Then, how the immediate outcomes of PT intervention affect STS movement will be discussed.
Methods and subjects: Five SD children aged from 4 to 8 years took part in this study. This research study was conducted after having obtained the approval of Osaka Prefecture University research ethics committee (2009-06). In order to assess STS movement before and after PT, a motion analysis system consisted of 2 cameras (Kinema tracer: made by Kissei Comtec, Japan) was used. STS movement data which included the total duration of STS movement and angular movement of each joint (trunk, hip, knee, and ankle) were collected and compared. In addition, one PT session, based on Neuro-Developmental Treatment approach, was administered by 3 physiotherapists with over 10 years experience for 40 minutes. To compare the sampled data, Wilcoxon's signed rank test was used. Statistical significance was set at p = 0.05.

Results and discussion: After PT, total duration of STS movement was significantly shorter than before PT (P=0.043). The transitional trunk angular movement after PT was significantly less than before PT (P=0.043), whereas the end ankle angular movement after PT was significantly larger than before PT (P=0.043). These findings indicate that PT would lead to inhibition of abnormal movement patterns. We concluded that PT intervention will be beneficial in improving STS movement in SD subjects.

Acknowledgement
This study was supported by a Grant-in-Aid for Young Scientists (B) from Japan Society for the Promotion of Science (23700618).

EVIDENCE-BASED CLINICAL RECOMMENDATIONS FOR PEDIATRIC SUPPORTED STANDING PROGRAM DOSING

Paleg G.
Montgomery County Infants and Toddlers Program

Course level: Advanced
Aim of the Course: Standing programs outcomes can be maximized with a complete understanding of the evidence for dosing.

1) Review of the evidence using ICF-CY format and CEBM criteria
2) Analysis of evidence for dosing for each ICF-CY category
3) Specific dosage recommendations will be made

Power point, videos, lecture and case stories will be used to demonstrate how a synthesis of the evidence can be used to make specific dosing recommendations for pediatric standing programs.

The evidence moderately supported that children with neuromuscular dysfunction who do not stand, walk and are not active for 5 hrs/day could benefit from standing for 45-60 minutes/day to improve their ROM and spasticity. There was fair support for improving hip position (subluxation) and improvement in BMD at limited sites with 60-90 min/day of stander use. For all outcomes, the legs should be fully loaded, in the best alignment possible, and the user should be positioned as upright as possible. Standing programs should be continued over

THE EFFECT OF TARGETED TRAINING THERAPY ON SITTING BALANCE AND TRUNK CONTROL IN MOTOR DISABILITY

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Scientific Background: Targeted Training (TT) is an innovative method of training postural control in motor disabled children.

Aim: To review the goal achievement of children consecutively referred for TT to promote trunk control and sitting ability over a 5 year period from August 2006 and examine the relationship between trunk control and hands-free sitting in these children.

Methodology/Results: Seventy-one children were identified who were working towards the goals of propped or hands-free floor or box sitting. The mean age was 4y8m (42 boys). Diagnoses included spastic
quadriplegia and chromosome abnormality, GMFCS Levels II-V/equivalent.
Propped floor sit: 25 children achieved (average 17 weeks)
Hands-free floor sit: 45 children achieved (average 21 weeks)
Propped bench sit: 26 children achieved (average 18 weeks)
Hands-free bench sit: 53 children achieved (average 16 weeks)
The Segmental Assessment of Trunk Control test (SATCo) static test showed that after TT, 40% of the propped floor sitting group were learning static control at thoracic level while 82% of the hands-free floor sit group were gaining lumbar/full trunk control. 23% of the propped bench sit group were learning static control at thoracic level while 91% of the hands-free bench sit group were acquiring lower lumbar/full trunk control.

Discussion/Conclusion: The focussed approach of TT assists the acquisition of trunk control and functional sitting ability in a moderate timescale. Previous research has shown that trunk control is gained sequentially from head downwards in typically developing infants with hands/free sitting emerging when the child has lumbar control. This process is delayed in neuromotor disabled children. This review has confirmed that hands-free sitting is reliant upon lumbar control and that Targeted Training provides a route to hands-free sitting enabling improved hand function.

IMPROVING POSTURAL CONTROL IN CHILDREN WITH CNS DAMAGE

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AIM: to introduce an assessment and intervention approach for babies and young children with cerebral palsy that focuses on treatment strategies for improving postural control inside the global rehabilitative approach

BACKGROUND: Postural difficulties are reported to occur in most serious neurological impairments and the achievement of everyday activities needs a good enough postural control. Many children have problems regarding walking and reaching/grasping because of their insufficient repertoire regarding postural balance; maintenance of stability is a critical factor in all movements. (Shumway-Cook and Woollacott, 2006).

METHODS & SUBJECTS: We studied 2 groups of 6 children each with different types of CP: the first one, from 4 to 8 years-old; the other, from 9 months to 4 years-old. GMFM (dimension B and D), Peabody Developmental Motor Scale, Sitting Assessment Scale for Children with Neuromotor Dysfunction, Pediatric Balance Scale, Balance Evaluation Systems Test were selected for measurements. We trained postural control for 10 weeks: in the first group the training started from standing position, with/without orthoses; in the second from sitting position because their postural development and degree of impairment. Functional assessments pre and after intervention were carried out.

An oscillating platform bearing on a central pin with reference to variable elastic fields was projected and carried out to apply controlled sways and imbalances to the child posture.

RESULTS: All trained children improved their postural control with 3-4 positions on average increased in the tests

CONCLUSIONS
The intervention performed demonstrate the improving not only in postural control outcomes but especially in daily life performances and the training could be considered effective.

IS THE NUSTEP® A FEASIBLE PIECE OF EQUIPMENT FOR ADULTS WITH CEREBRAL PALSY (GMFCS III & IV)?

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Background: Many adults with CP do not exercise enough and little is known about which types of exercise are most appropriate for this population.

Aim: To perform a feasibility test to determine if adults with CP (GMFCS III and IV) were capable of exercising on the NuStep® Recumbent Cross Trainer for a forty minute time interval without adverse effects such as post-exercise pain.

Methods & Subjects: Participants were 11 adults with CP (8 females, 3 males; 7 GMFCS III, 4 GMFCS IV with a mean age of 36 + 13 years, BMI 28.9 + 9.4 kg/m2). Participants were asked to complete a 40 minute protocol with the level of resistance increasing at 5 minute intervals. Every five minutes heart rate (HR), blood pressure (BP), oxygen consumption (VO2), and respiratory exchange ratio (RER) were recorded along with rating of perceived exertion (RPE). Immediately following the protocol, participants were asked to complete a post-exercise questionnaire. A follow-up phone questionnaire was administered the following day to assess levels of pain or discomfort.

Results & Discussion: All participants completed the 40 minute protocol. Four participants requested to take a break during the study. Five participants achieved a HR of 60% maximum or above, 10 of 11 participants had an increase in VO2, and all had elevated RER values throughout the study. Prior to the study, 4 of 11 participants reported feeling pain on a daily basis. Only one of 11 participants complained of pain one day after the study.

This study demonstrated the feasibility of exercise on the NuStep® Recumbent Cross Trainer for adults with CP GMFCS III and IV. Most participants appeared to receive benefits from the exercise with increases in HR and VO2 and reporting little to no pain one day after the study.

MAKING OF A MOULDED SEAT IN JOINT COLLABORATION OF THE PHYSIOTHERAPIST AND THE ORTHOPEDIC TECHNICIAN

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Scientific background: Multidisciplinary work is essential to achieve the optimum performance of orthopaedic splints.

Aim: To explain how to perform a moulded seat in joint collaboration of the physiotherapist and the orthopaedic technician. To show radiological evaluation, measurement of the coverage of the femoral heads and muscle lengths, the making of a mould in plaster and completion in orthopaedic materials.

Subjects and methods: In this paper, we will show all the stages of making a moulded seat. We will begin with a factorial clinical assessment, focusing on the radiological status, evaluating the possibility of lengthening the muscles and diagrams of the femoral head coverage by the acetabular. We will show the corrective positions in which both, the orthopaedic technician and physical therapist, will position the subject to get the best possible mould. After the making of the plaster mould on the subject, we will show the process of realizing the plastic seat in the orthopaedic workshop and the final result.

Results and discussion: The teamwork between orthopaedic technicians and physiotherapists has enabled better implementation of the splints during the last years. The joint evaluation and teamwork allows better outcomes for the benefit of all subjects with deformities.

QUANTITATIVE KINEMATIC COMPARISON BETWEEN 2-POINTS AND 4-POINTS SEAT BELT FOR WHEELCHAIR IN PATIENTS

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4Fumagalli srl - Italy
When the seat belt is properly placed and used in conjunction with a contoured seat cushion, the belt can assist in holding the pelvis in place.

The aim of this study is to make a quantitative comparison of 4-points vs 2-points seat belt in patients with spasticity, in order to evaluate if any differences between the two seat belt are present in terms of the pelvis stability during seating.

Materials and Methods

20 patients with spasticity (35%: spastic diplegia in CP, 50% spastic tetraparesis in CP, 15% tetraparesis after traumatic brain injury) (range: 4-12 years; GMFM: 35-86), in particular with spastic tetraparesis, were evaluated quantitatively during sitting on a wheelchair. The patients were evaluated using an optoelectronic system with passive markers for kinematic acquisition. Some parameters from 3D kinematics (trajectories, Range of Motion, …) were identified and calculated in order to make the comparison between the three conditions (2-points vs 4-points vs. no seat belt).

Results

Among the evaluated parameters, the most significant ones were the angle at the pelvis (calculated as the angle defined by the markers placed on the acromion, the ASIS and the knee) and the angle at the knee (calculated as the angle defined by the markers placed on the ASIS, the knee and the ankle). In particular we considered the % of variation in ROM of pelvis (%P-ROM index) angle and of knee angle (%K-ROM index) between PRE and POST session. From our data analysis we found that 14 patients (70%) revealed a very low stability without seat belt, evidencing a rolling down of the trunk and of the pelvis. In this group of patients, 3 sub-groups have been identified: GROUP A (better stability with 4-points seat belt), GROUP B (better stability with the 2-points seat belt) and GROUP C (no differences between 4-points and 2-points seat belt (%P-ROM and %K-ROM were lower than 5%).

CLINICAL DECISION MAKING FOR CHILDREN AT GMFCS LEVELS 4 AND 5

Paleg G.

Montgomery County Infants and Toddlers Program

Content:

Aim of the Course: The GMFCS can predict, by age 2 years, those children most likely to have severe decrease in activity and participation. This course will explore the evidence basis of ways to increase activity and participation in children at GMFCS levels 4 and 5.

Course format:

1) Review the GMFCS and GMFM-66 B and C
2) Review the one or two key skills that separate the levels at age 2
3) Learn to use percentile ranking to determine appropriate goals
4) Videos will be used to show devices and approaches that are being used around the world to address activity and participation for children who are Level 4 and 5
5) Case studies will be shown using video to demonstrate use of treadmill training in infants (7-9 months old), intensive movement training that includes infant kicking, and infant power mobility training (9-12 months). Assisted cycling, standing and whole body vibration will be described using a systematic review of the evidence (using CEBM levels) and sorted by ICF categories.
6) Participant response units (provided by speaker) will be used to ensure audience participation
7) Small groups will be used to enhance individual learning
8) Session will end with large group discussion

References: available upon request
THE PREVALENCE OF CONSTIPATION AS REPORTED BY ADULTS WITH CEREBRAL PALSY

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Background: Constipation can be a significant problem for adults with cerebral palsy (CP), affecting quality of life.

Aim: (1) To identify the prevalence of constipation in a population of adults with cerebral palsy who were able to self-report symptoms. (2) To evaluate relationships between Gross Motor Function Classification System (GMFCS) level, body mass index (BMI), gender and symptoms of constipation, using the Patient Assessment of Constipation Symptom questionnaire (PAC-SYM).

Methods & Subjects: Participants were a convenience sample of adults with cerebral palsy who presented to an adult CP physiatry clinic at a tertiary care center. Survey data of adults (aged 18 and older) with CP culled from a larger database was evaluated. A cohort of 63 individuals with initial PAC-SYM scores was identified. Individuals who were unable to self-report were not administered the PAC-SYM questionnaire and are therefore not included in this study. Global and subcategory (abdominal, stool, or rectal symptoms) PAC-SYM scores were calculated and then assessed by GMFCS level. Standard parametric statistics were used to evaluate for association.

Results & Discussion: 52.4% of all patients surveyed reported some symptoms of constipation. Global PAC-SYM scores of those reporting constipation symptoms ranged from 0.083 to 2.6 (mild to moderate). Subjects with decreased functional mobility (GMFCS III/V) had a significantly higher rate of constipation compared to those at GMFCS level I and II (p = 0.02). However, among subjects with symptoms, the PAC-SYM scores did not differ significantly between those groups. The mean BMI was 26.6, and did not differ based on presence or severity of constipation.

This study suggests a high prevalence of constipation in adults with cerebral palsy. Prevalence, but not necessarily severity, increases as functional mobility worsen. BMI and gender was not correlated with constipation.

7 Gait 1

THE MODIFIED AMSTERDAM GAIT CLASSIFICATION FOR CHILDREN WITH CP

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Scientific background: Amsterdam Gait Classification suitable for description of stance phase sagittal plane deviations in children with both uni-and bilateral involvement was used in our centre since 2003 in over 2000 children with CP. AGC however does not describe swing phase abnormalities but dropfoot.

Aim: To extend the AGC with selected swing phase abnormalities description.

Methods and subjects: During last 9 years of 2D gait assessment in our setting certain swing abnormalities were recognized, described and classified additionally to the AGC gait type description. After revision of 1000 written gait reports four most common swing phase deviations were added to the AGC. The modified classification was examined for everyday utility in 300 gait assessments.

Results and discussion: Gait classification describes both stance and swing phase deviations. From the original AGC type 1 - droopfoot was moved to the swing phase descriptions and replaced with type 1 indicating normal midstance pattern. The latter stance phase descriptions from AGC were preserved. Type 1 - midstance (MST): normal.
Type 2 - Knee (hyper)extension in MST without heel rise (HR)
Type 3 - Knee (hyper)extension in MST with HR
Type 4 - Knee flexion in MST with HR
Type 5 - Knee flexion in MST without HR

Four main types of swing phase deviations were established:
Type A - dropfoot (foot plantar flexion)
Type B - stiff knee (initial swing knee flexion < 60 degrees, or delayed)
Type C - limited knee extension in terminal swing
Type D - adduction (+/- endorotation) of the hip in terminal swing
The modified AGC seems to be time saving and feasible in everyday use. It delivers comprehensive data for team communication including physiotherapy, spasticity treatment and orthotic management. It enables the statistical analysis of qualitative gait data. The validation study is in progress.

RELIABILITY OF THREE-DIMENSIONAL GAIT ANALYSIS IN ADULTS WITH SPASTIC CEREBRAL PALSY

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Scientific background: Adults with spastic cerebral palsy (CP) frequently report a deteriorating walking function, and even if there is increasing awareness about their rehabilitation needs, reliability of three-dimensional gait analysis (3DGA) for adults with spastic CP has not been established.

Aim: To evaluate the test-retest reliability of spatio/temporal and kinematic variables from 3DGA.

Methods and subjects: Twelve ambulant adults with spastic bilateral CP (median age 38 years (range 22-42)) were consecutively recruited from the clinic at Sunnaas Rehabilitation Hospital, Norway. 3DGA was conducted on two separate days (median one day between the tests) by the same investigators. The participants walked a 10 meter walkway, and the Vicon motion system with MX13 infrared cameras was used to capture lower limb movements. Spatio-temporal and kinematic variables were calculated with the Plug-in-Gait model (Vicon Motion Systems, Oxford, UK). The average of five gait cycles from left leg was selected for the statistical analyses. Reliability was assessed using the one-way random intraclass correlation coefficient (ICC), the standard error of measurement (SEM), and Bland-Altman limits of agreement (LoA).

Results and discussion: Spatio/temporal variables showed excellent reliability, with ICCs ≥ 0.90 for cadence, stride length, step width, double support time and speed. ICC for kinematic variables ranged from 0.62 (ankle initial contact) to 0.90 (knee initial contact). The SEM for all kinematic variables was below 4º. The LoA plots showed an acceptable distribution of the data. Spatio/temporal and kinematic variables demonstrated an acceptably high level of reliability as measured by the ICC and SEM. This study provides data for future studies on adults with spastic CP using 3DGA as an outcome.

EFFECT OF RHYTHMIC AUDITORY STIMULATION ON GAIT VARIABILITY IN CHILDREN WITH CEREBRAL PALSY

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Scientific background: Previous studies suggested that rhythmic auditory stimulation (RAS) resulted in changes in kinematic parameters and immediately improved side-to-side asymmetry of step length in adults with cerebral palsy (CP).

Aim: The aim of this study was to determine the effectiveness of RAS on gait variability and gait speed in children with CP.

Methods and subjects: Fourteen children with CP attending a special-needs school were enrolled in this study. Children who needed assistance in walking and who had difficulty in understanding instruction were excluded from the study; eventually eight children with CP, ranging in age from 6 to 18 years, participated in this study. Gait analyses were performed in the presence and absence of RAS. RAS was provided using a combination of a metronome beat and hand clapping set to the individual’s cadence. Gait parameters were
the stride time coefficient of variation (STCV), a parameter of gait variability, assessed using an accelerometer (Trigno Wireless System, Delsys Co., USA), and gait velocity, assessed using a stopwatch. Paired t-tests were performed to determine the influence of RAS.

Results and discussion: The results of this study revealed that RAS significantly decreased STCV ($t = 2.794, P < 0.05$), but did not significantly change gait velocity ($t = 0.493, P = 0.637$). The entrainment between RAS and the Central Pattern Generator at the spinal level was considered to be the main cause for improvement in gait variability. Results of this study indicated that RAS had an immediate effect on gait stability, but not gait velocity in children with CP. Future studies should investigate changes in neural activity in walking with RAS, as well as the effect of RAS on spasticity and co-activation in children with CP.

**IS THERE A "HIDDEN" EFFECT TO TREADMILL WALKING ON STEP CHARACTERISTICS IN CHILDREN WITH CP?**

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Purpose: The purpose of the present study was to examine the immediate effect of treadmill walking (i.e. enforced walking at a fixed gait velocity), on gait variability among children with cerebral palsy and TD age matched controls. Methods: Eleven children with cerebral palsy and sixteen TD controls participated in this study. Ages were 7-13 years. Step time and length variability were assessed by an electronic walkway prior to and after treadmill walking for six minutes.

Results: When walking on level ground prior to the treadmill session children with CP walked with significantly increased step time and step time and length variability and significant reduced step length compared to the TD subjects. Treadmill walking reduced walking velocity, increased step time and decreased step length variability significantly among children with CP.

Conclusion: Walking on a treadmill at a fixed gait velocity impact gait characteristics among children with CP, with possible advantageous effect on step length variability.

**INCREASING ANKLE DORSIFLEXION MAY HAVE OTHER EFFECTS ON GAIT IN CHILDREN WITH CP THAN EXPECTED**


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Scientific background: Children with spastic Cerebral Palsy (SCP) often receive treatments for reduced ankle dorsiflexion possibility (ADF-P). It is presumed that reduced ADF-P causes decreased ankle dorsiflexion in gait (ADF-gait) and increased knee flexion in gait (KF-gait). However, associations between ADF-P and ADF-gait and KF-gait have not clearly been shown in the literature.

Aim: To test for 1) cross-sectional associations between ADF-P and ADF-gait and KF-gait in SCP-children and 2) longitudinal associations between those parameters.

Methods and subjects: We studied 16 walking SCP children (age=8.7(±2.8) years, who participated in the Splint study) each 2-5 times, with 3 months in between measurements. ADF-P was measured by applying a dorsiflexion moment of 4Nm with a hand-held ankle dynamometer while the child’s knee was extended. Furthermore, sagittal video recordings of barefoot walking were used to measure ADF-gait and KF-gait. In addition, the changes (deltas) for each parameter in between measurements were calculated (dADF-P,
dADF-gait, dKF-gait) to be able to investigate longitudinal associations. Analyses were performed using linear regression and general estimation equation statistics.

Results and discussion: Cross-sectional analyses showed that ADF-gait was smaller when ADF-P was smaller (terminal swing: beta=0.749, p=0.013; mid stance: beta=0.628, p=0.082; toe off: beta=0.834, p=0.048), but no cross-sectional associations were found between ADF-P and KF-gait. Longitudinal analyses showed that dKF-gait increased when dADF-P decreased (terminal swing: beta=-0.355, p=0.001; mid stance: beta=-0.384, p=0.01; minimum KF in stance: beta=-0.614, p=0.01), but no longitudinal associations were found between dADF-P and dADF-gait.

The longitudinal results suggest that increasing ADF-P increases KF-gait, but not ADF-gait, while such effects were unexpected from cross-sectional results. These observations are important for clinicians who consider treatments to increase ADF-P in order to improve gait patterns in SCP-children.

References

CAN A TURNING INWARDS PATELLA PREDICT AN EXCESS OF FEMORAL ANTEVERSION DURING GAIT?

Robert Debré Hospital, Paris, France

Scientific background: In children with spastic diplegia, a turning inwards patella during gait is often considered to be related to an excess of femoral anteversion.

Aim: To investigate the relationship of these two parameters during gait.

Methods and subjects: We retrospectively reviewed the charts of 188 children with spastic diplegia. One hundred three of them showed a turning inwards patella during gait (206 lower limbs). Data collected were: hip range of motion, femoral anteversion, spasticity and tightness of internal rotators, patella orientation, hip and pelvis kinematics at mid stance.

Results and discussion: One hundred forty nine lower limbs showed excess of femoral anteversion (72%). Among patients with excessive femoral anteversion, only 66 had kinematic internal hip rotation. Other causes were: internal pelvic rotation, isolated spasticity and/or retraction of medial rotator muscles.

Observational gait analysis was not sufficient to identify pelvic rotational troubles. The lack of kinematic data could conduct to a misinterpretation of turning inwards patella gait. Turning inwards patella during gait does not necessarily mean excessive femoral anteversion and excessive femoral anteversion do not necessarily result in turning inwards patella gait. 3D gait analysis is an essential tool to complete physical examination. It should help therapeutic decisions and limit the errors in diagnosis.

LOWER LIMB TORSIONAL PROFILE IN CHILDREN WITH SPASTIC DIPLEGIA

Robert Debré Hospital, Paris, France

Scientific background: Lower limb rotational troubles are frequent in children with spastic diplegia. These abnormalities are difficult to characterize by physical examination alone.

Aim: To describe lower limb torsional troubles in this population, based on kinematic analysis.

Subjects and Methods: We reviewed the medical records of 188 children with spastic diplegia. Kinematic data collected were: pelvic, hip and ankle rotation, and foot progression angle at 30% of gait cycle.

Results and discussion: After data analysis, we observed a large variety of lower limb rotational problems. Nevertheless, some frequent patterns have been identified. Rotational deviations are often internal: 61% of cases for foot progression angle, 55% for ankle rotation and 41% for pelvic rotation. Lower limb rotational troubles are often combined and acting in opposite directions for 46% of the cases, probably as a
compensatory mechanism. Pelvic rotational abnormality as an isolated cause of abnormal foot progression angle represented 17% of the cases and hadn’t been diagnosed by physical examination. Internal ankle rotation was an isolated cause of abnormal foot progression angle in 29% of the cases. In the light of these results, we think that three-dimensional gait analysis data combined with physical examination is essential to analyze the causes of lower limb rotational troubles. The lack of a detailed analysis could conduct to misinterpretation of data and errors in surgical planning.

DYSFUNCTIONAL GAIT AND PHYSICAL THERAPY. INTERACTION AND POSSIBILITY FOR CHANGE IN MOVEMENT QUALITY.

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Scientific background: Desire to get more knowledge of what happens in clinical practice, based on my clinical experiences, the prevalence of cerebral palsy and current research.

Aim: To analyze and document clinical practice. In addition, the purpose is to find out if change in quality of movement happens during treatment, and how this can provide an understanding of bodily expression in gait.

Method: A phenomenological-hermeneutical research design, with qualitative method and non-participative observation is used. N = two children with cerebral palsy (GMFCS level II, age 10 and 12), and two physical therapists. The data/material is discussed in aspects from natural science, phenomenology and theory of knowledge.

Results: The physical therapists emphasize adjustments to the base of support and this seems to affect the bodily interaction of the children with the environment. Specific handling directed towards part-components is of relevance to gait. This contributes to change in the body part in focus. In one observation, specific handling results in changed physical conditions in several part-components which are integrated in gait. In the second observation, absence of specific handling towards other body areas at the same time as focus is directed to part-components seems to contribute to maintain the established movement pattern in these areas. Furthermore, the study shows a mutual influence of what occur in the children’s field of attention and their movements.

Conclusion: Change in quality of movement in part-components related to gait emerges in both observations. There is a difference in how these changed physical conditions are integrated into the children’s gait. The actions of the physical therapists seem significant to how the children corporally interact with the surroundings and how body areas relate to each other and to space. The actions affect how the children’s intentionality is expressed.

GAIT TRAINER USE IN CHILD CARE SETTING

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Scientific background: Body weight support and treadmill training has been shown to be effective in inducing earlier independent gait in children with Down syndrome and has shown similar results in smaller studies for infants and toddlers with other diagnoses including cerebral palsy, spinal cord injury and developmental delay. Willoughby(2010), Paleg (1997), Low (2005) and van der Putten (2005) have shown that use of gait trainers could result in similar gains in activity, participation and functional mobility.

Aim: Gait trainers were used in a day care setting to improve activity and participation.

Methods and subjects: A retrospective chart review of a convenience sample of 10 children who used (1) gait trainers, (2) attended FICCC childcare and (3) turned 3 between Jan 2006- and Nov 2010 was conducted. A novel questionnaire and interview questions were piloted with two child care providers. Questions were modified and then administered to 10 providers. Visit notes and daily logs from the child care were reviewed and collated. Equipment used included Pacer, Bronco, Pony, Kidwalk, Walkabout,


**THE EFFECT OF TRAINING IN AN INTERACTIVE STANDING FRAME ON ANKLE DORSIFLEXION AND FUNCTION IN CP**

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Scientific Background: An innovative interactive standing frame (Happy Rehab, Innova
daid Aps, Denmark) has been developed to facilitate coordinated ankle activity using
computer games as feedback.

Aim: To investigate whether training in an interactive standing frame can increase gross motor function and
maximum active and passive ankle dorsiflexion in children with cerebral palsy.

Methods and subjects: 8 children from various institutions and locations in Denmark (age 4-10 years, 5
bilateral, 3 unilateral, 4 GMFCS I, 3 GMFCS II, 1 GMFCS III, 13 training ankles) trained either 30 minutes
per day twice weekly for 12 weeks or five times weekly for 10 weeks. Gross Motor Function Measure
(GMFM) and maximum ankle dorsiflexion with flexed and extended knee were measured at baseline and
following training. Video recordings of GMFM were scored blind by a single experienced physiotherapist
and active and passive ankle dorsiflexion were measured using an established protocol by the children's
primary therapist. Data was pooled for the two protocols to increase statistical power.

Results and discussion:

GMFM improved by a mean of 2.5 (SD 2.15, N=8, P=0.01). Maximum passive dorsiflexion with extended
and flexed knee increased by a mean of 7.0 degrees (SD 7.25, N=13, P=0.009) and 4.7 degrees (SD 6.9,
N=13, P=0.03) respectively. Maximum active dorsiflexion with extended knee increased by a mean of 8.2
degrees (SD 12.1, N=11 due to non-compliance of one subject, P=0.05). Maximum active dorsiflexion with
flexed knee showed no significant increase (mean 3.8 degrees SD 9.9, P=0.22).

It would appear from this small study that use of an interactive standing frame could significantly increase
range of passive and active ankle dorsiflexion and improve motor function for children with cerebral palsy
over a relatively short period of time.

**BONE MINERAL STATUS BY QUANTITATIVE ULTRASOUND AND VITAMIN D STATUS IN
SEVERE BILATERAL CEREBRAL PALSY: PRELIMINARY DATA.**


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Reduced bone mineral density is a frequent complication in patients with severe bilateral cerebral palsy
(BCP).

**Aims.** The aim of the study was to evaluate bone mineral status by quantitative ultrasound (QUS) and
vitamin D status in a group of patients with BCP.
Subjects and methods. We evaluated 38 CPST patients (age 11.0±5.0 y, 24 males and 14 females). All of them were on wheelchair and were not able to walk. None of the patients received vitamin D or calcium supplements. No patient were receiving phenytoin or phenobarbital treatment. In all patients QUS was measured at phalanges (first phalanx of II-IV digit) of the hand (Sonic BP, IGEA, Carpi, Italy) and vitamin D status was assessed by measuring circulating 25-hydroxyvitamin D (25-OH-D) levels by RIA.

Results. Amplitude-dependent speed of sound (AD-SoS) and Bone Transmission Time (BTT) were significantly reduced (P<0.0001) compared to reference values (Baroncelli GI et al. Bone 2006) (-2.4±1.1 and -2.8±1.4 Z-score, respectively). Serum 25-OH-D levels were reduced (15.6±5.0 ng/ml) compared to normal values (20-100 ng/ml). Thirty-two out of 38 patients (84%) showed a value of serum 25-OH-D below 20 ng/ml.

Discussion. Phalangeal QUS was able to detect a reduced bone mineral status in patients with severe BCP. The majority of the patients showed vitamin D insufficiency. These data suggest that phalangeal QUS may be a useful method to assess bone mineral status in patients with BCP without any side effect or discomfort for the patient. Vitamin D status should be regularly assessed in all patients with BCP. Vitamin D supplements should be recommended in all patients with vitamin D insufficiency to prevent osteoporosis and spontaneous fractures.

10 Adults, Mental health, Family

SPECIAL SUPPORT SERVICES FOR PEOPLE WITH CEREBRAL PALSY IN AGING PROCESS

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Scientific background: Aging in people with Cerebral Palsy (CP), is a very recent concern. The increasing life expectancy in people with CP should be considered in social policies, in support services and in professional practice. Providing the necessary support services is a real challenge nowadays.

Aims: Responding to requirements of the elderly people with CP through bio/psycho-social criteria so as to improve the ageing process and rehabilitation efforts with an interdisciplinary approach.

Methods and subjects: For this research, we have used qualitative techniques, which included participant observation, interviews and questionnaires. We detected demotivation for activities, lower rate, loss of mobility, etc. So, we created a specific day support for elderly people with CP. The admission criteria were: age (more than 45 years old), similar abilities (mobility, communication, and relationships), common interests, demotivation for activities, and an increase of the slowness during the tasks. The group had similar characteristics. This specific day support had more frequent breaks, activities according people’s preferences and their working rate, and individual attention.

Results: The participants and their families considered the specific day service highly positive. Nevertheless, we realized that activities with people with CP from different ages are also considered very positive and beneficial.

Conclusions: Knowing the expectations and requirements of the people with CP involves creating more appropriate services and searching for professionals specialized in their care. It is very important to investigate the bio-psycho-social factors of the aging process in people with CP, to get more flexible structures, better services and a change in personal attitudes.

CAPABILITIES OF INDIVIDUALS WITH SEVERE CEREBRAL PALSY IN THE AGING PROCESS

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Scientific Background : In Cerebral Palsy (CP) the percentage of adults with great dependency is very high.
We consider it essential to know them and approach their abilities, as the effect of physical, social and attitudinal situation are modifiable variables which affect their lives. 

**Aim:** Identify what severely affected PC people in the aging process can do.

**Methods and subjects:**

People with severe disabilities can make choices by identifying and communicating their preferences using systematic methods such as making inferences from preferences, use information technology and switches, observe forms of interaction, analyze verbal, gestural and communication efforts of any kind, record the amount of time spent on specific activities and ask relatives about preferences. We are not interested in what they can do independently, but in what they can do with the help of another person (partner, instructor, relative, assistant, etc.) And the quality and enjoyment of the things they can do alone or with aid (human and / or technical)

These people can move, learn, communicate, express emotions, take care of their body, give opinions and participate, have a decent life, practise sports, play, work, enjoy their free time and fall in love. The point is that other adults, parents or professionals give in some of their power and ask them what they want, listening to them with attention and respect, taking into account their point of view, tastes and preferences and incorporating their opinion in making a final decision.

**Results and discussion:** If professionals focus on what each person can do, the design of support is more effective. Interventions from abilities maintain or increase the correct running of people with severe cerebral palsy in the aging process.

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**PSYCHIATRIC DISORDERS AMONG CHILDREN WITH CEREBRAL PALSY AT SCHOOL STARTING AGE**

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**Scientific background:** A high prevalence of mental health problems in children with cerebral palsy have been found in questionnaire based studies.

**Aim:** The aim of the present population study was to estimate the prevalence of psychiatric disorders in children with cerebral palsy (CP), as well as the impact of comorbid conditions.

**Subjects and methods:** A cohort of children with CP born 2001-2003, and living in the Western Health Region of Norway were evaluated at school starting age with the child psychiatric diagnostic instrument Kiddie-SADS, to find the prevalence of psychiatric disorders.

**Results:** 67 children participated, including 43 boys, with mean age 7 years and 3 months (SD 6 years 8months). Most children had spastic CP, and 2/3 of the groups had GMFCS levels I and II. We found the diagnostic instrument appropriate for diagnosing psychiatric disorders in children with GMFCS levels I/IV, but inappropriate for children with GMFCS level V and intellectual disability, and results from the latter group were not part of the analysis. Child psychiatric disorders were present in 57% of the children, including 28 children meeting criteria for ADHD/ADD, the most common disorder. Communication problem was significantly associated with having a psychiatric disorder, whereas intellectual disability, type of CP and functional level did not account for significant differences. Subthreshold symptoms, defined as meeting at least 75% of criteria for a psychiatric disorder, were present in 33 children. Altogether 42 children (75%) met criteria for either a psychiatric disorder, or subthreshold mental health symptoms. One in four (14 children) were considered well-functioning from a mental health point of view, and we conclude with a recommendation for early psychiatric evaluation of all children with CP.
PSYCHOLOGICAL PROBLEMS IN ADOLESCENTS WITH AND WITHOUT CEREBRAL PALSY: PARENT -V- ADOLESCENT REPORT

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Background: Children with cerebral palsy (CP) are considered at higher risk for psychological problems than typically developing children. This risk is likely to increase in adolescence. However, few comparison studies exist and most rely on parental ratings.

Aims: (i) To compare psychological problems in adolescents with and without CP and (ii) To compare parent vs. child perceptions of such problems.

Methods: A cross-sectional study of adolescents with and without CP aged 13 to 17. Parent report (n=85) and self-report (n=62) data on adolescents with CP were identified from the SPARCLE study (Northern Ireland). Parents (n=720) and adolescents without CP (n=2174) were randomly sampled from schools in the same geographical region of the U.K. Psychological outcomes were assessed using the Strengths and Difficulties Questionnaire (SDQ). Analysis of covariance (adjusting for confounds) was used to compare SDQ outcomes in adolescents with and without CP, based on both parent and child reports. Effect sizes were noted.

Results and discussion: In comparison to their typically developing peers, adolescents with CP had significantly higher levels of emotional problems, conduct problems, hyperactivity and peer problems, when based on analyses of parental reports. Differences, based on adolescent reports, were only found within the domains of hyperactivity (p<0.001) and peer problems (p< 0.001). In all domains (except on prosocial behaviours), parents reported poorer psychological outcomes compared to the adolescents themselves. Adolescents with CP are at elevated risk for psychological problems compared to healthy peers. These differences are apparent based on both parental and adolescent self-reports. However, fewer differences and of a lower magnitude are discerned by the young people themselves. Clinicians should routinely ask about psychological problems in adolescents with CP and the importance of obtaining parent and self-report is emphasised.

CEREBRAL PALSY IN THE WORLD OF MOTION PICTURES

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Scientific Background: The impact of the media in creating the image of a man is tremendous at the present time- depiction of disability in the motion picture plays a major role in forming public perception of disability.

Aim: This study presents how movie arts illustrate a person with cerebral palsy (CP), the social impact from the media and the possibility of cerebral palsy education by the motion pictures.

Methods And Subjects: Over 900 motion pictures were reviewed in this study. The data of motion pictures was mainly obtained from major websites including IMDb. With the criteria of non-documentary movies, possibility of disability classification and availability, the total number of motion pictures about CP was reduced from 932 to 34.

Results And Discussion: Timeline - the motion pictures about CP range from 1932 to 2011. With the 5-year interval, the number of movie productions increased since 1990 and began to drop from 2005. The changes are due to the social awareness of the CP. Geographical Distribution - the total number of 34 movies distribute as America:12, Europe:11, Australia: 3, India:2, East Asia: 6. This distribution represents the development of movie industry and the social attitude to CP patients. The CP incidences in the real world and in the motion pictures are compared among different motor types and among different Gross Motor Function Classification System (GMFCS) levels. Comparisons of incidence between the real world and the movies are surprisingly matching. This also reflects the general public’s point of view to the CP patients.
CP is an unneglectable disease nowadays. The proper information about CP needs to be distributed to general public and medical students. With precise selection and medical professional explanations, motion pictures can play the suitable role making CP to be understood more clearly.

THE PERCEPTION OF MASCULINITY IN MALES DIAGNOSED WITH CEREBRAL PALSY

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Scientific Background: Literature suggests that males with a disability may struggle with their perceived level of masculinity. High masculinity is hypothesised to be associated with strong gender role identification (perceived ability to achieve typical gender roles); satisfaction with body image; and low self-objectification (preoccupation with physical appearance due to internalisation of societal messages which value individuals by external factors). Perceptions of males with cerebral palsy (CP) are not known, but should be investigated as they may have a significant effect on emotional well being and quality of life.

Aim: Examine perceived masculinity in young males with CP.

Methods and Subjects: Twenty/two males with CP (mean age 21.9 years, range 16 - 29 years) completed four scales that assessed aspects of masculinity, including: the Gender Role Conflict Scale (GRCS), Male Body Attitude Scale (MBAS), Self-Objectification Scale (SOS) and Differentiation of Self Inventory (DSI). Associations were analysed using Pearson product-moment correlations.

Results and Discussion: Although males in the study reported high body satisfaction (M = 2.92, SD = 1.11), they also reported high gender role conflict (M = / 1.16, SD = 1.66), low differentiation of self (M = 4.03, SD = 0.34) and high self-objectification (M = 4.99, SD = 0.87). Analysis of associations showed that low body image was correlated with high self-objectification (r = -0.51, p = 0.021) but not differentiation of self (r = -0.04, p = 0.873) or gender role conflict (r = -0.33, p = 0.392). Gender role conflict (GRCS) was not associated with self-objectification (SOS) (r = 0.02, p = 0.958). Data from this cohort suggests that young men with CP may experience difficulties with some aspects of perceived masculinity, in particular with the influence that societal messages have on perceived body image. Further research is required to determine any impact on mental health and to improve advocacy in this area.

MATERNAL WELL-BEING AND CEREBRAL PALSY: A POPULATION-BASED COHORT STUDY ON VERY PRETERM INFANTS

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Scientific Background: Parenting a child with cerebral palsy (CP) is more distressing than caring for a child without disability.

Aim: This study explores the relationship between presence of CP in very preterm infants (VPIs) assessed at two years corrected age and maternal psychological distress.

Methods and Subject: Participants were 1154 VPIs (121 with CP and 1033 without CP or other
severe disabilities), and their mothers. Patients were part of a larger population-based follow-up study on VPIs carried out in five Italian regions (ACTION 2 project). The General Health Questionnaire (GHQ-12) was used to measure the mother’s psychological well-being. We used a strict cut-off threshold of ≥ 5 for identifying severe psychological distress. Parental health and socioeconomic information were also collected. Children were assessed for health status and impairments (motor, language, cognitive, sensorial).

RESULTS AND DISCUSSION: Mothers of 959 VPIs completed the GHQ-12. 92 had children with CP and 867 had children without CP or other severe disabilities (control group). Within the CP group (n=92), 57 children had at least one severe neuromotor or sensorial disability.

The proportion of severe psychological distress was 26% in mothers of disabled CP children, 9% in those of CP children without severe disability, and 6% in those of control group (p<0.001). The relationship between presence of CP and maternal distress remained significant after adjusting for maternal education and other stressful life events in multivariable logistic analysis (OR 3.3, 95% CI 1.7-6.2), and became even stronger when only CPs with associated severe disabilities were considered (OR 5.6, 95% CI 2.8-11.3).

This study shows that mothers of children with CP are much more likely to show signs of severe psychological distress, and illustrates the need to monitor family functioning over time to optimize family well-being.

PARENT COACHING BY PEDIATRIC PTS: CURRENT PRACTICE AND NEED FOR PROFESSIONAL PREPARATION

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SCIENTIFIC BACKGROUND: Viewing parents as the predominant learner during early intervention sessions is hampered by the paucity of family-related and adult-learning content in professional higher education program preparation and further inhibited by professional attitudinal beliefs that continue to place a higher value on child characteristics for clinical decision making.

AIM: Research and best practice oblige therapists to transition from traditional child-centered to family-centered model. The aim of this study was to qualitatively observe pediatric therapists working with children with disabilities and their parents to establish a baseline of therapists’ direct interactions with mothers, the “other” potential clients of early intervention services.

SUBJECTS & METHODS: Four private practice pediatric physical therapists were recruited and videotaped with two young children diagnosed with movement dysfunction and their mothers. Using a coaching framework, therapist/parent interactions were analyzed within the coaching phases of initiation, observation/action, reflection, and evaluation. Triangulation of researcher and outside reviewer observations, therapist and parent interviews, and researcher journal notes allowed for conclusions to be drawn through the theoretical lenses of adult learning and motor learning.

RESULTS & DISCUSSION: Findings indicated that parent coaching was minimally employed by these four therapists. Therapists self-reported 3-5 times higher percentage of time dedicated to parent coaching/teaching than researcher observed calculations. Therapists evaluating parents’ learning during the individual intervention sessions was not observed. Only minimal reinforcement of parent-role by one therapist was noted. Lack of family-centered focus, minimal adult learning theory knowledge/application and nominal motor learning application to parental handling skill development further established diminished attention to the potential for building parent competence for parent-child reciprocity. The research to practice gap confirms a need in professional preparation and continuing education for moving forward on family-centered interventions and parent-child reciprocity.
SCIENTIFIC BACKGROUND: As reported in literature, living with a child with a disability can affect family life in various dimensions.
AIMS: To identify the family and adolescent determinants associated with the family impact of disability in specific dimensions.
SUBJECTS AND METHODS: This study includes 287 parents living with an adolescent with cerebral palsy from 13 to 17 recruited from 4 European registers within the SPARCLE project. One parent answered to questions on the impairments of the adolescent, the family background, socio-demographic characteristics and family functioning, the family’s environment and an extended version of the Family Impact of Childhood Disability (FICD+4).
RESULTS AND DISCUSSION: Among the factors extracted from the FICD+4 scale, four assessed specific impacts on time, finances, work, social relationship, and two provided information on parental positive feeling and family awareness. The parental level of education was the only family characteristics linked to the impact: low education had a small effect on time, work and family awareness (p<0.05; respectively eta2=0.036, 0.031 and 0.040). The levels of walking impairment, fine motor impairment, intellectual impairment, and difficulty in feeding and communicating were associated with the impact on finance, social relationship, time and work (p<0.001; eta2 from 0.051 to 0.201). Epilepsy explained a significant part of variation in the social impact, time and work (p<0.05; respectively eta2=0.092, 0.047 and 0.062). Parents of adolescent with no behaviour disorder expressed less impact on finance, social relationship and time than others (p<0.05; respectively eta2=0.040, 0.050, 0.033). High level of family functioning seems to have a protective effect against the negative impact on social relationship and time (p<0.05). Parental positive feeling and family awareness were significantly lower when the adolescents were able to walk or to communicate without difficulty. Clinicians are encouraged to interview in-depth parents particularly those living with a severe impaired adolescent, who need support.

HOW CAN BE IMPACT MOTHERS AND FATHERS TO HOLD CHILDREN WITH CEREBRAL PALSY?

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SCIENTIFIC BACKGROUND: Fathers and mothers who have disability children can be impact their quality of life and mood.
AIM: This study aimed to compare quality of life and depression levels of mothers and fathers who have children with Cerebral Palsy (CP).
METHODS AND SUBJECTS: Thirty-four parents who have children with CP were included this study. Children’s Gross motor functional levels identified with Gross Motor Functional Classification System (GMFCS) and manual ability levels assessed with Manual Ability Classification System (MACS). Mothers and fathers’ quality of life was assessed using Nottingham Health Profile (NHP) and depression levels were assesses using Beck Depression Inventory (BDI). Differences between groups were evaluated with Mann Whitney-U test.
RESULTS: Mean age of children with CP was 114.3±41.5 months. Twelve (70.6%) parents were low-income, 2 (11.8%) were moderate-income, 3 were (17.6%) high-income family. Ten mothers (58.8%) graduated from primary school, 1 (5.9%) was secondary school, 2 (11.8%) were high school, 2 were
QUALITY OF LIFE OF MOTHERS WHO HAVE CHILDREN WITH CEREBRAL PALSY IN DIFFERENT DISABILITY LEVELS

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SCIENTIFIC BACKGROUND: Quality of life and mood of mothers with disability children may be effected.

AIM: This study aimed to investigate life quality and depression levels of mothers who have children with Cerebral Palsy (CP) in different disability levels.

METHODS AND SUBJECTS: Seventy-eight children with CP and mothers were included this study. Children’s Gross motor functional levels identified with Gross Motor Functional Classification System (GMFCS) and manual ability levels assessed with Manual Ability Classification System (MACS). Mothers’ quality of life was assessed using Nottingham Health Profile (NHP) and depression levels were assessed using Beck Depression Inventory (BDI). For assessed functional independence level of children with CP, Pediatric Functional Independence Measure (WeeFIM) was used. Differences were evaluated with Kruskal-Wallis H test. Correlations between NHP, BDI and GMFCS, MACS, level of income and educational level were assessed with Kendall’s tau-b test.

RESULTS: Mean WeeFIM total score was 76.5. Mothers mean NHP and BDI scores were 167.6±124.9, 9.94±9 respectively. There were no statistically differences between total and subpart scores of NHP and BDI scores of mothers in different GMFCS levels and level of incomes (p>0.05). In different MACS levels, energy and pain subpart of NHP, results were meaningful for statistically (respectively; p=0.016, p=0.025), according to educational level, there were statistically differences for physical activity (p=0.012). There were high correlation between WeeFIM total score, GMFCS and MACS (respectively; r = -.857, -.799, p<.01), NHP total scores and self care subpart of WeeFIM scores are low correlated (r=-.232, p=0.05). Level of income and WeeFIM total, self-care, sphincter control, communication, social communication scores were low-medium correlated (respectively; r=.213, .232, .244, .296, p<0.05). There were high-medium correlation between BDI and NHP (r=.840, p<0.01).

DISCUSSION: This study showed that there were no differences between depression level and quality of life of mothers who have children with CP in different disability levels.

ATTITUDES AND FAMILY CENTERED CARE PROVISION AMONG CONDUCTORS IN A CONDUCTIVE EDUCATION CENTER

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SCIENTIFIC BACKGROUND: Pilot survey

AIM: To explore conductors' attitudes and family centered service provision
METODS AND SUBJECTS: A convenience sample of 72 participants (53 parents and 19 conductors) participated in the survey.

RESULTS AND DISCUSSION: Parents and conductors filled the MPOC20 and the MPOC-SP respectively. The conductors filled an adapted version for Conductors, of the "Occupational Therapists and Parents of Preschool Children with disabilities questionnaire".

The conductive center was perceived by both parents and conductors respectively as a family centered service (FCS) 'to a great extent' (M=5.67 on the 7 point scale, SD=0.88) (M=5.43, SD=0.64). Most conductors expressed positive attitudes towards working with parents. About 93% agreed that working with parents is more important than focus on skill development and 84% that it has a greater impact on a child than any other aspect of intervention.

Three issues that most commonly arose during conductors interaction with parents were 'the child's progress' (36.8%); 'parents personal difficulties' (31.6%), and 'parents adjusting to their child's disability' (26.3%). 'Ambulation' among six parental concerns was ranked as the highest by 73% of the respondents, and respondents spend three quarters of their time (75%) instructing parents about the care of their child, and only 25% of their time discussing all parent-directed concerns.

The most frequent positive feelings were 'parents' hopefulness' (68.4%) and 'parents' relief' (78.9), and most frequent negative feelings were 'parents' defensiveness' (84%), and 'parents' helplessness' (68.4%). All conductors (100%) believe that 'instilling a sense of confidence' is most important in order to develop an effective working relationship with the parents, and the majority (68.4%) 'being a good listener'.

Results indicate adequacy between conductors attitudes (M=2.5), and providing FCS (M=5.4). Conductors' professional training and parents as initiators of Conductive Education services outside of Hungary will be discussed as important features contributing to these results.

13 Impairment quantification and rehabilitation goals, CME

TRANSFORMING CONTINUING MEDICAL EDUCATION: NEGOTIATION OF KNOWLEDGE CREATION FOR IMPLEMENTATION

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Continuing Medical Education (CME) is an important aspect of a professional’s ongoing training. Yet evaluations indicate inconsistent effects in terms of transfer of learning through CME on clinical practice. The field of Adult Education has demonstrated the context specific nature of professional learning and knowledge is shown to be transferred from the training environment into the workplace. This research examines links between changes in Health Professionals’ behaviour, work practices, and their identity formation as a result of CME. It identifies barriers and factors important in enabling health professionals to change their practices as a result of CME including processes of self-work and collective understanding.

The paper presents analyses of semi-structured interviews with four Allied Health professionals, discussing their experiences during the 3-month transition period as they returned to work after completing the Paediatric Bobath Course. The data showed there was no direct transfer of learning. Instead, the professionals negotiated what they had learned in the CME program, with self and others, to resolve tensions created through the transition from a learning community to re-entry into their workplace. This analysis showed knowledge from CME programs continues to be constructed after the completion of the training program and it is revised to fit with the beliefs and values of the learner, their peers and organisational structures.

The link between education and practice is anchored by a professional’s identity formation; the ongoing social process of developing professional practice. Understanding educational outcomes this way has implications for program design and delivery. Course participants need to be supported through the transition period of workplace re-entry to ensure the uptake and use of skills and knowledge developed through CPE. This requires a longer term investment from CPE providers and attention needs to be directed towards empowering learners to make visible the negotiation process.
COMMUNICATION FUNCTION (CFCS), GROSS MOTOR FUNCTION (GMFCS) AND MANUAL FUNCTION (MACS) IN CHILDREN

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SCIENTIFIC BACKGROUND: The Communication Function Classification System (CFCS), Gross Motor Function Classification System (GMFCS), and Manual Ability Classification System (MACS) classify communication, mobility, and handling objects, respectively, at the activity/participation level of the International Classification of Function, Disability, and Health (ICF). Each classification has 5 levels.

AIM: To investigate the relationship among these three functional systems in children with CP.

METHODS AND SUBJECTS: Using questionnaires describing each scale, mothers reported GMFCS, MACS, and CFCS levels in 222 children with CP aged 2-17 years (94 females, 128 males). Children were referred from pediatric developmental/behavioral, physiatry, and child neurology clinics, in the USA, for a case-control study of the etiology of CP. Pairwise relationships among the three systems were assessed using Spearman’s correlation coefficients (rs), stratifying by age and CP topographical classifications.

RESULTS AND DISCUSSION: Correlations among the three functional assessments were strong or moderate. GMFCS levels were highly correlated with MACS levels (rs=0.69) and somewhat less so with CFCS levels (rs=0.47). MACS and CFCS were also moderately correlated (rs=0.54). However, many combinations of functionality were found. Of the 125 possible combinations of the three five-point systems, 62 were found in these data.

Use of all three classification systems provides a more comprehensive picture of the child’s function in daily life than use of any one alone. This resulting functional profile can inform both clinical and research purposes.

ICF-CY BASED PROJECT-PROGRAM FORM FOR CP CHILDREN IN A NEUROPAEDIATRIC REHABILITATION HOSPITAL

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SCIENTIFIC BACKGROUND: The use of International Classification of Functioning, Disability and Health – Children and Youth Version (ICF-CY) for the rehabilitation project is a resource for the multidisciplinary team due to the use of a common language in different clinical settings.

AIM: To verify the impact of a ICF-CY based project-program form, developed in our Institution; to follow-up the experience in the use of ICF-CY to define the rehabilitation project/program for children with cerebral palsy in our inpatient Rehabilitation Centre.

METHODS AND SUBJECTS: We collected data from the "project-program form" of the last three years for all the hospitalized patients in our neuropediatric rehabilitation hospital. The perceived effect of ICF-CY based project-program form was assessed by a structured questionnaire with a 0-5 Likert-type scaling for team members and families.

RESULTS AND DISCUSSION: The project-program form was used in 77 inpatient children (51 male, 26 female) affected by cerebral palsy with a mean age of 7y4m (± 6y2m). Number of team members involved in the project-program form varies from 1 to 8 persons. Most projects-program forms were filled appropriately, allowing the link of functional problems, objectives, rehabilitation activities and outcome indicators. The main advantages are: the improvement in the collaboration between members of rehabilitation team and between team and family; the use of a simple and common language,
easy to be understood; the sharing of the rehabilitation goals and methods that are clearly expressed; the improvement of the family participation in the rehabilitation treatment. The administered questionnaire showed the effectiveness of the utility in the 94.5%, adequacy of the work’s load in relation to the available time (45 min/person) in the 72.5%, utility and clarity of the ICF code in the 78%.

The results confirmed the feasibility of ICF implementation in neuropsychiatric rehabilitation centre.

ICF-CY BASED PROJECT/PROGRAM FORM FOR CP PATIENTS IN AN OUTPATIENT REHABILITATION CENTRE

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SCIENTIFIC BACKGROUND: The use of International Classification of Functioning, Disability and Health - Children and Youth Version (ICF-CY) for the rehabilitation project is a resource for a multidisciplinary team, providing a common language for the different clinical settings.

AIM: To verify the opportunities and the problems in the implementation of ICF-CY in defining the rehabilitation project/program for youths with CP attending daily the Centre. In the last two years we collected data from the ICF project-program formats of 22 CP outpatient adolescents. We evaluated the effectiveness of ICF in the description of functioning of our patients. We also used a questionnaire for the parents and the members of the rehabilitation team, with responses graded on a Likert 4 points scale, to investigate the perceived effect of the new tool.

RESULTS AND DISCUSSION: Most projects/programs forms were filled appropriately, allowing the link among functional problems, treatment objectives, rehabilitation activities, outcome indicators. The main advantages are: the improved collaboration among the members of the rehabilitation team and between the team and the family; the use of a simple and common language, easy to be understood; the sharing of the rehabilitation goals and methods that are clearly expressed; the improvement of the participation of the family in the rehabilitation treatment.

The main problems are: the time required for filling out the form, the difficulty in reporting differences in performances in different settings (i.e. family and school), the low sensibility of the generic qualifier to capture little changes in the functioning of the patients. The results confirm the feasibility and the utility of ICF in the definition of the rehabilitation project/program for severe disabled youths.

PERFORMANCE ASSESSMENT OF ADULTS WITH CP IN THEIR DAILY CONTEXT USING THE ICF

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SCIENTIFIC BACKGROUND: To describe the activity/participation of adults with CP in their daily context using the ICF in order to plan more effective interventions. Check the highest accuracy and exhaustiveness of the ICF over other tools of description of disability.

AIM: To describe the activity limitations and participation restrictions using the ICF, of the adult population ASPACE centers in Barcelona. To obtain performance profiles to enhance individual treatment plans.

PATIENTS AND METHODS: Sample of 87 adults with CP attending ASPACE occupational workshops. Mean age 29.9 years (range 21 to 56). Topography and CP motor type: 22% hemiplegia or diplegia and 78% tetraplegia, mainly spastic or mixed. GMF I-II 26.4%, GMF III 15% and GMF IV-V 58.6%. Mental capacity: normal and mildly retarded level 39%, moderate retarded level 39% and severe retarded level 22%. We use a group of 56 ICF codes of activities and participation. This “core-set” was performed by
selection of items that are considered relevant by a panel of experts. Each code is described by the center's professionals assigning a category between "normal functioning" and "full trouble".

RESULTS AND CONCLUSIONS: We obtained individual performance profiles and center profiles that defined more appropriately adult disability with CP. It has described more exhaustiveness functioning and disability status of these people than normal tools like GMF and IQ. Thanks to these functional profiles of the ICF, the center's professionals can develop programs of rehabilitation and care more precise and effective.

HOW WAS THE AGREEMENT BETWEEN THE ORIGINAL GMFCS AND THE NEW VERSION GMFCS-E&R?

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SCIENTIFIC BACKGROUND: To be able to compare data internationally for a better understanding of the CP-panorama, and in order to improve interventions for individuals with CP, it is important to use updated, age-related and standardized classification systems.

AIM: The purposes of this study were to examine the agreement between the GMFCS-E&R and the original GMFCS, and describe the characteristics of the individuals who changed gross motor function level when GMFCS-E&R was implemented.

METHODS AND SUBJECTS: Children and youths, with CP, aged 1-20 years, living in the southern most counties of Sweden who participated in the Swedish secondary prevention follow-up program for individuals with CP, CPUP were included. Information about the study was sent by e-mail to 69 PTs. Information about the study and the Swedish translated versions of the GMFCS manual and the GMFCS-E&R manual were attached in the e-mail. The new and revised parts of the GMFCS-E&R were highlighted. Out of the 706 participants 559 were assessed during 2009 by their regular physiotherapist (PT).

Descriptive, unweighted and weighted Kappa statistics were used.

RESULTS AND DISCUSSION: Assessment forms (n=662) from 559 participants were analyzed. The absolute agreement, with corresponding levels according to GMFCS and GMFCS-E&R was 97.3%. Unweighted Kappa showed K=0.96 (95% CI: 0.95-0.98) and weighted Kappa showed K=0.98 (95% CI: 0.98-0.99). No significant differences were found between age, age bands, gender and dominating neurological symptoms, between the persons with corresponding levels and the persons with different levels. The result of this study shows a very good agreement between GMFCS and GMFCS-E&R when it is carefully administrated. This is valuable information for CP registers and research that are based on longitudinal studies.

WEB-BASED FAMILY REPORT IS A RELIABLE AND COST-EFFECTIVE METHOD FOR GMFCS REPORT

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SCIENTIFIC BACKGROUND: Gross Motor Function Classification System (GMFCS) is the best available tool to evaluate severity of gross motor function impairment in cerebral palsy in population setting.

AIMS: To test interrater reliability between web based family report and physiotherapists' phone interview on GMFCS among Danish school aged children

To discuss the costs of different methods of GMFCS evaluation

SUBJECTS AND METHODS: Families of thirty children with spastic and dystonic cerebral palsy (age from 8 to 11 years, randomly selected from a cerebral palsy register) answered the web based GMFCS-Family Report. The families were later interviewed by two physiotherapists. Interrater agreement and
weighted kappa is calculated. Costs of web based questionnaire, phone interview and observation were calculated.

RESULTS AND DISCUSSION: The interrater agreement between the GMFCS-FR in Danish and the GMFCS-E&R is high (76%) and misclassification is minimal. There is a good agreement on the same or nearby levels (weighted kappa 0.76 and 0.81). The families rate the same or less ability, when compared with trained physiotherapists. Web based questionnaire is a reliable and the cheapest method of GMFCS evaluation when the study design does not contain observation by the health professionals.

ENVIRONMENTAL CONTEXT AND EVERYDAY FUNCTIONING OF CHILDREN WITH CEREBRAL PALSY IN ICF- CY CATEGORIES

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SCIENTIFIC BACKGROUND: Since 2009 the Welfare Department of Riga City Municipality has launched a long-term project on quality of life of children with special needs, within this project children’s functioning is facilitated by environment adjustments.

AIM: To describe and to evaluate relationship between the extent of environmental contextual factors and functioning of children with Cerebral Palsy (CP) using ICF-CY (WHO, 2007).

METHODS: Participants: 26 families who bring up 7-10 years old child (mean age 8,1±0,9) with cerebral palsy. As specific measures for ICF-CY domains Pediatric Evaluation of Disability Inventory (Haley et al., 1992) and GMFCS E&R (Palisano et al., 2007) were used.

RESULTS AND DISCUSSION: Our research showed the extent of need for the products and technologies for personal use in daily life (e/115) and products for personal indoor/outdoor mobility (e/1201), as well as complexity of technologies in relation to the severity of disability (GMFCS E&R). Occupational therapists employed by municipality assessed construction of buildings for personal use (e-150). Personal assistance (e/340) is highly needed to ensure child’s participation at the mainstream school. Still only 20.8 % of CP children have their personal assistants for a limited time period. 15% CP children with dyskinetic form need assistive products and technologies for communication (e/1251). Results showed the need for IT in education for 70 % of CP children. The total number of different assistive technologies were related to severity of disability. ICF- CY provided the opportunity to assess the benefits in functioning from the use of environment modifications in 62.5 % of cases.

Evaluation of the environmental factors using ICF-CY categories provides new information for service planning to ensure the best possible functioning of children with CP.

NEURO-MOTOR REHABILITATION EVALUATION SCALE FOR THE CHILD WITH CEREBRAL PALSY - PRELIMINARY FINDINGS

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AIM: Our project desire to investigate the efficacy of a the proposed new motor valuation scale (SED-PCI) for the Romanian cerebral palsied children among the therapists in the field of child rehabilitation and evaluation and for the evaluation of treatment outcomes.

The scale desire to be especially an observational instrument used to evaluate child's motor behaviour and to be a performance tool for supporting identification of children with neuro-motor skills difficulties.
METHODS AND SUBJECTS: The inter-rate reliability checks were conducted during assessments of 72 children with cp from 3 different rehabilitation centres from Craiova. The measurement protocol included assessments with the SED-PCI and the gross motor function measure (GMFM) at the beginning and at the end of 6 month therapy. Validity was tested by comparing changes in scores from parents and therapists independent ratings of the children's motor performance.

RESULTS AND DISCUSSION: Inter-rater reliability was calculated using intra-class correlations, and these were found to be high (0.76 and 0.89 respectively). The tool also hits into functionally relevant motor skills for primary age children and for rehabilitation programme planning. It is desired to be a quick, complete and easy evaluation tool with dual purpose of notify and update programme planning and demonstrate individual child's progress following therapeutically intervention.

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PUTTING THE FUNCTIONAL MOBILITY SCALE IN CHILDREN WITH CP INTO PRACTICE.

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SCIENTIFIC BACKGROUND: The Functional Mobility Scale (FMS) is a questionnaire describing walking performance in children with CP (CCP). When using measures such as the FMS the clinician assumes that the information gathered accurately reflects the child's every-day performance. However, this is not known.

AIM: To: (1) evaluate the ability of children with cerebral palsy (CCP) to conduct the various components of the FMS (2) establish the physiological strain [heart rate (HR) responses] of CCP to the FMS, and (3) determine whether parental reports of walking ability accurately reflect every day performance in CCP.

SUBJECTS AND METHODS: Fourteen CCP participated in this study (Gross Motor Function Classification system I-III). Parents reported the FMS. Children conducted the following tests: 25 meters run, 5-to-50 meters walk, 10 jumps, ascend and descent stairs, 500 meters timed walk (500MTW, including HR measurement), 10 meters walk (10MWT) and 6 minutes walk test (6MWT).

Clinicians scored the child's FMS according to the examination. Percentage of agreement between raters was calculated.

RESULTS AND DISCUSSION: Mean 500MTW (minutes) and 6MWT (meters) was 10.244 and 368, respectively. 500MWT mean and end HR were 130 pulse/minute (68.5% of maximal HR) and 145 (73% of maximal HR), respectively. Most children were unable to run/jump. Substantial agreement - >85% - was demonstrated between raters in FMS. The substantial agreement between parent reports of FMS and direct observation of FMS provide evidence to the measure's validity. However the elevated HR, prolonged 500MTW and inability to jump and run suggest decreased stamina that may prevent the desired participation with peer group activities. In addition it can be assumed that the FMS does not reflect CCP every-day performance (i.e. participation), but capacity.

DOES VARIOUS MOTOR CONTROL COMPONENTS OF CHILDREN WITH CEREBRAL PALSY EXPLAIN THEIR MOBILITY LEVEL?

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SCIENTIFIC BACKGROUND: In Cerebral palsy (CP) the ability to control voluntary selective movements is disturbed and is influenced by other factors such as spasticity and contractures. The 'Selective Control Assessment of the Lower Extremity' (SCALE) is a new innovative tool assessing selective motor control of each leg. Its relation to mobility has not yet been comprehensively evaluated.

AIM: to explore motor control as evaluated by the SCALE, association with mobility measures.

SUBJECTS AND METHODS: Fourteen children with CP participated. Various Motor control components were assessed using the SCALE. Mobility was assessed by: six minutes-walk test (6MWTD), 500 meters walk time (500MWT), comfortable and fastest gait speed over 10 meters (10MWT) and the ability to jump and run. Associations assessed with Pearson's correlations. Children were grouped according to motor control status (normal vs. abnormal). Independent t-tests assessed differences in mobility between these two groups. Effect size was calculated with Cohen's d. Chi square tests were used to establish proportions.

RESULTS AND DISCUSSION: SCALE total score left leg (STLL) correlated (>0.75) with 6MWT and 500MWT. SCALE total score right leg (STRL) correlated with 6MWT. Contractures' presence showed significant differences in 6MWT and 500MWT. Significant differences were also found in the presence of abnormal mirror and rhythm movements in 6MWT, 500MWT and fast 10MWT. Large effect sizes (>0.8) between children with normal and abnormal mirror and rhythm existed in 500MWT and fast 10MWT. Similar effect sizes were observed between children with and without contractures in 500MWT and 6MWT. The SCALE differentiated between children with various motor abilities. Specifically, mirror phenomenon affected short and long mobility tasks. Thus the inability to selectively control movement influenced mobility and is a consequence beyond peripheral/central fatigue and may relate to neural processing. Contractures negatively affected the ability to walk over long distances and therefore may be related to fatigue.

IDENTIFYING CONCEPTS CONTAINED IN OUTCOME MEASURES USED WITH CHILDREN WITH CP USING THE ICF-CY

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SCIENTIFIC BACKGROUND: Various outcome measures have been used with children and youth with Cerebral Palsy (CP). Content comparison of CP outcome measures is challenging because of the varying use of concepts.

AIMS: To systematically identify and quantify the concepts contained in outcome measures used with children and youth with Cerebral Palsy (CP). Content comparison of CP outcome measures is challenging because of the varying use of concepts.

METHODS: We conducted a systematic literature review 1998 and 2012 in MEDLINE, EMBASE, PSYCINFO, CENTRAL, CINAHL. Inclusion criteria were: children aged 2-18 years, CP, English language, and study designs consistent with intervention studies (RCTs, before and after, etc) and observational studies. Outcome measures were extracted and concepts contained in the outcome measures were linked to the ICF-CY. Screening and data extraction were conducted by two independent reviewers. RESULTS AND DISCUSSION: From the 862 citations retrieved, 230 papers were included. Sixty-two percent of the studies were intervention studies. Overall, 116 questionnaires and 268 clinical parameters were identified. A total of 2,238 concepts were linked to 353 ICF-CY categories. Content of outcome measures covered mainly the component activity & participation (51%) and body functions (31%). The most used ICF-CY categories were recreation and leisure, moving around, emotional functions, temperament and personality functions.

The ICF-CY provides a useful reference to identify and quantify the concepts contained in outcome measures used in CP. The results of this study will provide clinicians and researchers with additional information, useful when selecting outcome measures.
DEVELOPMENT OF A CEREBRAL PALSY POPULATION REGISTER: CASE STUDY IN NEW ZEALAND

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AIM: To document the process of developing a cerebral palsy (CP) population register using New Zealand (NZ) as a case study. This case study may stimulate and assist register development in other countries.

METHODS: Register planning commenced by establishing a clinical need. Current international best practice and research for children with CP indicates the benefits of a patient population register, including accurate prevalence estimates; assistance with service planning in health and education sectors; population specific clinical surveillance and research studies. A register may also identify regional or ethnic health inequalities in the population. The process for developing a register in NZ included: i). Review of current national databases and register services. This identified a limited number of informal clinical databases for the CP population. ii). Consultation with stakeholders, including medical clinicians, therapists, health service managers and representatives from the CP society, cultural representatives and managers of other patient registers, nationally and internationally. iii). Formation of a local steering committee. iv). Review of local ethical requirements and options for consent. v). Development of a business case, including clinical details and practicalities (how and what data to collect); governance structure; IT framework options; budget and timelines. vi). Identification of funding options and submission of applications. vii). Dissemination of business case to key stakeholders for discussion. viii). Submission of ethics and funding applications.

RESULTS AND DISCUSSION: There was a six month timeframe for development of the business case, with an additional two months proposed for business case review by stakeholders and planned six months for the ethics and funding body reviews to be completed. Guidelines for the process have been established. The framework for a national CP register can be developed in a six month period, with an anticipated additional 12 months to establish ongoing funding and develop an operational register.

THE BURDEN OF EPILEPSY IN A NATIONAL REGISTRY OF 5-YEARS-OLD CHILDREN WITH CEREBRAL PALSY

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SCIENTIFIC BACKGROUND: Epilepsy seems to be associated with worst functional abilities and participation in persons with cerebral palsy (CP).

AIM: Assessment of the prevalence of epilepsy in children with CP by clinical types, risk factors, associated comorbidities and association to special education needs.
METHODS AND SUBJECTS: Cross-sectional study with nested case-control analysis, based on actively reported 5-year-old children born in Portugal in 2001-2005 (National Surveillance of Cerebral Palsy). SCPE definitions and functional classifications were used, as well as Portuguese scales for assessment of communication (as producer), feeding ability and drooling control. Epilepsy was defined by post neonatal seizures. Risk factors for epilepsy were identified by logistic regression analysis (LRA).

RESULTS AND DISCUSSION: Information about epilepsy was recorded in 565 of 649 children with CP (87.1%). 238 children had epilepsy (42.1%). It was more frequent among those with spastic CP (42.7%, but 63.5% if 4 limbs affected) and dyskinetic CP (40.8%). Children with epilepsy were more often on levels IV-V of GMFCS (64.6% vs. 26.6%), as well as for BMFM, MACS and the oromotor assessment scales. IQ<50 was more frequent (68% vs. 32%), as were sensorial deficits. Non-inclusive schooling was more frequent in CP with epilepsy (61.5% vs. 38.5%). Epilepsy was significantly more frequent in term than preterm children, and in those having brain malformations. Early neonatal seizures were the strongest predictor of epilepsy in CP children born at term (OR 4.1; 95%CI 2.0-8.15), as was twinning in very preterm children (OR 0.39; 95%CI 0.16-0.97). Epilepsy is a heavy burden in CP, it afflicts mainly term children, especially those that had seizures in their first 3 days of life, and very frequently aggravates the condition of children with the most severe motor function. The recent trend of increasing proportion of epilepsy in children with dyskinetic CP is confirmed at a national level.

DESCRIPTION OF A COHORT OF CHILDREN WITH CEREBRAL PALSY AT A TERTIARY REFERRAL CENTRE IN SOUTH AFRIC

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INTRODUCTION: There are limited descriptions available on Cerebral Palsy in South Africa. AIM: To describe a cohort of children with Cerebral Palsy in a tertiary referral centre in South Africa. METHODS: Patients attending RXH Cerebral palsy clinic were randomly selected during routine visits and information regarding classification and aetiology was collected from January 2012 to March 2012. Patients with a diagnosis of cerebral palsy between the ages of 6 months and 16 years were included. Individual folders were reviewed to complete data collection. Gross motor functional classification was used to document functional ability.

RESULTS: Seventy-one patients were reviewed. The mean age was 65 months (range 6-195 months). Forty five (64%) were male and 26 (36% female). The commonest aetiological factors were birth asphyxia (32% n=21), and post infectious (15% n=11) The majority of patients were classified as bilateral cerebral palsy: 87% (n=62), and 25% (n=18) were unilateral. The predominant tone abnormality was spasticity: 77% (n=55), 12.68% (n=9) were dystonic, 8.45% (n=6) were described as mixed and only one patient was reported as hypotonic. Fifty five percent were classified as GMFCS V. Fifty percent were reported to have severe to profound global developmental delay (n=36). Co-impairments were common with 48.6% (n=35) diagnosed with Epilepsy, 30% with visual impairment, 4% (n=3) hearing impairment, while 15%(n=11) had musculoskeletal complications. Ten children (18%) had confirmed Gastro oesophageal reflux disease and inco-ordinate swallowing which required surgical management (Nissan fu ndoplication) and gastrostomy in 8 children (11%).

CONCLUSIONS: In keeping with other developing countries the commonest causes of cerebral palsy in Cape Town are preventable: birth asphyxia and post infectious. The majority of patients have severe physical disability, multiple co-impairments and moderate to severe global developmental delay.
A WEB BASED MOTOR & COGNITIVE TRAINING PROGRAM FOR CHILDREN WITH CEREBRAL PALSY.

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SCIENTIFIC BACKGROUND: It is known that in order to drive neuroplasticity changes in the brain, much more intensive and long-lasting training is necessary than what has been assumed previously. It is likely that this fact is also applicable for people with cerebral palsy. The training system is developed in order to help people with cerebral palsy to obtain a low-cost, individually, systematic, intensive and sufficient training under supervision of one or more therapists. The self-training aspect leaves the client a possibility of taking control and responsibility of own training and development possibilities. The system is developed upon the basis of theories of the brains neuroplastic and dynamic abilities. The training system makes it possible to include more specialists profiessional expertise into one and the same training programme.

METHODS: The training system consists of a webcam and a computer with internet access. Using green tracking bands, the web camera captures the movement of the child. The computer translates the movement and can thereby control the special designed exercises.

Each training programme is individualized. The therapist is able to follow the training via the internet and make adjustments in the training and thereby make it progressively harder as the person improves.

RESULTS: This is an ongoing project until appr. March 2012. So far the results are promising concerning progressions in cognitive, physical abilities and ADL skills. There are significant progressions in the following areas: AMPS, motor and process skills, Visual perception, Functional strength in lower extremities and tests for physical fitness.

DISCUSSION: The results are promising and indicates that this programme will be usable not only for people with cerebral palsy but for many types of diagnosis, neurological and others.

Keywords: internetbased training system, hometraining programme, activity programme, neuroplasticity, individualized training system, therapeutic training programme

JIVADHARA - HOPE FOR THE HOPELESS

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AIM: To introduce JIVADHARA, a new treatment in Alternative system very much effective for cerebral palsy.

CONTENT_1: JIVADHARA - HOPE FOR THE HOPELESS

Jivadhara is a new treatment method a unique combination of two ancient and well known treatment methods from two different continents, Chinese Acupuncture and Italian Electrohomeopathy. These unique combination was tried for the first time by Dr Sr Mary Eassy MD(AM)PhD to form Jivadhara. Jivadhara is mainly Acupuncture treatment, one course of Jivadhara is of 12days of acupuncture (20mins per day) and there will be an interval of 15days before we start the next course and Electrohomeopathic medicines (both internal and external) are given along with it. Electrohomeopathy is an Italian originated treatment system in which medicines are extracted from medicinal plants through a process called colobation, its non toxic and non alcoholic. Both of these treatment are without any side effects and so is Jivadhara. Both these treatments are based on the principles of polarity. Acupuncture helps to create balance in the vital energy and EH medicines helps to balance the vital fluids like blood and lymph. So the combination can sustain the body in a balanced mode, thus helps the patient to enjoy his wholesome life. Dr Sr Mary Eassy has being practicing this unique system for the past 16 years. The thesis of Jivadhara was presented in the Zorastrian college, Mumbai in 2006, which was awarded the Gold medal for the nest thesis of that year.

CONTENT_2: JIVADHARA RELATED TO CEREBRAL PALSY

Related the cerebral Palsy, in Jivadhara we have 184 patients who have started their treatment below the age of 15 years of them 85 started below the age of two years from October 2009 till
February 2012. We have kept their medical records, details of treatment, stages before starting treatment, during treatment and current stages with photos/videos and other records and we are glad to say all of our patients are having positive and notable changes as per the progress of treatment their age and which are supported by their parent’s testimonials. Our first batch patient Manju Martin is now studying in 8th standard as a normal child in a normal English medium school, she walks, plays and does all her day to day activities of a normal child and have very good results in her studies too. We have 35 kids who has completed their treatment and enjoying life of normal kids by achieving all their major milestones and the rest in various stages of recovery. We can provide the whole set of details for reference. We have more details in our official website www.jivadhara.com

CONTENT_3: EFFICACY OF JIVADHARA

Efficacy of Jivadhara is certified by various pediatricians and neonatal neurologists. Among them the most prominent support comes from Dr P.K Rajiv (www.drprajiv.net), the former head of new born division of the famous Amrita Institute of Medical sciences in Kochi, he is now the head of neonatology in NMC hospital, Dubai. Various other doctors and pediatricians like Dr Venugopal MBBS DCH, Dr Abraham John MBBS, MD(pediatrics) etc. agree with the results of Jivadhara and send their patients to us. Kids of age 2 years and below have a quick and complete cure, they can achieve their milestones without much delay and in 2-3 years of treatment they are physically and mentally fit as normal kids. They go to the normal schools as normal kids with normal IQ. Spastic children and children with damaged brain too recovered very well with this treatment. We have the MRI scan reports to prove. In JIVADHARA system earlier the treatment starts faster is the cure.

CONTENT_4: VISION OF JIVADHARA

Our mission is to develop the Jivadhara System to a perfect treatment wing for diseases like Cerebral Palsy, Mental Retardation, Autism, Hyper Activity, and many more.

We are moving ahead with a great aim to eliminate such ailments from the society so as to make a healthy new generation to the world. We concentrate in treating kids specially that we need to save the next generation of kids from being avoided from the mainstream of life for being a victim of such “incurable” diseases. A kid with such a disease is a pain for the whole family thus healing a child with such a disease is a great relief to the whole family.

We have a batch of children completed treatment from Jivadhara institute, most of them are studying in normal schools as normal kids, and we follow up them in intervals of 4 to 6 months by checkups.

The need to start good training centres in this field is very high. We need to impart this great knowhow to the next generation. We look forward to start new training centres and colleges for training new batches of doctors in this stream. A good campus with all modern learning facilities is in our dreams.

We also wish to do research to expand our horizon of treatment to other chronic diseases and ailments which are possible in Jivadhara system but are held up due to the space and resource constrains

We need to propagate this system, we aim to conduct seminars, and workshops, outreach programs other programs national and international for the propagation of this system.

Let's stand united to bring back the light to their lifes… Let's give them a chance….

CEREBRAL PALSY - AN AYURVEDIC MANAGEMENT

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AIM: The protocol of Ayurvedic management has been evaluated on established Cerebral Palsy cases after a pilot study over 500 cases and results have been encouraging, comparative to currently available treatment irrespective of systems and methods.

METHODS AND SUBJECTS: CP patients ranging between 1 year - 8 years are subjected to a management over a period of 6 months comprising of 3 sittings with an interval of 2 months. Each sitting with a duration of 2 weeks consists of Abhyangam (massage with medicated oil), Pinda Swedam (massage with special rice boiled in herbal decoction and milk) and Vasthi (medicated decoction introduced through rectum) in sequence daily, followed by oral therapy during the interval period as well. The improvement is assessed in terms of relaxation of spasticity, range of movements, in turn attaining motor milestones, acquiring speech, overcoming swallowing difficulties and psycho-social nutritional improvement.
RESULTS: Spasticity is the first significant feature relieved in 400 of 500 cases (80%). Attaining motor milestones like neck hold is improved in 180 of 300 cases (60%). Prone in 150 of 300 cases (50%). Sitting in 300 of 400 cases (75%). Standing in 311 of 445 cases (70%). Walking in 276 of 460 cases (60%).

Convulsion episodes have come down significantly when treated with Ayurvedic medication along with modern medication. Drooling symptom has reduced in 70% of cases and improvement regarding swallowing difficulty is also observed. Speech is improved in 70% of cases.

DISCUSSION: The results have been attributed to established mechanism where the GEPE system carrying all neuronal functions as a standby when a chief organ like brain function is derailed as in Cerebral Palsy. However, Abhyangam and Pinda Swedam has impact on the muscles by heat application and massage as motor areas receive stimulation through cutaneous receptors resulting into enhanced power of corresponding muscle.

PROVIDING SPECIALIST PAEDIATRIC REHABILITATION SERVICES TO THE TOP END: VISITING CLINIC MODEL

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SCIENTIFIC BACKGROUND: Provision of specialist paediatric rehabilitation services in the Top End of Northern Territory (NT), Australia, has previously been identified as a health service gap.

AIM: This paper describes the implementation and ongoing development of an interagency collaborative visiting Paediatric Rehabilitation Service to Darwin, NT, from Adelaide, South Australia (SA).

METHOD AND SUBJECTS: The Northern Territory Rehabilitation Strategy 2006 - 2010 (NT Government) recommends the establishment of a local Paediatric Rehabilitation Service, in conjunction with a coordinated visiting service to the Top End. A visiting clinic model was proposed and includes provision of a clinic three times per year, education sessions for local medical and allied health staff, a Botulinum Toxin injection service, and other specialist interventions. The clinic targets children across diagnostic groups including cerebral palsy (CP) - 66% of children attending the clinic have CP. The service covers a region occupying 522,561 square kilometres with an estimated resident population of 153,687 people.

RESULTS AND DISCUSSION: Since implementation in 2009, there have been 274 clinic attendances over ten clinics. Forty one children have been treated with Botulinum Toxin over seven sessions. The visiting team includes a Paediatric Rehabilitation Specialist, a Physiotherapist, an Occupational Therapist and a Clinic Coordinator. Between visit coordination occurs via telephone, email or videoconference as required. Ongoing collaboration has ensured appropriate referrals, with ten education sessions and attendance at the clinics supporting the ongoing up skilling of local staff. The clinic has resulted in children requiring less interstate travel to access rehabilitation services with an estimated saving of more than $1,750 (AUD) per child. There is a commitment to further develop the service, including identifying and addressing indigenous-specific needs and reviewing the feasibility of an expanded multi-disciplinary clinic. Ongoing collaboration between agencies is important to improve long term outcomes for this client group.
THE EFFECTS OF AN INTENSIVE INDEPENDENT LIFE SKILLS THERAPY BLOCK UPON ADOLESCENTS WITH CP

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SCIENTIFIC BACKGROUND: For adolescents to reach their full potential many life skills are necessary to assist them in dealing with everyday life, including personal care, leisure, education, financial skills and social interaction. Adolescents with CP face many barriers to these activities, often being at a disadvantage to their peers to successfully manage the adult world.

AIM: To provide specialist Bobath therapy to adolescents with CP focusing upon Independent Life Skills (ILS), providing them and their parent’s, support to become more independent and to provide them with a greater skill set for adult life.

METHOD: 5 adolescents with CP (15/16 years) and their parents attended 9 individualised therapy sessions (1hr 15 mins each) and 2 group lunches over 1 week. The Canadian Occupational Performance Measure (COPM), and individualised SMART Goal Attainment Scaling (GAS) of functional activities were used pre and post block.

Therapists analysed the reason for the young people’s functional limitations within their chosen activities, reducing these through therapy to increase participation.

All had the opportunity to socialise at lunchtimes, providing them time to share experiences with each other and with the Family Support Worker.

RESULTS AND DISCUSSION:

COPM:
- All achieved a significant change in performance (2 points) (mean: 3.02; range: 2.4 - 5.6) and satisfaction (mean: 4.23; range: 2.2 - 6.4).

GAS:
- 11 out of 13 achieved.

Intensive blocks of Bobath Therapy can be effective in improving performance and satisfaction of ILS in adolescents with CP.

Feedback indicated the adolescents’ confidence had increased, with them and their parents looking to the future with more positive outlooks, particularly regarding independence. All identified benefit in meeting and socialising with other adolescents with CP and their families.

SERVICING A GAP FOR CHILDREN WITH CP: A HOSPITAL BASED AMBULATORY REHABILITATION SERVICE MODEL

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SCIENTIFIC BACKGROUND: Children who undergo medical and surgical procedures to address the natural history of Cerebral Palsy (CP) require rehabilitation interventions to regain loss of function and support advances in their mobility, communication, function and health.

AIM: The aim was to create a service model which supports multi-disciplinary intensive rehabilitation interventions following surgical or medical procedures for children with CP and which avoids a hospital admission and enables multiple tertiary services to be provided in a context appropriate to the child and their family. This poster outlines the service model, activity to date and how it meets a significant gap in rehabilitation for children with CP.

METHODS AND SUBJECTS: The service model defines eligibility, service provision and referral pathways for children with CP. Liaison with acute services, including the Orthopaedic and Allied Health Departments, was required to form working relationships and ensure efficient and effective referrals. Recruitment of multi-disciplinary specialist paediatric rehabilitation staff to this unique service model was challenging.
RESULTS AND DISCUSSION: A model was established which provides accredited intensive rehabilitation (up to 4 hours daily) by a team of multi-disciplinary professionals. Programs are goal directed, utilizing the Canadian Occupational Performance Measure (COPM). Starting in July 2010, twenty nine episodes of intensive Ambulatory Rehabilitation for twenty two children with surgical procedures and seven children with medical procedures have been successful in avoiding hospital admissions. Effective transition at the end of the program is facilitated through liaison with community services. The model achieved clinically significant functional improvements for patients and families while reducing costs to the hospital through avoiding lengthy and costly hospital admissions. Surveys indicated a high level of acceptance and satisfaction of the service by the children and their families.

A MODEL OF CARE UNIT: PEDIATRIC NEUROPSYCHOMOTOR REHABILITATION CENTER „DR. N. ROBANESCU”, BUCHAREST

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BACKGROUND AND AIMS: Therapeutic success in saving the lives of children with diseases occurred at birth, meningoecephalitis, stroke after cerebral malformations, vertebromedular and craniocerebral trauma and the need of rehabilitation therapy in congenital malformations of the limbs and spine(cifoscoliosis), postraumatic disorders of the limbs, sequelae after cardiopulmonary arrest in surgery for cardiac congenital malformations and the others, has generated the appearance of care units for children with chronic disorders, so that he wouldn’t be excluded by the society he should be inserted in. The goal of our paper is to present the Pediatric Neuropsychomotor Rehabilitation Center „Dr. N. Robanescu”, Bucharest which is the reference center in the field in Romania.

METHODS: Accommodation in hospital and care method meet European standards and protocols as it could be seen in images during therapy.

RESULTS: The results are comparable to those in the literature (with country specific differences)

CONCLUSION: We follow the global developments in the field trying to adapt them to our socio-economic conditions.

INTENSIVE REHABILITATION: SUSTAINABILITY AND EFFECTIVENESS IN THE LONG RUN

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SCIENTIFIC BACKGROUND: In the management of cerebral palsy many different approaches exist, which means that there are many controversies about rehabilitation treatments. A considerable degree of uncertainty remains about using the appropriate intensity of treatment.

AIM: To determine sustainability and effectiveness of intensive rehabilitation according to the Stojcevic Polovina method in children with cerebral palsy in the long run.

METHOD: Children enrolled in the previous 5-year study of effectiveness of intensive rehabilitation were re-evaluated after 3 years and the GMFCS levels were compared.

RESULTS AND DISCUSSION: Out of 24 children that were initially included in the previous study of effectiveness of intensive rehabilitation, nine children stopped with intensive rehabilitation (two families became dissatisfied with child's improvement, five were unable to follow the program, two for unknown reasons). In four out of 15 children that continued with intensive rehabilitation (26.66%) GMFCS level improved by one level, in one child the GMFCS level was one level lower (6.67%) and the rest stayed on the curve. The average age of children is 11 years 4 months with an average duration of intensive rehabilitation of 9.5 years. According to our experience, it is possible to improve GMFCS level in some
REHABILITATION PROBLEM SOLVING OF CHILDREN WITH CEREBRAL PALSY IN LATVIA

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SCIENTIFIC BACKGROUND: Cerebral Palsy (CP) is the most disabling health condition in childhood. Children with CP usually present impairments, activity limitations and participation restrictions.

AIM: To organize focus groups and to explore and analyze:
- functioning and activities of children with Cerebral Palsy (CP) using ICF-CY Model (WHO, 2007),
- Rehabilitation Problem Solving Form (Steiner et al., 2002) as communication tool in CP program to provide patient centered rehabilitation approach and to structure decision making process.

METHODS: Multiprofessional rehabilitation team provided detailed assessment of 20 children with spastic and dyskinetic form of CP (mean age for the overall children (3-12 years) sample was 8.2 (SD 3.1). Individual “core sets” were defined for each child. Rehabilitation Problem Solving Forms (RPS-F) based on functional evaluations were completed.

Participants: two parents’ focus groups and a health care professionals’ group were organized. The discussions were transcribed verbatim and a descriptive thematic analysis was performed.

RESULTS AND DISCUSSION: The focus groups were introduced to the principles ICF-CY, RPS-Form and the results of the functional assessment. The visualization of target problems, as well as the target mediators helped to define practical, meaningful, measurable and attainable therapy goals for children with CP. The focus group discussions stimulated active involvement of family in the decision making. These findings suggest that the communication between multiprofessional rehabilitation team and children’ parents needs to be enhanced.

RPS-Form can be used to identify specific target problems, set realistic goals and plan the most appropriate interventions for CP children.

Use of this form can facilitate cooperation among parents of children with CP and medical, social and education sectors of municipality.

5 Hips & Spine, Pain, ITB

INTRATHECAL BACLOFEN TREATMENT IN CHILDREN WITH CEREBRAL PALSY ACROSS EUROPE

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Scientific background: In cerebral palsy (CP) secondary complications due to spasticity are common, affecting quality of life for children and their family/carers. Intrathecal baclofen (ITB) has been shown to improve the management of spasticity and pain. Access to interventions for spasticity problems are thought to greatly vary across Europe.

Aim: To describe variations in ITB treatment across Europe for children with CP.

Methods and subjects: Surveys were sent to SCPE partners and clinical networks, exploring the possibilities of data collection regarding children with CP and ITB, and to countries across Europe exploring the availability of ITB on national/regional/local level. Additional information was accessed through Medtronic, manufacturer of medical pumps. Results were related to health economic variables (Gross Domestic Product, GDP, % of GDP spent on health). Children born 1990-2005, with spastic and dyskinetic CP, at all GMFCS levels were included.

Results and discussion: Population/based data were provided by Sweden, Norway, Northern England, Portugal and Slovenia, 75 (3.4%) of 2217 had ITB, ranging from 0.4% to 4.9% by center. Centers in Belgium and the Netherlands provided additional information. Of all treated children known, 155 (95%) of 163 were non/walkers, 108 were boys and 55 girls. Gender difference was significant among Swedish children, where 6.3% of boys and 2.5% of girls with CP had ITB (p=0.002). Age at implant differed between centers (p<0.01), Norway had the youngest implant age (<5 y), while mostly older children received ITB in other centers.

On country/center level 27 of 32 responders from 22 countries across Europe reported availability of ITB for children with CP, median 9 years (range 2-22). The access to ITB for children in correlated to GDP per capita (p<0.01) and % GDP spent on health (p<0.01). The variety of access to ITB treatment illustrates inequalities of care for children with CP in Europe.

THE AUSTRALIAN PAEDIATRIC INTRATHecal BACLOFEN THERAPY AUDIT TOOL

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Scientific Background: Intrathecal baclofen therapy (ITB) is one intervention used to manage severe spasticity and dystonia in children with neurological impairment.

Aim: An increasing clinical use of ITB in Australian tertiary paediatric hospitals, along with the need for standardised assessment and reporting of adverse events has seen the formation of the Australian Paediatric ITB Research Group (APIRG). In June 2011, after two years of collaboration, the APIRG launched a national ITB Audit tool designed to capture clinical outcomes and adverse events data for all Australian children receiving ITB therapy.

Methods and Subjects: The Australian ITB Audit is a 10 year, longitudinal, prospective, clinical audit. Data from clinical outcomes across body functions and structure, participation and activity level domains will be collected and entered at baseline, 6 months, 12 months then annually after ITB pump insertion for every child having an ITB pump implant before the age of 16. Data will also be collected on adverse events, their severity, relatedness and intervention required. All de-identified data entered into the Australian ITB Audit Tool will be pooled to enable investigation of clinical and adverse event outcomes following ITB therapy in Australia.

Results and Discussion: To our knowledge, this is the first Australian study that aims to capture clinical and adverse event data from a complete population of children and adolescents with neurological impairment receiving a specific intervention. This multi-centre study will inform and guide Australian and international clinical practice in the use of ITB in children and adolescents, provide clear indications for patient selection,
record and help guide decision making regarding adverse events and investigate the impact of ITB therapy on family and patient quality of life.

**EFFECTIVENESS OF SURGICAL INTERVENTIONS IN HIP PROBLEMS IN SEVERE CEREBRAL PALSY**

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Scientific background: Soft tissue surgeries and osteotomies have extensively been used in order to stabilize subluxated/ dislocated hips in Cerebral Palsy.

Aim: A systematic review was performed in order to determine the effectiveness (in terms of diminishing pain and decrease of migration percentage) of preventive (soft tissue) and corrective (bony) surgical interventions in hip (sub)luxation in patients with severe cerebral palsy.

Subjects and methods: An extensive literature search was performed. Inclusion criteria were diagnosis of severe Cerebral Palsy (GMFCS4 and 5), evidence of a hip subluxation or dislocation, objected by Migration Percentage (MP), a surgical intervention had been proceeded and the outcome measures were decreasing MP and diminishing pain. A qualitative analysis and a best evidence synthesis, accordingly to Steultjens and Van Tulder et al was performed for the soft tissue surgery and the osteotomies separately.

Results and discussion:
The literature search resulted in 224 abstracts of which the first selection based on title and abstract obtained 23 articles. All were observational studies. Finally 5 articles concerning soft tissue met the inclusion criteria of which only one fulfilled the qualitative analyses. Therefore there is insufficient evidence for soft tissue surgery for stabilizing the hip.

Osteotomies (9 articles were included with sufficient quality) were performed in 189 patients. The mean MP at follow-up ranged from 6-29%. The percentage of patients who had a MP less than 33% after surgery differs between the studies (53%-75% in DVO alone and 85% or higher in the DVO combined with pelvic osteotomy). No relationship could be established between the effect of the surgical procedure and patients’ age and duration of follow-up. Pain decreased from 81% preoperatively to 5% at follow-up. In 25% of all interventions complication occurred like osteoarthritis, ulcers or fractures. We concluded that there are indicative findings for the effect of bony surgery on stabilizing the hip, however insufficient evidence for decreasing pain.

**LONGITUDINAL MORPHOMETRIC ANALYSIS OF THE HIP IN CEREBRAL PALSY USING COMPUTED TOMOGRAPHY**

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Although early surgical intervention in patients with spastic hip disease has been reported to lead to better long-term outcomes, there were few scientific studies that confirm the effectiveness of surgical intervention objectively. In order to investigate the effectiveness of the muscle-release surgery for children with cerebral palsy (CP), we analyzed 140 hips in 70 spastic CP patients using longitudinal three-dimensional computed tomography (CT). Methods and subjects: 62 hips in 31 patients underwent muscle-release surgery for iliopsoas, rectus femoris and hamstrings with the mean age of 5 years and 1 month (Group A). 78 hips in 39 patients had no surgical intervention with the mean age of 5 years and 5 months (Group B). All hips of both groups were examined twice using CT. Group A hips were examined before the surgery and at 2 years
postoperatively while Group B hips were examined twice with 2-year interval. We referred to the age- and weight-specific pediatric protocols of the multidetector CT, and limited the dose of irradiation. CT data were reconstructed to three-dimensional model using original software. The fitting plane of ilium was projected onto the coronal plane, and then the angle formed with a horizontal line was defined as CTα. The neck/shaft angle (CTNSA) and the femoral anteversion (CTFA) were also measured. The center of the acetabulum and the femoral head were determined to calculate the migration percentage (CTMP). Results and discussion: The mean CTMP was 40.1% to 16.7% in the group A (p<0.001). CTα (p=0.2, 0.2), CTNSA (p=0.6, 0.2) and CTFA (p=0.1, 0.5) were not significant difference in the two groups. Our data supports that muscle-release surgery for spastic hips in CP children appeared to be advantageous for improving hip subluxation.

HIP LUXATION IN CEREBRAL PALSY - A EUROPEAN SURVEY

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Scientific background: In cerebral palsy (CP) secondary complications, such as hip luxation affect the quality of life for children and families/carers. Without hip screening combined with active intervention in the case of hip dislocation, 10-20% will have a hip luxation. In a Swedish follow-up program (the CPUP) this has been proven to be preventable. Follow-up routines are thought to vary across Europe.

Aim: To study the current standards of follow-up and prevention of hip luxation and to describe variations in prevalence of hip luxation in children with CP across Europe.

Methods and subjects: Surveys were sent to SCPE partners and clinical networks, exploring the possibilities of data collection regarding hip luxation in CP, and to countries/centers across Europe regarding systematic registration of hip status in children with CP, standard definition and diagnosis of hip luxation and guidelines for management or prevention of hip luxation. Children spastic and dyskinetic CP, born 1999-2001, at Gross Motor Function Classification (GMFCS) levels III-V were included.

Results and discussion: Population-based data on hip luxation were provided by Norway, England, Portugal and Sweden (n=261). CP-Netz reported data from 12 German centers (n=185). The occurrence of hip luxation differed between centers (p<0.01). However, definitions varied between migration index >65% and 100%. CP type in children who had undergone surgery differed between centers (p<0.01), but the majority (69%) had bilateral spastic CP. Operated children were at GMFCS level III in 17%, IV in 29% and V in 54%.

On country/center level 15 of 31 responders across Europe registered hip status in children with CP, and 20 reported guidelines for hip management (5 national, 7 regional, and 8 local) used for a wide range of years (1-23). Several guidelines were reported to be underway. Such guidelines constitute a foundation for decisions regarding management of the secondary complications in CP.
NHS GRAMPIAN CEREBRAL PALSY HIP MONITORING PROTOCOL - OUR EARLY EXPERIENCE

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INTRODUCTION
Hip displacement is common in children with cerebral palsy. There is a broadly linear relationship between severity of spastic cerebral palsy and the likelihood of hip problem. NHS Grampian introduced a local protocol in March 2008 to guide clinical and radiological monitoring of hips at risk in children with cerebral palsy.

AIM
- If current clinical practice followed the recommended protocol
- Outcome for children following hips X-ray

METHODS
A retrospective case study of patients (0-19.0 years old) currently living in the Grampian with the diagnosis of spastic hemiplegia, spastic diplegia/quadriplegia. Data is collated from patients CCH notes using a proforma.

POPULATION
153 children (0-19.0 years old) with spastic hemiplegia, diplegia and quadriplegia identified meet the criteria for the audit. The incidence of cerebral palsy in this caseload during the audit period was 1.6 per 1000 live births.

RESULTS
41 (26.8%) children had hip surveillance X-ray done from March 2008 to 1st August 2010. Total number of children assessing the surveillance hip X-ray is low in the spastic hemiplegia (n=3) and spastic diplegia/quadriplegia (GMFCS I/III, n=17) group. Annual examination was done in 86.3% and 94.3% of these two groups respectively. All children with GMFCS IV-V have annual examination and 21 (65.6%) children have surveillance hips X-ray.

From the 41 surveillance hip X-rays, fourteen (34.1%) were abnormal; 10 (71.4%) children are from the GMFCS IV/V group and the rest from the spastic diplegia/quadriplegia (GMFCS I/III) group. Five (35.7%) children went on to have surgery (all from the GMFCS IV/V group) and the rest being actively monitored in Orthopaedic clinics.

CONCLUSION
Our early experience with this surveillance programme shows that hips problem was detected in one third of the children screened and one third of them went on to have surgery. Local hips monitoring protocol introduces a standardised approach to assess children with cerebral palsy, resulting in timely referral to Orthopaedics service.

BAROGRAPHIC MEASUREMENT OF SEATING POSITION IN CHILDREN WITH CEREBRAL PALSY UNDERGOING HIP SURGERY

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Scientific background: Children with Cerebral Palsy GMFCS IV/V are often wheelchair bound necessitating symmetrical and low pressure seating in order to prevent skin pressure ulcers and pain.

Aim: To determine whether surgical correction of hip luxation or subluxation and hip dysplasia improves seating position. Furthermore this study aim to establish a method of barographic measurement of seating position in children without postural seating control.

Subjects and methods: 10 children with Cerebral Palsy underwent barographic measurement of seating position and postural balance before and after hip surgery. A recording of 30 seconds with the child seated on the flexible ConforMat with a back inclination of approximately 90 degrees was performed using the Clin Seat Type 5315 Sensor, Tekscan, Boston, Mass, USA.
Results and discussion: Analysis of the barographic measurements were performed using original software. Each recording were averaged in order to obtain a static measurement for the statistical analysis. The midline was estimated and the peak contact pressure for both the left and the right sides was calculated. Results shows improvement in asymmetry in 2 of 10 patients and improvement in asymmetry but shifting to the opposite side in 3/10 patients. 3 of 10 patients had worsening of asymmetry and 2 of 10 patients had worsening of asymmetry but shifting to the opposite side.

In conclusion, it has not been documented that unilateral hip surgery improves seating symmetry measured by barography of seating position.

DO BOTULINUM TOXIN IN ILIO-PSOAS MUSCLE PREVENT FROM HIP LUXATION IN YOUNG CEREBRAL PALSY CHILDREN?

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Content:

Scientific background:
Hip luxation is a major concern in cerebral palsy (CP). Botulinum Toxin (BT), as used to prevent from hip excentration, gave conflicting results.

Aim of the study:
To look for the effectiveness of BT injections in the ilio-psoas muscle (involved in hip instability), along with other hip muscles, in delaying hip migration in a group of young CP children.

Subjects:
Ten children, aged 2y4m to 5y4m classified GMFCS was III for five patients and IV for the others were enrolled

Hip migration was measured by Reimers index (RI) and was between 27 and 41% at least for one hip at the beginning of the study.

Method:
Children received uni or bilateral BT (type A) injections in ilio-psoas muscle (inguinal route, echographic guidance) associated with injections in hamstring and hip adductors, at a rhythm of 0,6 to 1,8 per year. Total dose per session was calculated according to recommendations; maximum dose in each ilio-psoas was 10 to 20 units (for Botox) or 50 units (for Dysport). Radiographic surveillance was done at frequency of 1 to 1,7 per year.

Results:
2 children dropped out of the study, one of them because a rapidly evolutive luxation.
8 children (14 hips) were followed more than 24 month (maximum 65 month).
Average RI was 33,78% (SD: 4,38) at the beginning and 31,64% (SD: 4,46) at the end of following.

There was no adverse event.

Discussion:
This observational study demonstrates that the injection of BT in ilio-psoas is safe and useful in CP children who are at a high risk for Hip luxation.
The stability of hip migration index, during a follow up as long as 5 years in 8 of 10 children, is to be compared to its natural rate of progression (10% per year).
Targeting ilio-psoas muscle in a program of BT injections could there be an interesting treatment to delay hip surgery in young children.

VALIDITY OF RADIOLOGICAL METHODS ASSESSING THE PROXIMAL HIP GEOMETRY IN CHILDREN WITH CEREBRAL PALSY

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Scientific background
Numerous radiological methods with various levels of validity are available to assess the specific hip deformities of children with cerebral palsy.

Aim
The aim of this systematic review was to assess the current validity, reliability and limits of use of the radiological methods measuring the proximal hip geometry in this population.

Methods
A database search was conducted using relevant keywords and inclusion/exclusion criteria in 7 databases. The quality assessment was rated using a customized scale that evaluates the quality of the article and its metrological strength.

Results and discussion
18 articles met the inclusion criteria. The migration percentage using X-rays, evaluated in 7 studies, showed excellent reliability and concurrent validity with 3D CT scan measure of hip migration. Thresholds for a true change were between 8.3% and 22%.

Regarding acetabular dysplasia, the acetabular index (X-ray), evaluated in 3 studies, had moderate concurrent validity with a 3D CT scanner measure. Despite only moderate validity, the acetabular index had good reliability. Thresholds for a true change were between 3.7° and 5.9°. 3D CT scan indexes, evaluated in 5 studies had greater reliability.

The measure of neck shaft angle (NSA) using X-rays, evaluated in 3 studies showed excellent concurrent validity with measures from 3D CT scanner and excellent reliability. 90% of the measures were reported to be within 10° of error.

Regarding femoral anteversion, one study found excellent correlation between the 2D CT scan and trochanteric prominence angle test and excellent reliability. Two others showed less evidence for the use of CT scan or ultrasound based techniques.

Hip migration, acetabular dysplasia and NSA can be measured reliably using X-ray, knowing the limits of use. If needed, 3D CT scan can be used reliably for acetabular dysplasia. Further evidence is required regarding the validity of 3D CT-scan and non-irradiative methods (ultrasounds and MRI).

PAINFUL HIP IN CHILDREN WITH CHRONIC PAIN RELATED TO SEVERE SPASTICITY IN COURSE OF CITB

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Spastic hip subluxation and dislocation are common problems in children with spastic cerebral palsy (CP). The incidence of dislocation correlates with the severity of the spasticity. Established painful hip dislocations is the foremost indication to surgery: related spasticity, distonia, contractures and impaired oropharyngeal function, malnutrition, increase surgical risk. The difficulty in assessing pain in these children who cannot verbalize or self-report their pain, such as those with cognitive impairment, continues to pose a significant barrier to effective pain treatment. We aimed to investigate destiny of painful hip in quadriplegic children to explore the timing of CITB or needed surgery. Six children with quadriplegic spastic CP, (age range 2y-8y; 3boys, 3girls), partially dislocated painful hips. All patients were assessed level IV or V GMFCS and had poor communication skills. All children started continuous intrathecal baclofen therapy (CITB) were followed for 1 month. Outcome measure were individualized by rating scale before pump implantation and after 1 month. MAS, GAS and FLACC were our tools. The clinical efficacy of CITB was confirmed by the change over time in the modified Ashworth scale and lowering of pain had been achieved. The introduction of CITB was associated with changes across GAS areas. CITB in this study appears to decrease painful hip. Advances in understanding both the pain in the children with cognitive impairment and CITB’s pharmacology could help better define the therapy’s indications. The choice of CITB may be guide the multidisciplinary team in their timing of therapy during painful hip monitoring.
HIP RECONSTRUCTION IS MORE PAINFUL THAN SPINE FUSION IN CHILDREN WITH CEREBRAL PALSY

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Scientific Background: Concerns about pain control in patients with Cerebral Palsy (CP) are especially anxiety provoking for children and parents; a better understanding of the magnitude and the quality of the pain these patients experience after surgical procedures would better prepare the patients and families.

Aim: The purpose of this study is to quantify the amount of postoperative pain in children with CP undergoing hip reconstruction and spinal fusion. Specifically, the study will compare pain scores and the amount of narcotic used between the two groups.

Materials/Methods: This is a retrospective chart review of all children with CP undergoing hip reconstruction (femoral osteotomy, pelvic osteotomy, or both) and posterior spinal fusion at a tertiary-care pediatric hospital. The primary end point was the total narcotic used by the patient during the hospitalization, by converting all forms of narcotics to morphine equivalents. The secondary end point was the documentation of pain with standard pain scores at standard time points postoperatively. Adverse effects related to pain management were documented for both groups. Student’s t-tests were utilized to statistically compare differences between the groups (significance p<0.05).

Results and Discussion: 42 patients with CP who underwent hip reconstruction (mean age 8.3) were compared to 26 patients (mean age 15) who underwent PSF. The total narcotic used, normalized by body weight and by days length of stay (DLOS), in the hip group was 0.49 mg Morphine/kg/DLOS, compared to 0.24 for the spine group (p=0.014). The mean pain score for the hip group was 1.52 compared to 0.72 for the spine group (p=0.013). There were no significant differences in the occurrence of adverse effects between the two groups. The knowledge that hip reconstruction is more painful than spine surgery for patients with CP will better prepare families about what to expect in the postoperative period.

PARENTAL CARE AND OSTEOPATHIC TREATMENT: AN EARLY APPROACH TO EXPLOIT THE POTENTIAL

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Scientific background
Newborn at risk of neurological suffering requires maximum effort for help to realize all its potential; early intervention is a great opportunity to improve possibilities of development and the quality of life in the future.

Aim
Work objectives are:
- early intervention to limit problems associated with prematurity and perinatal distress, to allow the maximum expression of the potential for each child.
- involvement of parents to propose an adequate environment to stimulate the development of child in daily life.

Methods and subjects
In the Department of Pediatrics and Nenatology in the Hospital of Desenzano del Garda there are a new service for take care early newborn with prematurity (late preterm) and with perinatal suffering. The project includes:
- manipulations for neuro-motor stimulation and osteopathic treatment for the prevention and correction of dysfunctions that may limit growth and development.
- suggestions for parents to promote the development, with “qualifying caregiving” (modalità di accudimento abilitativo).
- neurological monitoring and timely recognition of sign of delayed development in order to start immediately a program of specific rehabilitation.

Results and discussion
In 1 year 60 children in follow up. This type of intervention has shown positive effects on:
- Neuromotor development;
- Resolution of troubles like: plagiocephaly, postural asymmetries, alterations in muscle tone, hyperexcitability and tremors, myogenic torticollis, gastrointestinal disorders (constipation and gastroesophageal reflux), disorders of the sleep-wake rhythm.
- Quality of parent-child relationships.

The encouraging results of this experience suggest the effectiveness of this approach and the need to extend the project.

REACTS: A SIMPLE SCORING SYSTEM TO STRATIFY RISKS FOR PATIENTS WITH CEREBRAL PALSY AND SCOLIOSIS

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Scientific Background: Posterior spinal fusion (PSF) for children with cerebral palsy (CP) and severe scoliosis carries a significantly high risk; complication rates have been reported greater than 25%, and perioperative mortality has been reported at 1-2% for severe cases. The ability to stratify risk preoperatively could assist surgeons and families in making the difficult decision of whether to proceed with surgery or not.

Aim: The purpose of this study is to determine whether the REACTS scoring system correlates with postoperative complications in a population of patients with CP undergoing PSF.

Methods and Subjects: This is a retrospective review of patients with CP and scoliosis undergoing PSF. The REACTS scoring system gives points for preoperative morbidity in six areas: Respiratory, Eating, Ambulatory, Cognition, Talking, and Seizures. A REACTS score based on the patients’ preoperative status in the six areas was determined. Complications were then rated on a scale of 1 to 5, with one being a very minor complication requiring no additional treatment and 5 being death. The REACTS score was then compared to the complication score for each patient to determine correlation.

Results and Discussion: 23 patients (mean age 15) were included in the study. Twelve patients had a complication (52%), although five were only minor complications. The mean REACTS score was 8 (range, 1 to 11). The correlation of the REACTS score with the presence of a significant complication (complication score of 3, 4, or 5) was statistically significant (p<0.000001). The use of the REACTS scoring system showed good correlation with the risk of complications and could potentially stratify and identify those patients with a significant risk of perioperative mortality and allow for further preoperative evaluations to minimize complications. Prospective evaluation of this system with a larger sample size is needed to confirm its clinical utility.

ORTHOPAEDIC EVALUATION AND PHYSIOTHERAPY DURING EIGHT YEARS IN A ADOLESCENT WITH CEREBRAL PALSY

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Scientific background: The degree of goniometric measurements varies as performed or not automatic relaxation maneuver.
Aim: To compare the changes obtained in orthopaedic disorders during the last eight years in a thirteen year old child with cerebral palsy (diplegia), grade II+ (Tardieu-Hanssen Scale), treated with physical therapy by “Therapeutic Motor Education” according M. Le Météayer from January 2000 until today.

Methods and subjects: Within the five levels of the “clinical factor assessment” according to G. Tardieu of the subject with cerebral palsy (Functional-neuromotor, Orthopaedic, Sensory-Neuroperceptiva, Intellectual Cognitive, Behavioral-Affective) this study focuses on functional assessment, neuromotor and mainly on orthopaedic assessment. The goniometric measurements that were made will be shown with figures and graphs to get a visual impression of the results from 2004 to 2012.

Evaluation: During these eight years, we have perceived that the muscles shortened and more limited joint range and functionality are the following: soleus, gastrocnemius, adductors minor and medial hamstrings. We have also measured the degree of pathological femoral antetorsion, which has increased very significantly, especially in the left body side. That result will be shown with graphs. The degree of coverage of the femoral heads have remained without signs of decentration.

Results and discussion: After studying the results of goniometric assessments, we have conclude that despite the orthopaedic precautions employees during the last 12 years (seats plaster moldings, plaster splints, standings in abduction, night splints of lower limbs, Dafo) it does not preclude the need for possible surgery for femoral rotation correction and cotilus reconstruction once the child’s growth period had finish. Better notes and following of orthopaedic disorders will allow us to predict how these changes will evolve in the future.

ANKLE-FOOT-ORTHOSES IN CHILDREN WITH CEREBRAL PALSY - A POPULATION BASED STUDY

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Scientific background
Children with cerebral palsy (CP) in Norway are systematically followed up with both specialized and general health care, and since 2006 The CP-follow-up program (CPOP) has been implemented in South-Eastern Norway.

Aim
The aim of this study is to generate knowledge on the use of ankle-foot-orthoses (AFO) to prevent contractures, deformities and functional limitations in children with CP.

Subjects and methods
All children with CP born after 01.01.2002 in South-Eastern Norway, representing about 50% of the Norwegian population, are assessed according to a standardised protocol once or twice a year. The registrations are collected in a central CPOP database at Oslo University Hospital. The results are analysed with descriptive statistics in SPSS 18.

Results and discussion
447 children born from 2002/2011 in South-Eastern Norway were assessed in 2011, and 60 % of the children used AFOs. CP subtypes were classified according to SCPE, showing that 61 % of the children with bilateral CP used AFOs, 45 % with unilateral CP, 44 % with dyskinetic CP, 21 % with ataxic CP, and 20 % of the children not classified. The classification of functional level with GMFCS shows that 43 % of the children at Level I used AFOs, 61 % at Level II, 78 % at Level III, 60 % at Level IV and 53 % at Level V. Nearly 80 % of the children used AFOs more than 5 hour daily. The intention with the AFO is to prevent contractures and deformities, increase function and balance, and the distribution on the three goals will be discussed. 93 % of the children reported effect related to the three goals. Almost all of the children treated with BoNT and orthopaedic surgery in lower limbs used AFOs in combination with physiotherapy.
EFFECT OF A NEW INSOLE TO REDUCE THE SPASTICITY FOR CHILDREN WITH CEREBRAL PALSY

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Scientific background: For the patients with cerebral palsy (CP), brace therapy is effective to control the spasticity of their lower extremity and correct the alignment of walking.

Aim: We develop a new insole to decrease the primitive reflex and control the spasticity of lower extremities. By use of the insole, their toes are stretching toward extension and their MP joints do not contact on the sole. To fix their heels, the sole includes a counter support around the heel part and a plantar arch support. The purpose of this study is to evaluate the effect of this insole to decrease the spasticity.

Methods and subjects: 5 case of CP with spastic diplegia took part in this study. Measurement of reciprocal inhibition from ankle dorsiflexors to ankle plantarflexors by the H-reflex technique. We measure the effect of common peroneal nerve (CPN) stimulation on the rectified and averaged stimulus-triggered soleus EMG for 100 sweeps. The short-latency reciprocal inhibition is seen at a latency of 40 ms after the stimulus. The amount of inhibition was expressed as the amount of EMG measured corresponding to the period of inhibition as a percentage of the background EMG level.

Results and discussion: The short-latency reciprocal inhibition with the insole was significantly larger than that without the insole for CP children (p<0.05).

Conclusion: Results suggest that one of the reasons why this new insole reduces the spasticity is to activate the reciprocal inhibition from ankle dorsiflexors to ankle plantarflexors.

INFLUENCE OF KINESIOLOGY TAPING ON TREATMENT WITH ANKLE-FOOT ORTHOSIS FOR CEREBRAL PALSY CHILDREN

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In children with cerebral palsy (CP), increased ankle plantar flexion moment is a common problem. For decreasing enhanced ankle plantarflexion, there are several contributory methods on conventional treatment such as neuro/developmental treatment, stretching exercises, kinesiology taping (KT) and ankle foot orthosis (AFO). AFOs have been suggested to improve the dynamic efficiency of the gait of children with CP. Unfortunately, AFOs sometimes are not efficient enough to provide heel contact during early stance. The aim of this study is to evaluate the contributory effects of KT to provide more natural heel contact for the hemiplegic foot with AFO.

The gait characteristics of 8 children with spastic hemiplegia (GMFCF level II) were assessed by video based observational gait analysis. Special-designed pressure-based electronic device is used to visualize the heel contact. Participants have been using AFOs for 6 months. Their gait with AFOs satisfied physical therapists, orthopedists and families. Kinesiology taping with dorsiflexion assist was applied to each of participants. All of them were walking at their self selected speed. Initial contact, loading response and midstance sub-phases of the gait were analyzed for the cases with shoe, AFO and combination of AFO plus KT (KT+AFO). Comparison between cases were performed by Wilcoxon signed-rank test statistical method where p<0.05.

There are significant differences in the usage of shoe vs KT+AFO and the usage of AFOs vs KT+AFO in all 3 phases. On the contrary, there are no significant differences between usage of AFOs and shoes for the improvement of the premature heel rising at the interested phases.
Present study shows that each AFO may not prevent premature heel rise within the orthosis. Combinations of AFO and kinesiology taping with dorsiflexion assist have strong reasons to help out physical therapy on preventing premature heel rise and keeping heel contact more natural for children with spastic hemiplegia.

GAIT DEVELOPMENT USING MULTILIVELLO© ORTHOSES IN A LITTLE GIRL WITH ATAXIA.

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Introduction: Although the use of leg - foot orthoses in walking children with cerebral palsy (CP) has been part of current re-educational practice for some time now, orthopaedic technicians are never told by doctors what mechanical characteristics are expected and very rarely have the chance to precisely evaluate the functional needs of the individual the brace will be worn by. As a result, the appliance is prepared without being familiar with the characteristics required, according to the technician’s orthopaedic experience alone; it often results in the introduction of external moments that prove, on the contrary, to be a further hindrance to balance.

Purpose: Conversely, we propose a lower limb brace in which the connection between the thigh strap and leg strap is constituted by flexible sheets that work in extension. A system of elastic bands connects the hip strap to the thigh strap.

Materials and methods: These braces, named Multilivello, were used from six years of age by a little girl, F, with normal cognitive and social abilities, diagnosed with ataxia of unknown origin. Before using the braces, F.’s gait was characterised by great instability and the presence of heightened compensations of little functional use when walking.

Results: In just 2 months using the Multilivello hip-thigh-leg-foot brace, a significant change in gait was observed (figure 2): the dynamic alignment of the various components is better and, consequently, there is an overall, finer and more adaptable dynamic stabilisation of the various bodily parts.

Discussion and conclusions: The progress achieved in learning motor control can be attributed to the fact that the functional exercise of the changes in position and gait, in the child’s natural life, take place thanks to the significant kinetic personalisation of the Multilivello brace, which keeps the tibiotarsal joint and knee dynamically aligned.

GAIT REHABILITATION IN CHILDREN WITH CONGENITAL HEMIPARESIS: THE USE OF “JOINTLY AID”

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Scientific background

The therapeutic rehabilitation method, presented in this study, refers to Neurocognitive Rehabilitation, a cognitive rehabilitation theory proposed by Prof. Perfetti, that indicates as assumption of study that the quality of the recovery, both spontaneous and guided by the rehabilitator, strictly depends on the type of activated cognitive processes and their activating modality.

Aim

The aim of this study is to control knee’s hyperextension during gait in children with congenital hemiparesis after training exercises of “load transfer” performed on “jointly aid”, a tool of Neurocognitive Rehabilitation.

The performances obtained during the exercises were then studied by kinematic analysis with Costel system.

Subjects and methods
We have studied 4 children (2 with right congenital hemiparesis and 2 normal healthy children) while performing selected exercises of “load transfer” according to 3 way:

1. “load transfer” on balance
2. “load transfer” on “primary aid”
3. “load transfer” on “jointly aid”

The performances obtained during the exercises were then recorded by kinematic analysis with Costel system.

Results and discussion
The selected therapeutic exercise of “load transfer” on “jointly aid” can achieve the control of knee’s hyperextension during gait in children with congenital hemiparesis. This result is confirmed by kinematic analysis and by videorecording of children gait. The exercise, in fact, realized variable and dynamic, therefore functional, relationships between body’s parts, that may be effective in facilitating control of knee’s hyperextension.

THE EFFECTS OF BOTULINUM TOXIN A ON OVERALL GAIT IN ADULTS WITH SPASTIC CEREBRAL PALSY

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Scientific background: This study is a secondary report on a 16 week double-blind placebo-controlled RCT on botulinum toxin A (BoNT-A) for lower limb muscle overactivity in ambulant adults with spastic cerebral palsy (CP), with a recently developed measure, the Gait Deviation Index (GDI) derived from three dimensional gait analysis (3DGA) kinematics and data related to gait and walking previously not reported.

Aim: To investigate the effects of BoNT-A in adults with spastic CP on overall gait and walking.

Subjects and methods: Sixty-six persons with spastic CP, mean age 37y (SD=11.4), treated with injections of BoNT-A (n= 33) or placebo (n = 33) participated. Outcomes: GDI and spatiotemporal variables from three-dimensional gait analysis, and a questionnaire for subjective treatment effects on walking. Statistical analyses were paired sample t-test, analysis of covariance, and the Fischer’s exact test with relative risk (RR).

Results and discussion: No significant between/group differences were found for GDI (mean difference=0.91, 95% confidence interval (CI)=1.8; 3.7) or spatiotemporal parameters (e.g. step width: mean difference=-0.6, 95% CI=-2.0; 0.8). Both groups reported subjective improvements on the questionnaire related to walking, with a significant difference between the groups in favour of BoNT-A for the items “walking ability” (p=0.0013; RR=1.8, 95% CI=1.12; 2.86) and muscle stiffness (p=0.044; RR=1.6, 95% CI=1.02; 2.37). Thus, the results are in line with our previously reported results, showing no effects of BoNT-A on objective outcomes from 3DGA, but a treatment effect in favour of BoNT-A on subjective outcomes. As walking is an essential activity for daily life, and adults with CP frequently relate increasing stiffness to decreasing walking ability, further studies on BoNT-A with long term follow-up and post injection rehabilitation are proposed.


NO EFFECT OF BOTULINUM TOXIN-A ON ANKLE JOINT BIOMECHANICS DURING GAIT IN CHILDREN WITH CP

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NO EFFECT OF BOTULINUM TOXIN-A ON ANKLE JOINT BIOMECHANICS DURING GAIT IN CHILDREN WITH CP
Scientific background
In clinical practice, injections with botulinum toxin-A (BoNT/A) are used to reduce the spasticity of the calf muscles in children with cerebral palsy (CP), and thereby reduce equinus and improve function of the ankle joint.

Aim
The aim of the study was to retrospectively investigate the effect of BoNT/A injections in m.triceps surae on the kinematics and kinetics of the ankle joint during gait in children with CP.

Methods and Subjects
The inclusion criteria were diagnosed unilateral or bilateral CP, clinically measured spasticity treated with BoNT-A in m.triceps surae of the affected leg(s) and pre- and post treatment clinical gait analysis. Twenty-six children with a total of 37 affected legs fulfilling the inclusion criteria were selected from our clinical database. The subjects had a mean age (SD) of 8.0 (2.8) yrs. The mean dose was 97.0 (50.7) units of botox (Allergan) giving a relative mean of 4.0 (2.0) units per kg. bodymass (BM), administered in 1 ml. dilutions injected in m.triceps surae as recommended by the manufacturer. The biomechanical parameters A) dorsiflexion angle at initial contact, B) peak dorsiflexion during stance and C) mean plantarflexor moment during the initial 50 % of the stance phase were selected, as they would hypothetically be associated with spasticity during gait.

Results and Discussion
No significant improvements were observed (A: 12.6(7.9) to 11.4(8.9) degrees plantarflexion (P=0.24); B: 5.6(7.2) to 6.9(6.7) degrees dorsiflexion (P=0.15); C: 0.52(0.18) to 0.50(0.19) Nm/kg.BM (P=0.30)). Several factors that influence the clinical effects of BoNT-A have been suggested. In the present study, the doses were administered in relatively small dilutions and the injections were given without ultrasound guidance; this may have influenced the clinical effects. Furthermore, the results of this study may add to the ongoing discussion as to whether spasticity is the correct criterion for BoNT-A treatment.

ROBOTIC ASSISTED GAIT TRAINING AND GAIT PATTERN IN CHILDREN AFFECTED WITH CEREBRAL PALSY (CP)
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Scientific background: Robotic assisted gait training (RAGT) is a rehabilitation strategy based on the principle that task-specific and repetitive practice is required to develop and improve a motor skill such as walking.

Aim: The aim of this study was to evaluate through 3D Gait Analysis (3DGA) if adding paediatric RAGT to task-oriented physiotherapy (TOP) in children with CP could improve gait pattern compared to intensive TOP.

Methods and subjects 19 children with CP, aged 4 to 16 years, were divided into two groups: the 9 children of RAGT+TOP group had 20 RAGT sessions and 20 TOP; the 10 children of ITOP group had 40 sessions of TOP.

RAGT was performed using the Lokomat, and during each session, the children walked for 30 minutes with body-weight support fixed at 50% and the leading force at 100%. The only parameter that was modified during the treatment sessions was the gait velocity. Three clinical assessments were performed: pre (T0), post-treatment (T1) and 3 months after the end of treatment (T2).

As outcome measures gait velocity and Range Of Motion (ROM) of lower limb joints on sagittal plane were calculated. For both the groups, the mean values for each parameter was calculated at To, T1 and T2. Results and discussion: Both the groups didn’t significantly increase their gait speed after the training: children of RAGT+TOP group, whereas children of ITOP group passed from 0.8 ±0.3 m/s at T0 to 0.9±0.2 m/s at T1 and 0.9±0.2 m/s at T2. For both the groups, the parameters’ differences after the training and three months after the training were not statistically different.
No between groups differences were found. Compared to intensive TOP alone, the addition of RAGT to TOP didn’t significantly change lower limb joint kinematic of children with CP and the gait pattern was maintained over time.

EMG ACTIVITY DURING ROBOTIC ASSISTED GAIT TRAINING: A CASE STUDY

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Scientific background: Robotic assisted gait training (RAGT) is a rehabilitation strategy that promotes the recovery of walking following neurological gait disorders.

Aim: was to compare EMG activity of lower limb muscles in a 10-years old girl during RAGT according to different body weight supports and patient’s passive/active movement.

Methods and subjects: DL is a ten years old girl affected with left hemiplegia due to vascular cerebral lesion, who had RAGT on pediatric Lokomat (Hocoma, Zurich, CH).

During RAGT, bilateral surface EMG activity of soleus (SOL), vastus medialis (VAM) and biceps femoris caput longus (BFCL) was recorded using FreeEMG (Bts, IT) at 1000Hz for at least 20 sec. Three training conditions were tested: A) 100% of body weight (BW) supported by the Lokomat and passive movement; B) 100% of BW supported by Lokomat and active movement; C) 80% of BW supported by Lokomat and active movement.

Results and discussion: During A condition there was EMG activity only on healthy limb muscles (red signals in Figure, column A). When the patient was asked to perform active movement, EMG activity was present in sound and impaired limbs, both during fully BW support and with 80% of BW support. This case study showed that during RAGT EMG activity of impaired limb muscles was present only when the patient performed active movement and seemed increase when the BW Lokomat support was reduced. EMG activity of sound limb muscles was present during passive movement too (SOL and BFCL) and seemed increase during active movement passing from 100% BW to 80% BW of Lokomat support. These data suggest that during RAGT is important that the patient performs active movement in order to have muscles activity.

DENNYSON-FULFORD PROCEDURE FOR CHILDREN WITH SEVERE HINDFOOT VALGUS. A RETROSPECTIVE STUDY

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Scientific background: Dennyson-Fulford subtalar extra-articular arthrodesis is among the several modifications of the Grice-Green procedure used for correction of severe valgus hindfoot deformities in children.

Aim: We review our experience with the Dennyson-Fulford technique in a retrospective study of patients submitted to the Department of Children’s Orthopaedics at Aarhus University Hospital.

Methods and subjects: Between 1996 and 2010, 51 arthrodeses were performed in 33 children with severe hindfoot valgus deformities. We performed a review of the medical records, identifying indications for surgery, complications to the procedure and clinical outcome. Radiographs were reviewed in order to assess healing. The Gross Motor Function Classification System (GMFCS) was used to assess the gross motor function in patients with cerebral palsy (CP), before and after surgery. Applied statistics were paired t-tests.

Results and discussion: Etiologies were CP (n=18), myelomeningocele (n=6), over-corrected congenital talipes equinovarus (n=3) and others (n=6). The mean age at the time of the operation was 11,7 years (range 4,8; 16,9). Clinical healing was achieved at six weeks in 33 feet. Complications, leading to revisional surgery, were non-healing, hardware failure, pain, over-correction and recurrence of the deformity. Revisional surgery was performed in 10 feet. Satisfactory clinical outcome was obtained in 80,4 % of the
feet. The GMFCS-score was significantly improved after surgery (p=0.0208). Radiographic healing could not definitely be assessed in 41 feet at 6 weeks after surgery. We find the Dennyson-Fulford subtalar extra-articular arthrodesis useful in the treatment of severe, flexible hindfoot valgus deformities with successful clinical outcome in 80.4% of the cases and a significant improvement in the GMFCS-score in CP-patients. Conventional radiographs are inadequate in order to assess bony union in the subtalar extra-articular arthrodesis. To day there is no consensus on which method provides the best results, neither does an acknowledged regime exists for the procedure.

9 Physical activity

WALKING STRIDE RATES ASSOCIATED WITH MOBILITY RELATED PARTICIPATION IN CEREBRAL PALSY

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Scientific Background: Ambulatory children with cerebral palsy (CP) experience limitations in walking activity that negatively impact their ability to physically participate in day to day life.

Aim: Examine association of community walking stride activity levels to daily participation in ambulatory children with CP.

Methods and Subjects: A cross-sectional cohort of 128 children with CP (41% female) participated across GMFCS levels I-III, ages 2-9 yrs with 49% having hemiplegia and 72% spasticity. Average strides/day was collected from a 5 day sample with the StepWatch accelerometer and were normalized by knee height. Dichotomized for high/low walking activity levels, “high” walking stride activity was defined as > 148 stride/day per cm knee height. Participation was measured with parental report of the Assessment of Life Habits (Life-H) Total, Mobility and Housing categories on a 0-10 scale. Regression analysis controlled for age, weight, and Gross Motor Function Classification (GMFCS) level.

Results and Discussion: High walking stride activity was significantly associated with higher Mobility and Housing participation scores respectively (1.6 points, p=.001 and 1 point, p = .03). A greater level of walking stride activity was not associated with Total participation. Thus, a child with a 33 cm knee height and an average stride per day rate of equal to or greater than 4884 strides/day would have approximately a 1.6 point higher Mobility participation score and a 1 point higher Housing participation score. GMFCS subgroup analysis suggests interaction effect. These findings suggest that interventions to enhance day to day walking activity have potential to positively influence mobility related participation such as moving around within the home, on streets and sidewalks, on slippery or uneven surfaces, riding a bicycle, being transported in a vehicle, doing housekeeping tasks and using furniture and outdoor play equipment at home.

EFFECT OF TRAINING VIA A LOW-COST, COMMERCIALLY AVAILABLE GAME (WII) IN CEREBRAL PALSY

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Background: Coordination made a large contribution (21%) to upper limb activity, followed by spasticity (9%), contracture (7%) and strength (1%), with the shared component accounting for 25% in our previous study (Chiu et al 2010), so it is necessary to support the effect of coordination training.

Aim: Our aim is, for children and adolescents with hemiplegic cerebral palsy who are able to understand simple instructions, to improve the performance of upper limb via coordination training in the short-term.
Methods and subjects:
A prospective, randomized controlled with concealed allocation and assessors are carried out on affected upper limb of people with hemiplegic cerebral palsy who are able to understand simple instruction. Participants are randomly allocated into either experimental group (coordination training) or control group (no intervention) by an independent researcher, thereby concealing the randomization schedule from the recruiter.

Coordination training is being performed via Wii Sport Resort Activities (Bowling, Frisbee, Basketball, Air Sports), 10 minutes per activity, 40 minutes a session, 3 sessions a week for 6 weeks. Outcome measures are collected at the same time points for participants in both groups on admission to the study and at 6 weeks. Outcome measures include coordination, strength and Caregiver Functional Use Survey. The statistical significance is determined from the p value of a repeated-measures analysis of variance.

Results and discussion:
Data are collected from 16 participants with hemiplegia (8 in each group), aged from 6 to 12 years. Results show a tendency that children who receive Wii Sports Resort training have improvement in the measurement of coordination, strength and the score of Caregiver Functional Use Survey, but not statistical significance ($F_{5,10}= 1.5, p = 0.26$). These findings imply that more intensive or longer practices have a potential benefit for people with cerebral palsy.

PHYSICAL ACTIVITY IN YOUTH WITH CEREBRAL PALSY DURING THERAPEUTIC HORSEBACK RIDING: A PILOT STUDY.

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Scientific Background:
Despite numerous studies investigating the effectiveness of therapeutic horseback riding (THR) in improving gross motor function, there is limited evidence investigating its value regarding physical activity in children and adolescents with cerebral palsy (CP).

Aim:
To assess the feasibility of measuring movement using an activity monitor during THR in five non-ambulatory youth with CP.

Methods and subjects:
A convenience sample of youth with CP (N =5; 4 males, 1 female; age range 7 - 18 years; Gross Motor Function Classification System (GMFCS) distribution: n=2 Level III, n=3 Level IV) were recruited from a local THR program. Movement was objectively assessed in 3-second recording intervals or epochs using the ActiGraph GT1M activity monitor. Participants wore the accelerometers over the hip and at the wrist during all waking hours for two days with THR and two days without THR. Movement levels during THR were compared to the same time and the most active time on a day without THR.

Results and discussion:
During an hour long THR session, participants were active for an average of 43.0 min compared to 7.4 min/hr on a non-THR day. Hip activity counts during THR were significantly higher for all participants as compared to the same time on a day without THR, and significantly higher in 3 out of 5 participants compared to the most active time. THR was more valuable in increasing hip activity than wrist. In conclusion, this pilot study showed that it is feasible to measure movement during THR using accelerometry. Future studies should investigate how movement during THR translates into physical activity and energy expenditure.
FUNCTIONAL ELECTRICAL STIMULATION (FES)-ASSISTED CYCLING TO IMPROVE FITNESS IN CHILDREN WITH CP.

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Scientific background: Children with CP are at risk for health declines due to diminished physical activity. Cycling is a suggested means of exercise for this population.

Purpose: To compare the effects of an 8-wk volitional vs. FES-assisted cycling intervention on cardiorespiratory fitness and walking function in children with spastic diplegic CP.

Methods: Eleven subjects (6 volitional exercise (VOL/group) and 5 FES-assisted (FES/group); mean age 13.3±1.8 yrs.; GMFCS levels II-IV) participated in the study. The subjects participated in a recumbent cycling program, 3x/week, 30 min per session for 8 weeks. Baseline tests determined the individual’s target cadence, power output and heart rate reference points for the training sessions. Computer game-like feedback of cycling power assisted subjects to maintain targeted outputs. All subjects exercised at home. Stimulation settings for the FES-group were identified and preset for training at home. Pre (0/wk) and post (8-wk) evaluations assessed changes in aerobic capacity, cardiovascular performance, functional mobility, and walking ability.

Results: Significant (P<0.05) improvements in the peak heart rate (HR) (mean±SD, pre: 136.8± 14.9b/min; post: 149.2±10.4b/min), net peak HR (pre: 51.6±9.8b/min; post: 64.7±11.1b/min), and Timed Up and Go (TUG) test (pre: 20.4±21.8sec; post: 19.86±21.5sec) were observed for the VOL/group. A significant difference was observed between volitional and FES-assisted cycling groups for total distance traversed during the 6-MIN walk (VOL/group: 22.15±23.3 % pre to post; FES/group: /23.9±16%). No significant increases in peak VO2 and 1-MIN walking distance for the VOL/group and peak HR, net peak HR, gait cadence, and step length were observed for the FES-group.

Conclusion: These findings suggest that cycling interventions could be beneficial for the overall fitness and functional activity of children with CP, however, the data to date is too premature to assess if novel techniques such as FES-assisted cycling offer a beneficial alternative to achieving fitness benefits in this population.

FORCE RATES AND CYCLING ABILITY IN CHILDREN & ADOLESCENTS WITH CEREBRAL PALSY

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Scientific Background
Children with cerebral palsy (CP) produce lower maximal voluntary forces, have slower rates of force development (RFD), and have slower relaxation times when compared to their typically developing peers (Tammik 2008).

Aim
It was hypothesized that RFD and relaxation rate would be more closely related to cycling ability than maximum force. The ability to quickly contract and relax muscles may be more important than maximal strength during functional activities.

Methods & Subjects
Eleven children with spastic diplegic CP (ages: 10-18, GMFCS II-IV) underwent strength testing of the knee extensors. They were instructed to extend their knee as forcefully as possible, and then following a 2-3 sec contraction to relax. No verbal cues were given in reference to the speed of the contraction, but encouragement was given to help elicit maximal effort. The maximum force, peak & average RFD, and peak relaxation rate were recorded.
Recumbent cycle testing was performed using the Wingate which requires a person to pedal as fast as possible for 1 minute. Resistance was increased to the highest level at which the subject could still pedal independently. Peak cadence & power were derived using the SRM PowerMeter.

Results & Discussion
Correlations were calculated between the independent strength variables and the dependent cycling variables. Peak relaxation rate was more closely related (inverse) to peak cadence ($r^2=.684$, $p=.002$) & power ($r^2=.594$, $p=.005$) than maximum force ($r^2=.534$, $p=.011$; $r^2=.436$, $p=.027$ respectively). During cycling, muscle timing must be regulated quickly to produce effective reciprocal motion. The ability to "shut off" activated musculature is an essential aspect of repetitive functional movement. Targeting this impairment in addition to strength may be more effective at making functional gains than targeting strength deficits alone.

DEFICITS IN TWO VERSIONS OF A CONTINUOUS PERFORMANCE TEST IN ADOLESCENTS WITH CEREBRAL PALSY

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Scientific background: Sustained attention deficit (i.e. difficulty maintaining alertness and vigilance through time) can have a profound impact on social competence as well as on academic and professional functioning, but it has never been investigated in adolescents with cerebral palsy (CP). Aim: To evaluate sustained attention in adolescents with CP. Methods and subjects: Sustained attention was evaluated with a manual (Experiment 1) and oculomotor (Experiment 2) versions of the Conner’s Continuous Performance Test in adolescents with spastic CP and healthy age-matched controls ($n=10$ per group in each experiment). This widely used attention test is one of the most reliable measures of sustained attention. Results and discussion: In both experiments, patients with CP showed more omissions and their reaction time was more variable than controls. In Experiment 2, patients also showed more commissions. This last problem was not observed in Experiment 1, possibly because of the presence of a hand movement deficit in CP. Taken together, the results show that sustained attention and inhibition capabilities are affected in adolescents with CP. The present study also demonstrates that eye movements could constitute an interesting alternative for measuring sustained attention when hand movement is affected.

ROLE OF HALLIWICK TECHNIQUE IN REHABILITATION TO SCHOOL-AGE CHILDREN WITH CEREBRAL PALSY

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Objective: To observe the effects of Halliwick on School-age Children with Cerebral Palsy.
Method: Thirty-one cerebral palsy children of Guangzhou Rehabilitation Experimental School were selected as subjects. These subjects were divided into the control group (treated with conventional therapy, $n=15$) and the experimental group (treated with conventional rehabilitation therapy plus Halliwick technique, $n=16$). There were no evident differences on sex, age, Intelligence, ability of social adaptation, gross motor function and the berg balance scale scores. The gait functions, Gross Motor Function Measure and the Berg Balance Scale were assessed before and after 4-month training.
Result: Most of the experimental group mastered swimming skills. The total scores of GMFM-88 and the BBS improved significantly in the experimental group ($P<0.05$), but not significantly in the control group ($P>0.05$) after training. After treatment, evident differences were found on gait function ($P<0.05$) and on the time-space parameter of gait (except for the load response of left, pre-swing of right) in experiment group ($P<0.05$). Favorable changes were no significant change on the time-space parameters of gait in
control group before and after treatment (P>0.05), slight change was found by comparing the locus diagram of centroid offsets of plantar pressure and plantar pressure evident significant change was found on other parameters (P>0.05).

Conclusion: Halliwick technique is an effective way to learn swimming for school-age children with cerebral palsy. The Halliwick technique based on conventional rehabilitation therapy has significant effectiveness on the motor function, balance and gait functions.

EFFECTS OF HORSEBACK RIDING ON GROSS MOTOR FUNCTION AND SPASTICITY IN CHILDREN WITH CEREBRAL PALSY

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Scientific background
Therapeutic horseback riding (THR) is an emerging method for management of motor control in children with cerebral palsy.

Aim
This study aims to investigate the effectiveness and safety of therapeutic horseback riding in children with spastic diplegic cerebral palsy.

Methods and subjects:
The inclusion criteria are as follows: (1) spastic diplegic cerebral palsy; (2) not receiving botulinum toxin injection within 6 months; (3) no history of orthopedic surgery or neurosurgical intervention. A total of 18 children (five girls and 13 boys) with spastic diplegic cerebral palsy, age range from three to eight years old (5.6±2.4) were recruited. The participants had therapeutic horseback riding twice a week for three months.

Outcome measures including Gross Motor Function Classification System (GMFCS) for gross motor function, modified Ashworth scale (MAS) for spasticity, modified Tardieu scale (MTS) and range of motions (ROMs) were evaluated before, six weeks, and twelve weeks after training with therapeutic horseback riding.

Results and discussion
At six weeks, the GMFCS, MAS, MTS and ROMs of the participants did not significantly differ from the conditions of their own baseline. These parameters also show no significant change at twelve weeks as compared to the data of baseline and six weeks after THR training. There are no any adverse events through the period of this study. Our results fails to demonstrate the effect of therapeutic horseback riding on gross motor function, range of motions, and spasticity in children with spastic diplegic cerebral palsy. The long-term effect of therapeutic horseback riding on children with spastic diplegic cerebral palsy remains to be determined in future studies. Multi-center trials with more participants and combination therapy with others like botulinum toxin injection are necessary to prove the efficacy of therapeutic horseback riding.

A SYSTEMATIC REVIEW OF HABITUAL PHYSICAL ACTIVITY MEASURES IN YOUNG CHILDREN WITH A MOTOR DISABILITY

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Aim: To identify measures of habitual physical activity (HPA) in young children with a motor disability and systematically review clinimetric properties.

Method: Five databases were searched for HPA measures including: children aged <6.0 years with a neuromuscular disorder, physical activity defined as “bodily movement produced by skeletal muscles causing caloric expenditure”, reported HPA as duration, frequency, intensity, mode or energy expenditure (EE), and evaluated clinimetric properties. The quality of papers was assessed using the COSMIN-checklist. A targeted search of identified measures found studies of typically developing young children (TDC).

Results: Four activity monitors met inclusion criteria. Two studies of overall ‘good’ methodological quality showed ‘good’ evidence of the ability of the Minimod® to measure steps during continuous walking, but one study demonstrated ‘poor’ ability to measure steps during free-living walking. One study of overall ‘good’ methodological quality showed the Ambulatory Monitoring Pod® had ‘poor’ ability to measure continuous walking steps and steps during free-living walking activities. One study of ‘good’ methodological quality showed the StepWatch® had ‘good’ ability to measure steps in continuous walking trials in TDC. Three studies of the StepWatch® were of ‘poor’ methodological quality and the quality of clinimetric properties could not be determined based on these. One study of ‘good’ methodological quality showed the Intelligent Device for Energy Expenditure and Activity® had ‘poor’ ability to measure EE during free-living activities and continuous walking.

Interpretation: Few HPA measures have been utilised in young children with motor disabilities. The StepWatch® and Minimod® show good validity for measuring continuous walking only. Pedometers have limited utility for children whose primary means of ambulation is not walking. Studies assessing the clinimetric properties of HPA measures are urgently needed to allow determination of the relationship between HPA and health outcomes in children with motor disabilities across the spectrum of functional capacity.

SWIMMING TO BREAK THE VICIOUS CYCLE OF DECONDITIONING IN YOUTH WITH CEREBRAL PALSY

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Scientific background
Youth with CP have lower physical activity levels than age group peers, leading to a cycle of deconditioning.

Aim
The aim of this study is to investigate the effect of a 10/week swimming intervention on different factors of the International Classification of Functioning, Disability and Health (ICF) model that are contributing to this vicious cycle.

Methods and subjects
Fifteen children with CP, aged 7 to 17 years and a GMFCS level I to III, participated in a randomized controlled trial comparing a swimming intervention (10 weeks, 2/wk, 30 to 60 minutes) to no extra therapy, with a 5/week follow-up period. The primary outcome measures were pain, fatigue, walking capacity and swimming skills. The secondary outcome measures were coordination, functional independence, self-esteem and QOL.

Results and discussion
Participation level to the program was 95 %. The experimental group had a significant (p<0.01) increase of 26 % in swimming skills compared to a 7 % increase in the control group. For the experimental group this result remained significant at follow up (p<0.01). After the intervention period, the experimental group had an increase of 11.6 meters on the 1-min walk test with an effect size (ES) of 0.68, compared to a decrease of 7.7 meters for the control group. At follow-up, the experimental group had an increase of 18.9 meters compared to baseline (ES of 1.18). For the 10-meter walk test the control group had a 0.13 m/s decrease after the intervention compared to an increase of 0.02 m/s for the experimental group. There was no significant deterioration for pain or fatigue. The secondary outcome measures have not been analysed to date.
These results show the positive improvements in walking capacity and swimming skills for youth with CP, without increasing the levels of pain or fatigue. This demonstrates that swimming is a safe and effective physical activity for youth with CP.

GROSS MOTOR TRAINING AND PHYSICAL ACTIVITY AMONG CHILDREN WITH CEREBRAL PALSY: SURVEY AMONG PARENTS

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Scientific background: Preschool children with cerebral palsy (CP) take part in several forms of physical training to improve motor functioning that are scarcely described and evaluated from a parent perspective.

Aim: To describe gross motor training and physical activity among preschoolers with CP in Norway, and to explore relations between characteristics of the child, parents, physical training, and parent-rated child benefits.

Methods and subjects: Survey among parents of preschoolers with CP (n=360) and data from the Norwegian CP follow up program. Responds rate 34%.

Results and discussion: No significant differences between participants and non-participants regarding age, type of CP and GMFCS level were found. Among the participants, 86.4% had additional CP related problems, 43% five or more. Three out of four conducted gross motor training, 42% 3-7 times/week and 51% several times a day. For 78% the training was incorporated in daily activities; 73% of the parents took active part, and more often with children which severe gross motor limitations (GMFCS III-V) compared to GMFCS I-II (p=0.05). Two out of three children participated in physical activities, such as horseback riding, ‘swimming’ and outdoor activities, most frequently 1-2 times/week (62%), performed individually and in groups, involving 56% of the parents. Both topographical distribution and additional problems were related to frequency of physical activity (p= 0.01). Gross motor training and physical activities were highly goal-directed, 89%, 63%, respectively. The majority of the parent’s rated significant child benefits of both gross motor training (84%) and physical activities (79%). Setting goals was also related to more benefits (p=0.01). Gross motor training >2 time/week showed a tendency of higher benefits (p=0.03). Neither child, nor parent characteristics or parent involvement in training were significant related to benefits. Setting goals and frequency of gross motor training seem to be important for parent’s experiences of child benefits.

TREATMENT IN CHILDREN WITH CP BY HYPPOTERAPY: EXPERIENCES AND RESULTS

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“Vittorio di Capua” center is a part of the UONPIA (Unità Operativa Neuropsichiatria dell’ Infanzia e dell’ Adolescenza) of A. O. Ospedale Niguarda (Milan) and works closely with all clinical departments of this general Hospital. The interdisciplinary team of the Center introduced horses in rehabilitation since 1981, assuming that the movement of horse transmitted to the body of patient could improve postural control, balance and quality of movements.

Our horses are prepared by equestrian team to be reliable, to have armonic movements and they are different in size, walking and behaviour. The reciprocal corporeal interaction between patient and horse and the subsequent emotional activation make easier separation- individuation process and let to have a large amount of proprioceptive and other receptive sensations and to acquire experiences in time and space. The therapies in stimulating and highly motivating environment (often with other children) could prevent withdrawal and isolation, phenomena that the cerebral palsy itself and the heaviness of medical remedies favour.
Our experience: We enrolled 20 children aged 3 to 12 years with exclusion of children with spine or hip skeletal deformities.

Before starting the treatment each patient has been object of:
- Anamnesis in order to assess family background, medical and rehabilitative paths, cognitive or psychopathological problems.
- Clinical assessment to confirm diagnosis and find out possible contraindications and cautions;
- Functional assessment with video recorder.

Individual rehabilitative project and program was done for each patient.

Results: The results were evaluated before the beginning and after 40 therapeutic sessions by Gross Motor Function Measure, Wee Fim or Vineland Scale, Development and Intelligence scales. We noticed improvements not only in motor functions but also in other adaptive functions compromised by CP. We registered improvements in quality of life and a good compliance to the treatment.

11 QoL and Participation

SCHOOL-BASED PHYSICAL ACTIVITY PARTICIPATION OF CHILDREN WITH CEREBRAL PALSY

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Scientific Background: The Queensland ‘SmartMoves’ Physical Activity Program was developed to promote students’ participation in at least 30 minutes of moderate intensity school-based physical activity (PA) per day (≥ 8% time at ≥ 3.0 METs). This challenge is difficult for students with cerebral palsy (CP).

Aim: Determine (1) PA volume and intensity of students with CP at different GMFCS levels; (2) whether PA levels meet recommended guidelines and (3) classroom/playground tasks that maximise PA.

Methods and Subjects: Physical activity of 10 children with CP (age 8-12 years, mean 10.6 years; eight males; two per GMFCS level) was measured for five school days using (a) an ActiTrainer accelerometer to derive body position, steps, and PA intensity and (b) a PA diary completed by each child’s teacher to provide contextual information about activities. Activity intensity (mean, minimum and maximum METS) and duration (lying, sitting, standing and walking) was examined.

Results and Discussion: Children at GMFCS-I/III spent ≥ 8% time in moderate intensity PA (range 14.7-31.4%, mean=2.4 METS) but those at GMFCSIV-V did not (0-7%, mean=1.5 METS). Sitting was the predominant activity for all children (1.0/2.0 METS). Duration was similar across GMFCSI-III (64-82%), but increased for GMFCSIV-V (84-98%) due to seated wheelchair time during breaks. Children at GMFCSIV-V spent time in lying (1.0 MET), usually for cares (1.7-13.6%). Walking did not vary across GMFCS I (27-33%), II (17-30%) or III (25-26%), however intensity was limited for children at GMFCSI/III by walkers (3.5-4.0 METS), whereas children at GMFCSI-II performed slow walking through running (1.0-5.0 METS). Classroom programming and lunchtime activity capacity were major facilitators of PA opportunity and intensity. Therapy support could assist teachers to increase PA opportunities, e.g. non-mobile children benefit strongly from: standing frames (2.0 METS), floor exercises (2.5 METS), sit-stand activities (3.5 METS), musical instruments (1.8-4.0 METS) and using a manual wheelchair/walker (≥ 4.0 METS).
CINDERELLA: AN INCLUSIVE BALLET PROGRAM FOR TYPICAL AND SPECIAL NEEDS CHILDREN

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Scientific Background: The advantages of adaptive sports and recreation are well known to both families and care takers of children with special needs. An adaptive ballet program would combine the positive attributes of music therapy with that of adaptive sports to provide an enriching environment for children with development disabilities, their families, and the community in general. Designing that program to be inclusive, to integrate the children with special needs with typical children in a combined ballet production is ideal.

Aim: The purpose of this project is to discuss the development of an inclusive ballet program for children of all abilities to provide stimulation and a template for similar programs worldwide.

Methods and Subjects: Cinderella, the story of a little orphaned girl who becomes a princess, was a perfect choice for the first collaborative effort of the Ballet Academy of Arizona and United Cerebral Palsy (UCP). The Ballet Academy brought together students from typical classes with students from classes at the UCP center. The older students - some typical, some with special needs -- took mentor roles in the production of over 100 children. Dancers included typical children and those with a variety of special needs, ranging from patients with cerebral palsy in wheelchairs to patients on the autism spectrum with severe sensory issues.

Results and Discussion: The development of an inclusive ballet program for both typical children and children with development disabilities was widely accepted throughout our community as an example of how such integrated programs should be designed. Our children, parents, ballet volunteers, and spectators consistently commented on the powerful message of inclusion and community that this program projected. The next step would be to use quality of life standard measurement tools for future documentation of the benefits this type of adaptive program have for everyone involved.

CP-PARTICIPATE: FACILITATORS AND BARRIERS TO EDUCATION PARTICIPATION FOR YOUNG PEOPLE WITH CP

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Cerebral Palsy League.

Scientific Background: Literature acknowledges that young people with cerebral palsy (CP) tend to experience more limited education attainment and fewer participation experiences compared to typically developing youth. However, despite the ICF describing function as a product of person/environment interactions, little is known about the specific impact that environmental factors play in these education opportunities and experiences.

Aim: CP-PARTICIPATE aims to quantify the person/environment factors impacting education participation of youth with CP.

Methods and Subjects: Seventy-four young people with CP (aged 13-24 years, 64% 13-17 years, 36% 18-24 years; 45 males; GMFCS I=22, II=13, III=6, IV=12, V=21) completed the CP-PARTICIPATE survey (or interview) to record how their secondary and post/school education participation experiences have been impacted by environmental factors defined by the ICF: e1 Products and Technology, e2 Natural/Human-made Environment, e3 Supports and Relationships, e4 Attitudes, and e5 Services, Systems and Policies. Content and thematic analysis was performed.

Results and Discussion: Environmental barriers to education participation were reported by 80% of young people, with only 20% reporting no barriers. Activities most frequently affected in secondary school were: physical education/sports (69%), toileting/changing (66%), moving about school (63%), and communication with teachers (50%). Post-school education activities most affected were: completing assessment (55%), accessing settings (45%), participating in-class activities (45%) and participation in social activities (45%). Most common environmental barriers included: ‘Attitudes’ of students/teachers (e4=28%); ‘Physical environment’ (e2=23%) and inadequate ‘Equipment and Technology’ (e1=23%). The strongest facilitators
were access to ‘Supports and Relationships’ especially therapy (e3=44%), ‘Products and Technology’ (e1=33%) and supportive ‘Attitudes’ of students/teachers (e4=37%). Environmental factors greatly influence education experiences for young people with CP. Young people report needing more therapy support and assistive technology to enhance communication, mobility and performance in class; education to reduce stigma/ignorance of others; and more flexible learning programs that accommodate factors such as additional time needs.

Acknowledgements: Funding by Gambling Community Benefit Fund.

**CP-PARTICIPATE: FACILITATORS AND BARRIERS TO COMMUNITY PARTICIPATION OF YOUNG PEOPLE WITH CP**

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Cerebral Palsy League.

Scientific Background: Although the ICF describes function as a product of person-environment interactions, we know little about the impact of environment on participation of young people with cerebral palsy (CP).

CP/PARTICIPATE is a study mapping how environmental factors influence participation of people with CP at home, work, education and in the community.

**Aim:** Quantify person/environment factors impacting community participation of youth with CP.

**Methods and Subjects:** Seventy-four young people with CP (aged 13-24 years, 64% 13-17 years, 36% 18-24 years; 45 males; GMFCS I=22, II=13, III=6, IV=12, V=21) completed the CP-PARTICIPATE survey (or interview) to record how their community-based participation is impacted by environmental factors defined by the ICF: e1 Products and Technology, e2 Natural/Human-made Environment, e3 Supports and Relationships, e4 Attitudes, and e5 Services, Systems and Policies. Content and thematic analysis was performed.

**Results and Discussion:** Young people with CP characterised community-based participation as ‘being part of something’, ‘doing things with others’ and ‘opportunities for experiences and learning’. However 72% of respondents indicated that they encountered barriers to participating in the community. These included: ‘getting into the community’, particularly using transport (58%) and once ‘in the community’, using public toilets (68%); staying away from home overnight (57%), and making/keeping friends (47%). Main environmental barriers included inaccessible physical ‘Environments’ (e2=34%) and negative ‘Attitudes’ of others (e4=34%). Barriers resulted in 44% feeling isolated in community-based life domains, however 73% encountered positive experiences in other settings. The most helpful environmental facilitators were: adequate ‘Supports’ from family/friends (e3=55%) and positive ‘Attitudes’ of others (e4=33%). Young people with CP recommended several environmental improvements: designing physical environments with universal access to facilitate mobility within and between settings; increasing disability accessible public amenities and public transport in local communities (not just cities); and increasing community activities for adolescents to support the transition to adult independence.

Acknowledgements: Funding by the Gambling Community Benefit Fund.

**MEASURING QUALITY OF LIFE OF FINNISH CHILDREN WITH CEREBRAL PALSY**

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Scientific background: The quality of life (QOL) of Finnish children with cerebral palsy (CP) has not earlier been evaluated using CP-specific questionnaires.

**Aim:** The aim of the study was to examine QOL of Finnish children with CP, both from the child’s and the caregiver’s point of view, and to analyze the effect of the background factors on QOL.
Methods and subjects: This study is a part of a national research project aiming to find reliable, valid and clinically feasible set of outcome measures for children and adolescents with CP via a multiprofessional working model. The study is based on validated questionnaires (CP QOL-Child) measuring QOL of children with CP. 128 questionnaires were sent to parents who had a 4 to 12 year-old child with CP. Children between 9 and 12 years were asked to fill in an additional questionnaire themselves. Background factors included gender, CP subtype, functional classification scales and information of daycare or school arrangements.

Results and discussion: Responses were obtained from 78 guardians and 27 children, with a response rate of 61% in both cases. The overall QOL was reported to be good in Finnish children with CP. The correlation of QOL scores between the caregivers and children was good (r=0.687, p=0.000), except in the domain of “pain and impact of disability”. Parental estimates were consistently lower in all domains. Regarding the background factors, all the functional classification scales were associated inversely with QOL in both groups, especially the Manual Ability Classification Scale (p=0.043 and p=0.01 respectively). The QOL questionnaire can be utilized in clinics for targeting support and setting goals for rehabilitation plans together with the child and caregivers.

IMPACT OF MOTOR IMPAIRMENT, AGE AND SEX ON QUALITY OF LIFE OF CHILDREN WITH CEREBRAL PALSY

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Scientific background: The level of motor impairment in a child with cerebral palsy affects the ability to participate in daily activities and may impact your quality of life. Aim: To assess the impact of motor impairment level, age and sex on quality of life of children with cerebral palsy. Subjects and Methods: Caregivers of 125 children (girls=50, boys=75) with cerebral palsy responded to the Child Health Questionnaire (CHQ-PF50). The questionnaire consists of 14 scales: Physical Functioning (PF); Role/Social/Physical (RP); General Health Perceptions (GH); Bodily Pain (BP); Family Activities (FA); Role/Social Emotional/Behavioral (REB); Parental Impact-Time (PT); Parental Impact Emotional (PE); Self esteem (SE); Mental Health (MH); Behavior (BE); Family Cohesion (FC); Physical Summary (PhS); Psychosocial Summary (PSS). The children were aged between 5 and 14 years were stratified by the severity of cerebral palsy using the Gross Motor Function Classification System (GMFCS). For the comparison between boys and girls for each variable we used the Student’s t-test (p≤0.05) and Pearson Correlation Coefficient to investigate the relationship of age and degree of motor impairment with the variables. Results and discussion: The average age of the children was 8 (±2.9) years. The classification was to the GMFCS level I (7%), II (13%), III (20%), IV (27%), V (33%). There was significant difference between boys and girls to the scales TP (p=0.035) and AF (p=0.007). It has been found: (a) a moderate positive correlation between the level of GMFCS and BE and GMFCS and MH; (b) a weak positive correlation between GMFCS and REB; GMFCS and FA; FC age, age and PT; age and REB; age and PF; (c) a weak negative correlation between GMFCS and GH. The results indicate that age, severity of motor impairment and gender has an impact on some aspects of quality of life of children with cerebral palsy.

CAREGIVERS HAVE DISCORDANT PERCEPTIONS OF QUALITY OF LIFE OF CHILDREN WITH CEREBRAL PALSY

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Scientific background despite the increasing focus of research in child-caregiver agreement in perception of quality of life (QoL) of children with cerebral palsy (CP), four critical methodological issues arise in this area: (1) Generic QoL measures, instead of the cp-specific QoL questionnaire, were used in these QoL studies; (2) Many of the items in the QoL questionnaires used in CP studies measured children’s capability and focused on their difficulties or limitations; (3) Previous studies adopted self-report qol by children who lacked the adequate cognitive ability required to understand and respond to questionnaires; (4) Most studies on child-caregiver agreement only used relative reliability analyses.

Aim to disentangle the issues mentioned, this study aimed to examine the agreement of perceptions of QoL in children with cp between children and their caregivers using a cp-specific QoL questionnaire.

Methods and subjects fifty-eight elementary children with CP, 9 years of age or older, and their caregivers were recruited in this study. The child’s QoL was assessed by the self-report and primary caregiver-proxy report versions of the cerebral palsy quality of life for children (CP QoL-child). the agreement was examined by Intraclass Correlation Coefficients (ICCs), Standard Error of Measurement (SEM), and Smallest Real Difference (SRD).

Results and discussion the results of the ICC values ranged from 0.73 to 0.80 with wide 95% cis. The SEM and SRD of the CP QoL-child ranged from 4.73 to 11.08 and from 13.11 to 30.71 respectively. The SEM% and the SRD% in each domain ranged from 9.70% to 25.72% and from 26.89% to 71.30% respectively. The child-caregiver agreement of QoL in children with cp was far from being perfectly concordant. Clinicians and researchers should be very cautious when using proxy reports to understand QoL of children with CP.

DISABILITY LEVEL AND HEALTH RELATED QUALITY OF LIFE IN YOUNG CHILDREN WITH CEREBRAL PALSY

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Scientific background: There is a lack of evidence in the literature about the health related quality of life in young children with cerebral palsy.

Aim: The aim of this study was to compare the disability level and the health related quality of life (HRQoL) in young children with cerebral palsy.

Methods and subjects: 41 children and their mothers were included in the study. They (mean age: 6±0.7 yrs) were diagnosed as cerebral palsy. After taking sociodemographic information, the child Health Questionnaire Parent Form (CHQ/PF50) was used to assess health related quality of life (HRQoL) and the Pediatric Evaluation of Disability Inventory (PEDI) was used to assess disability level and the functional performance in activities of daily living.

Results and discussion: There were positive correlations between global health and self care domain (p:0.029, r:0.342) and total score of PEDDI (p:0.037, r:0.328), physical function and self care , (p:0.016, r:0.374) mobility (p:0.000 r:0.439) domains and total score of PEDI (p:0.006, r:0.421), emotional limitations and mobility (p:0.004 r:0.561), physical limitations and self care (p:0.005, r:0.429), mobility (p:0.00, r:0.561) domains and total score of PEDI (p:0.008, r:0.407), global behavior and self care (p:0.024, r:0.353) and social function (p:0.020, r:0.361) and total score of PEDI (p:0.050, r:0.309), self esteem and self care (p:0.015, r:0.377), mobility (p:0.001, r:0.482) domains and total score of PEDI (p:0.002, r:0.463), parent impact-emotional and self care (p:0.044, r:0.316 ), parent impact-time and self care (p:0.018, r:0.367). There was no correlation between any of PEDI subsections and general health perception, bodily pain/discomfort and behavior subsections of CHQ-PF50.

The results showed that physical status can affect the social and emotional participation in young children with cerebral palsy. It is also concluded that physical disability have drastic effect on the level of independence in the activities of daily living in young children with cerebral palsy.
THE IMPACT OF SEVERITY OF CEREBRAL PALSY AND BEHAVIOR PROBLEMS ON CHILD'S SELF-CARE

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• Scientific background: Self-care is restricted in children with cerebral palsy, and severity of CP has strongly effect on self-care. In addition, behavior problems, commonly associated with cerebral palsy, also have a negative impact on child development.

• Aims: This study was aimed to investigate the developmental trajectory of self-care over two years and the impact of severity of CP and behavior problems on the development of self-care.

• Methods and subjects: Forty-eight children with CP and their caregivers were evaluated at three time points, i.e., at study entry, one and two years after study entry. Self-care was assessed with self-care domain in the Functional Skill Scale (capacity) and the Caregiver Assistance Scale (performance) of the Pediatric Evaluation of Disability Inventory. Severity of CP was assessed with the Gross Motor Function Classification System. Behavior problems were assessed with the Strength and Difficulties. Separate Growth Curve Models (GCMs) were conducted to analyze the longitudinal data of self-care domains in the FSS and CAS. The developmental trajectory of self-care was investigated by conducting GCMs with which the initial self-care capacity and performance (intercepts) and their developmental patterns (slopes) were obtained. Furthermore, the effects of severity of CP and behavior problems on the intercepts and the slopes were examined.

• Results and discussion: Self-care capacity increased during the two years, while self-care performance had no significant change. It may be because the relatively short follow-up period did not allow seeing the developmental changes in performance. Severity of CP significantly influenced the development of self-care, i.e., the higher the severity level, the worse the initial self-care status, and the slower the growth pattern of self-care capacity. However, behavior problems did not show any significant influences on self-care, which may be because the sample size was too small to reflect the impact of behavior problems on self-care.

VALIDATION OF THE ITALIAN VERSION OF THE PEDSQL-CP MODULES: CORRELATION WITH FUNCTIONAL FEATURES

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Scientific background: recently quality of life (QOL) in children with cerebral palsy (CP) and their families has received increasing attention not only as an essential health aspect, but also as an outcome measure of different interventions.

Aim: to present the validation of the Italian Version of PedsQL-CP Modules and its correlation with functional features in a cohort of children with cerebral palsy.

Methods and subjects: an Italian Version of the questionnaire was produced according to the linguistic validation guidelines of the PedsQL. The translated questionnaire was administered to the parents of 20 children with CP aged 2 to 18 years (12 males, 8 females; 5 children per age group: 2-4 years; 5-7 years; 8-12 years; 13-18 years). The 15 children older than 4 years independently completed the child self report. Spearman non-parametric correlation was computed to investigate the relationship between mean scores of PedsQL-CP Modules and neurofunctional measures (MACS and GMFCS levels). We used a 2x7 mixed analysis of variance for repeated measures (ANOVA) to analyze the PedsQL profiles obtained by children and parents. The significance level was set to 0.05.
Results and discussion: all the participants easily completed the questionnaire and did not show any difficulty in understanding items, instructions and response choices. No correlations were found between mean scores of the 7 dimensions of the questionnaire and neurofunctional measures in the 15 child self reports. Mean scores of Daily Activities and Eating Activities dimensions were related with GMFCS and MACS levels in the 20 parent reports. A negative correlation was also found between Movement and Balance scores and GMFCS. Mean scores of parents were more severe in all dimensions with the exception of Pain and Fatigue dimensions, where the results were similar to those of children. Fatigue was the main area of vulnerability in child self reports, particularly with respect to School Activities, Movement and Balance, Eating Activities dimensions.

ASSESSMENT OF QUALITY OF LIFE OF CHILDREN WITH CEREBRAL PALSY

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Aim: to state differences in assessment of quality of life children and adolescents with and without cerebral palsy, equal by gender and age. It was also to state differences among children and adolescents with cerebral palsy.

Material and Methods: the sample formed two groups of respondents. Children and adolescents with cerebral palsy, reported to rehabilitation center „Sveta obitelj” Mostar and associations „Marija naša majka” Široki Brijeg, in period from 1990. to 2002. and pupils of Special primary school škola Mostar. Other group consisted of respondents without cerebral palsy, equal in gender and age, pupils of Srednja medicinska škola Sestara milosrdnica and Primary School Petar Bakula in Mostar.

Questionnaire was used as measuring instrument.

Conclusion: the quality of life between children and adolescents with cerebral palsy and healthy children and adolescents are different in almost every life aspect. Children and adolescents with cerebral palsy, are less satisfied with possibilities of choose extracurricular activities and attitudes their school colleagues as they are older. Socioeconomic status, gander and mental status don’t affect significat on assessment of quality of life of children and adolescents with cerebral palsy.

Key words: quality of life, cerebral palsy, children, adolescents.

CP-CHILD - INITIAL VALIDATION IN A GERMAN COHORT

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Scientific background: Validation of the translated Caregiver Priorities and Child Health Index of Live with Disabilities (CP-CHILD©) to measure health related quality of life (HRQOL) in a german cohort of children with severe cerebral palsy according to the gross motor function classification system (GMFCS level III-V).

Aim: The aim of the study was to validate the CP-CHILD© questionnaire for the german language.

Methods: We investigated n=68 patients (w: n=33, m=35; age: 10.9 ± 5.1 years) with cerebral palsy and GMFCS level III (n=14), level IV (n=28) and level V (n=26). The original questionnaire and manual were translated and re-translated. Patients and caregivers were invited to participate by personal contact or letter.
The families were recruited from special outpatient clinics in Munich and Freiburg, Germany. The CPCHILD© currently consists of 37 items distributed over among 6 sections representing the following domains: 1. Activities of Daily Living/Personal Care, 2. Positioning, Transferring & Mobility, 3. Comfort & Emotions, 4. Communication & Social Interaction, 5. Health, 6. Overall Quality of Life. Testing and scoring followed the manual and interpretation guide.

Results and discussion: Mean total CP-CHILD© scores across GMFCS levels were 67.1 ± 14.9 for GMFCS level III, 56.6 ± 11.8 for IV and 44.3 ± 12.9 for V. Construct validity (ANOVA, GMFCS) was significant for total score and standardized scores for ADL, Transfer, Communication, Health. Retest-Reliability showed ICC between 0.436 and 0.897. Face validity showed that all items were above a significance level of 2. The German translation of the CP-CHILD© seems to be a valid questionnaire for measuring HRQL in severely affected children and adolescents. Psychometric properties are satisfying; implementation in a clinical setting seems to be possible to measure HRQOL. Single domains have to be analyzed in detail for differences between the original CP-CHILD© in a Canadian and German cohort.

12 Upper limb

THUMB-IN-PALM DEFORMITY IN CHILDREN WITH CEREBRAL PALSY

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Scientific background: The Cerebral Palsy Follow-up Program (CPOP) was implemented in South-Eastern Norway in 2006. All children with cerebral palsy (CP) born after 01.01.2002 are registered.

Aim: The aim of this population-based study is to acquire knowledge about the thumb-in-palm deformity in children with CP, and the correlation between thumb-in-palm and handfunction, according to Manual ability classification system.

Subjects and methods: The children with CP are assessed annually according to a standardised CPOP protocol including CP subtypes, Manual Ability Classification System (MACS), House functional hand classification system and House classification of thumb-in-palm deformity. The first assessment of their most affected hand is registered before 4 years of age.

Results and discussion: 330 children born from 2002 to 2007 are assessed according to the CPOP protocol. 51 % of the children have a thumb-in-palm deformity according to House classification; 22 % of the population have type I, 13 % have type II, 7 % have type III and 9 % have type IV. 51 % of the children with unilateral spastic CP, 35 % of the children with diplegic bilateral spastic CP and 87 % with quadriplegic bilateral spastic CP have a thumb-in-palm deformity. The correlation between thumb-in-palm deformity and MACS is significant (p<0.00); on level I 17% of the children have a thumb-in-palm deformity, on level II (64%), on level III (72 %), on level IV (88%) and on level V (76 %). The correlation between thumb-in-palm deformity and House functional hand classification system is also significant (p<0.00); 70 % of the children with no use of their hand, 91 % of the children with a passive assistant hand, 68 % of the children with an active assistant hand, and only 14 % of the children with a spontaneous assisting hand have a thumb-in-palm deformity.

MEASUREMENT INSTRUMENTS FOR BIMANUAL ACTIVITIES IN CHILDREN WITH CONGENITAL UPPER LIMB IMPAIRMENTS

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Scientific background: Children with unilateral upper limb impairments are limited in their performance of daily bimanual activities. For assessment of hand function and treatment outcome several measurement
instruments for bimanual activities are used in these patients. To date, no systematic clinimetric review of these instruments has been published.

Aim: To identify all measurement instruments that measure bimanual activities in children with congenital upper limb impairment, assess their goal and clinimetric properties and discuss their applicability for clinical practice.

Methods: A systematic literature search was performed in different databases. The abstracts and selected articles were evaluated independently by two reviewers. Clinimetric properties of the selected instruments were assessed by Terwee’s quality criteria.

Results: Four measurement instruments were identified: two functional tests (Assisting Hand Assessment (AHA) and Unilateral Below Elbow Test (UBET)) and two questionnaires (ABILHAND-Kids questionnaire and Prosthetic Upper Extremity Functional Index (PUFI)). These instruments evaluate hand function at ICF activity level. All these instruments demonstrated good content validity but failed to meet all of the other quality criteria. Only the AHA demonstrated good reliability.

Conclusion: The AHA can be considered as an adequate discriminative measurement instrument for bimanual activities in children with upper limb impairments. Despite the fact that ABILHAND-Kids questionnaire, the UBET and the PUTF are valid measurement instruments it cannot be concluded that they have good discriminative properties. So far none of the 4 instruments met the quality criteria needed to evaluate the effect of treatment or measure change over time.

MOTOR PLANNING IN CHILDREN WITH LEFT HEMIPLEGIA COMPARED WITH CONTROLS

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Scientific background: In addition to difficulties with motor execution, hemiplegia can also lead to problems with motor planning. This has particularly been noted in right hemiplegia (1).

Aim: To determine whether motor planning skills develop differently with age in children with left hemiplegia and healthy controls.

Methods: Participants were 14 children with left hemiplegia (10 male) and 10 healthy controls (6 male) with ages ranging from 4-15 years. A handle rotation task for assessing motor planning in children was adapted from the design used by Mutsaarts et al. (2). Children used their dominant hand to complete twenty four 180-degree turns of the handle, which were electronically timed. Planning time was calculated as the time between presentation of instructions and commencement of turn.

Results and discussion: A significant negative relationship between age and planning time was observed in the control group (r = .639, p < 0.05). No such relationship was observed in the hemiplegic group. This pilot study suggests that healthy children become more proficient at motor planning with age, reflected in shorter times to plan 180-degree turns. However, motor planning appears to develop differently in children with left hemiplegia.

References:

HAND FUNCTION IN YOUNG ADULTS WITH UNILATERAL CEREBRAL PALSY: A 6-YEAR FOLLOW-UP

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SCIENTIFIC BACKGROUND: The development of hand function during the late adolescence is unclear although it is known that they can improve by CIMT.
AIM: To describe the development of hand function in young adults with unilateral cerebral palsy (CP), who participated in a Constraint Induced Movement Therapy (CIMT) camp six years earlier.

METHODS AND SUBJECTS: 11 participants (16-22 years) were contacted for follow-up assessment of the hand function, six years following a 2-week CIMT day camp. All but one participant were in MACS level II. Assessments were performed in three occasions during 2005 and once in 2011. Different aspects of hand function were assessed using the Assisting Hand Assessment, Jebsen-Taylor Hand Function Test (JTHFT), the Melbourne Assessment and grip strength (Grippit®).

RESULTS AND DISCUSSION: All participants maintained their performance on the Assisting Hand Assessment and JTHFT at the 6-year follow-up (p>0.05), although improvement after the CIMT for JTHFT was not maintained. Strength increased in both the involved (+80.9%) and non-involved hand (+94.4%) (p<0.05), while there was a trend towards decreasing quality of movement measured using the Melbourne Assessment (-7%). These results indicate that young adults with unilateral CP have maintained hand function in speed and effectiveness of use at the same level as in early adolescent period. Interestingly, the grip strength has increased over time even for the involved hand.

MANUAL ABILITIES ASSESSMENT USING MACS IN CEREBRAL PALSYED CHILD REHABILITATION

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The classification of manual abilities (MACS) for the children with cerebral palsy made possible estimate the child skills of objects manual manipulation during daily activities. Abilities can’t be measure directly and must be deducted from the child performance.

AIM. Our study investigate the results after application of a rehabilitation complex therapy (kineotherapy) in 3 rehab centre from Craiova-Romania for 37 cases of CP with upper limb, unilateral or bilateral, spastic forms, age between 7-14 years old, in 3 evaluation moments (starting of the study, after 3 and 6 month). The witness group (WG) -18 subject receive the conventional rehabilitation therapy for the spastic form of cerebral palsy and research group (RG) - 19 children receive also electrostimulation therapy applied to antagonists muscle in upper extremity.

RESULTS. At the beginning of the study the RG has no significant different levels of MACS (I/1, II/7, III/8, IV/2) comparing with the WG of children (I/1, II/7, III/9, IV/2), p >0.05.

At the end of the 6 month study, the MACS levels was improved for 7 (38.9%) patients from RG and 3 (15.8%) patients from WG.

CONCLUSION. Electrostimulation therapy associated with the conventional rehabilitation program for cerebral palsy therapy improve the manual abilities of the child.

DIFFERENTIATION OF HAND POSTURE IN CHILDREN WITH CEREBRAL PALSY

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Scientific Background: Hand posture emerges during reach and reflects object shape early in the reach trajectory, however, this shaping requires motor planning that may be compromised in children with hemiplegic cerebral palsy (CP).

Aim: To compare the evolution of hand shaping during reach in the less-affected extremity in children with hemiplegic CP; to determine how planning contributes to grasp shaping ability.

Subjects and Methods: Two groups of children, age range 6-13: 5 typically developing (TD) children (mean age 9.4 + 2.5), 5 children with CP (mean 8.4 +2.5) grasped rectangular, concave, and convex objects with their dominant/less-affected hand (10 trials per shape), while fitted with reflective markers. Metacarpal and proximal interphalangeal joint flexion and digital abduction were calculated. To summarize hand posture across joint angles, discriminant analysis was performed at 5% intervals. Results from the discriminant
analysis were used to construct a matrix and calculate a “visuomotor efficiency index” (VME a score of 100 reflects perfect discrimination between objects), to summarize the extent to which hand posture reflects object shape. This methodology allows for subtle detection of changes in joint configuration.

Results and Conclusion: Overall, participants with CP demonstrated a lower visuomotor efficiency index (VME) than controls in the less-affected hand during reach (p=0.002), indicating less effective posture differentiation. There was also a difference in the evolution of VME. The difference early in the reach was greater (TD=65, CP=45, at peak acceleration) than at object contact (TD=95, CP=88). All kinematic parameters were non-significant between groups. Thus, VME is sensitive detecting shaping differences otherwise not quantifiable. These results indicate less effective shaping in the less-affected hand of children with CP, particularly during the early phase of reaching, suggesting motor planning deficits independent of motor deficits. These deficits require additional attention in rehabilitation approaches that typically focus on motor execution.

THE ROLE OF THE SHOULDER IN UPPER-LIMB MOTION IN CHILDREN WITH HEMIPLEGIC CEREBRAL PALSY

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Background: The pathophysiology of abnormal shoulder motion in children with hemiplegic cerebral palsy is not yet well understood.
Aim: The aim of this study was to compare the motion of the two principle shoulder joints in children with hemiplegic cerebral palsy and typically developing children.

Methods and subjects: 10 children in each group carried out 6 tasks recorded by an optoelectronic system. The analysis protocol was based on an acromion marker cluster, a functional method to determine the glenohumeral rotation center and different Euler sequences thus providing three dimensional thoracohumeral, scapulo-thoracic and gleno-humeral kinematics during upper-limb motion.

Results and discussion: In the children with hemiplegic cerebral palsy, the scapulo/thoracic joint was more protracted (P<0.05) and tended to be more laterally rotated depending on the tasks and the degree of humeral elevation. The gleno/humeral joint was limited in elevation (P<0.09), internal rotation (P<0.05) and plane of elevation (P<0.05) depending on the task. At rest, the orientation of the arm was more related to the scapular posture than to the gleno-humeral orientation, the latter which appeared to compensate the initial internal arm rotation at the beginning of the motion. The scapulo-thoracic joint plays a key role in arm posture at rest and during motion but does not seem to limit arm motion. The gleno-humeral joint compensates the scapula orientation at small degrees of humeral elevation but has a reduced total range of motion. Clinical management should focus on both joints taking into account their respective roles in upper-limb motion in this population.

UPPER LIMB CLASSIFICATIONS OF YOUNG CHILDREN WITH CEREBRAL PALSY

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Scientific background: The Manual Ability Classification System (MACS) classifies the hand function of children with cerebral palsy (CP) over the age of 4 years. Emergent evidence suggests the tool to be reliable for younger children, but used with caution in children under the age of 2.
Aim: The study aimed to compare a representative group of younger children’s MACS classifications with the known population MACS distributions in 4+ year olds published from Sweden.

Methods and subjects: Sixty-three children aged 2-3 years with cerebral palsy (36 males/27 females, GMFCS I-V) registered on the New South Wales CP Register (32% cross section of 2008 birth cohort) were assessed using the MACS and House Hand Function Classification. Correlations were conducted using Pearson correlations.
Results and discussion: The sample’s MACS and House Hand Function Classification scores were modestly correlated $r = -0.462$ ($p < 0.01$), confirming that the two tools were measuring a similar construct. MACS distribution profiles were similar in younger Australian children to older Swedish children (MACS I: 23% vs 31%; MACS II: 34% vs 24%; MACS III: 17% vs 15%; MACS IV: 11% vs 14%; MACS V: 15% vs 16%), with the younger Australian children appearing to be slightly over-represented in the MACS II group. This may suggest that MACS is less stable in younger and milder affected children owing to their hand function not yet being fully developed by the age of 3. More research on the stability, using age-specific descriptors of the MACS under the age of 4 is recommended. However, the findings also suggest that early classification of children with a moderate to severe limitations in hand function will reliably enable early planning concerning introduction of compensatory assistive technology options to promote literacy development during the preschool period.

EFFECT OF CONSTRAINT INDUCED MOVEMENT THERAPY IN GRAPHIC PRODUCTION OF CHILDREN HEMIPLEGIC

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Scientific background: Children with cerebral palsy have limited the development of several sensorimotor skills essential for functional performance, which undermines the use of the affected limb in the performance of many activities. The Constraint Induced Movement Therapy (CIMT) was developed in order to improve the motor performance of upper limb. Aim: This study aims to determine the effect of the protocol adapted from Constraint Induced Movement Therapy on graphic produces for a child with spastic hemiplegia. Subjects and Methods: Participated in the study of a female child, with eight years old, diagnosed with cerebral palsy spastic left hemiplegic type, a dominant right side, with the left arm with little functional use. The protocol adapted from Constraint Induced Movement Therapy was developed by two straight weeks with three hours of daily activities. Data collection occurred in the moments before and after the intervention and consisted of 10 repetitions of an activity outlined in one brand of graphics tablet Wacom Intuos3 model, with the paretic limb. The acquisition and data analysis were performed by the software MovAlyser 6.1. For comparison between pre and after intervention for each variable, we used the Wilcoxon test for dependent samples. Results and discussion: The results indicate that: (1) after the intervention the number of segments (strokes) decreased ($p = 0.0273$), (2) no significant difference in execution time ($p = 0.1309$), (3) the peak vertical velocity did not differ significant ($p = 0.1309$), (4) normalized jerk was not significantly different ($p = 0.375$), (5) absolute velocity increased after the intervention ($p = 0.0488$), (6) absolute jerk no significant difference ($p = 0.7695$), (7) pressure pen increased after the intervention ($p = 0.0137$). Based on data obtained it is concluded that the Constraint Induced Movement Therapy promoted improvement in the fluency of graphic production.

CAREGIVERS AS INTERVENTIONISTS: A FEASIBLE HOME-BASED BIMANUAL THERAPY FOR CHILDREN WITH HEMIPLEGIA

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Scientific Background: The feasibility of an intensive home-based bimanual training program in young children with hemiplegic cerebral palsy has not been studied. Aim: To determine 1) whether caregivers can be trained as primary interventionists and 2) if hand function improves in young children with hemiplegic CP after a Home-based Hand-arm Bimanual Intensive Therapy (H-HABIT).
Methods and Subjects: H-HABIT was performed in home-based settings with children and their caregivers. Children between the ages of 33-54 months (n=4) participated in 90 hours of H-HABIT over 9 weeks. Daily logs were used to track compliance and measure difficulty of fulfilling daily training requirements. The Parental Stress Index-Short Form (PSI-SF) was used to measure changes in psychosocial dynamics of the caregiver-child dyad, the Assisting Hand Assessment (AHA) to measure changes in quality of bimanual hand-use, and the Canadian Occupational Performance Measure (COPM) to measure perception of performance on functional goals. Video observations of H-HABIT were behaviorally scored to examine the quality of the intervention.

Results and Discussion: Children completed all 90 hours of H-HABIT. Scored video observations indicated children spent on average 39% of the time with the affected hand in contact with an object. AHA scaled logit scores improved 2.1 points (p<.005). There was no significant change on COPM although the scores improved 3 points in both the performance and satisfaction domains—a clinically meaningful improvement. There were no changes in the PSI-SF. The results suggest that it is feasible to train caregivers as interventionists without increasing parental stress. Children remain engaged during activities and make significant improvements in hand function. Using caregivers as primary interventionists to perform intensive bimanual therapy in a home-based setting is a cost-effective alternative to expensive day-camps. H-HABIT also permits intervention at younger ages when there may be greater brain plasticity and greater potential for improving hand function.

A PILOT STUDY ON CONSTRAINT INDUCED MOVEMENT THERAPY FOR ADULTS WITH SPASTIC UNILATERAL CP

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Background: Adults with spastic unilateral CP often report deteriorated function in their affected hand and pain related to over-use in their non-affected arm, but it is not known whether a specialized intensive training regime can compensate for this.

Aim: To gain knowledge on whether Constraint Induced Movement Therapy (CI-therapy) may improve hand function in adults with spastic unilateral CP. Is this type of training viable for adults with spastic unilateral CP, and do the results provide a basis for a larger study?

Methods and subjects: The pilot study applied a prospective experimental design with randomization of 12 participants (MACS I-II) into two groups. The intervention group (n=7) trained intensively for 10 days with CI-therapy, while the control group pursued "business as usual". Outcome measures were: Jebsen-Taylor Hand Function Test (dexterity/fine motor efficiency), Biometrics E-Link (grip strength) and the Canadian Occupational Performance Measure (COPM). The participants were tested at the start of the project, after two weeks and after three months. Mann-Whitney U Test and Wilcoxon Signed Rank Test were applied.

Results and discussion: The intervention group showed significant improvement in dexterity/fine motor efficiency after the intervention, and the results were still significant after three months (P=0.01), but no significant changes in maximum or endurance grip strength. The control group did not show any significant changes in dexterity/fine motor efficiency. None of the groups displayed any significant changes in subjective activity performance appraisal or satisfaction with performance. Two participants in the intervention group showed a clinically relevant increase in satisfaction with activity performance after three months.

The pilot study showed that CI-therapy is a viable method for adults with spastic unilateral CP. The results were promising and provide a basis for a larger study with focus on individual goal-directed training, and considering maintenance training to strengthen transfer into everyday life.
MOTOR IMAGERY TRAINING IN REHABILITATION OF UPPER LIMB FUNCTIONING IN CEREBRAL PALSY

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Scientific background: Motor imagery training is one tool of Neurocognitive Rehabilitation, a rehabilitative theory proposed by Prof. Perfetti, that looks for recovery through the programmed activation of cognitive processes which, acting on the structure of the nervous system, modify its organization.

Aim: The motor deficits occurring in children with cerebral palsy (CP) are not only related to problems with motor execution, but also to impaired motor planning. The aim of this study is to evaluate the effectiveness of motor imagery training during therapeutic rehabilitation program in CP and the children’s capacity to form a mental image of their own movement.

Subjects and methods: We present 2 single cases of CP children treated by motor imagery training during rehabilitation of upper limb functioning. The way of use of motor imagery are different:

1. use of motor imagery of unaffected arm and its comparison with motor imagery of affected arm
2. use of motor imagery of affected arm
3. use of motor imagery by visual-somatosensory transformation

Results and discussion: Motor imagery training in therapeutic rehabilitation of cerebral palsy needs a lot of engagement for young children especially by the use of the first and the second way to form motor imagery. The use of motor imagery by visual-somatosensory transformation is easier for children and is effective in control motor irradiation and facilitating motor planning.

A CASE STUDY OF TRANSCRANIAL DIRECT CURRENT STIMULATION IN HEMIPLEGIC CEREBRAL PALSY

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1Institute of Applied Health Sciences - University of Aberdeen – Aberdeen – UK, 2Institute of Psychological Sciences - University of Leeds – Leeds – UK, 3Occupational Therapy Department -Royal Aberdeen Children’s Hospital – Aberdeen – UK, 4Faculty of Health and Social Sciences - Leeds Metropolitan University – Leeds – UK.

Scientific background: Transcranial direct current stimulation (tDCS) is a non-invasive stimulation technique that modulates brain function by increasing or decreasing cortical excitability.

AIM: In chronic stroke patients, tDCS, has been shown to improve function of the affected arm, and thus has the potential to accelerate motor learning. Using kinematic outcome measures this pilot study aimed to examine if tDCS can improve performance of the affected upper limb in young people with hemiplegic cerebral palsy.

Methods and subjects: A 14 year old boy with mild hemiplegia, Full-scale IQ 96, Manual Ability Classification System level II, with no known history of seizures completed the five stages of the protocol. At baseline, during anodal tDCS (20 minutes at 1.5 mA), at 24 hour follow-up, during sham tDCS, and at 24 hour follow-up kinematic data was collected using a computer-based movement assessment tool. MRI was used to confirm electrode placement.

Results and discussion: Overall motor performance improved significantly from real tDCS to next day follow-up (p=0.005) but not after sham tDCS. This improvement was due to significant shortening in movement time (p=0.001) rather than changes in tracing accuracy.

This is the first account of a series of single case studies in which tDCS was applied to young people with hemiplegic cerebral palsy. The patient tolerated the two sessions of active and sham tDCS well. The test results are encouraging and call for further research on a larger scale. If found to be effective, tDCS could be used in the treatment of cerebral palsy. This is of particular interest given its portability, ease of use, low cost, and potential for home-based use with assistive computer-game technologies.
IMPROVEMENT IN UPPER LIMB FUNCTION IN CHILDREN WITH DYSTONIA FOLLOWING DEEP BRAIN STIMULATION

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Purpose: To explore changes in upper limb function following Deep Brain Stimulation (DBS) in paediatric dystonia.

Method: Upper limb outcomes, using the Melbourne Assessment of Unilateral Upper Limb Function, are reported in 20 cases of childhood dystonia (unilateral n=1, four limb n=19) at 6 and 12 months following DBS.

Results: Improvement in at least one upper limb was seen in the majority of cases (n=17, 85%) at 12 months following DBS. Deterioration of scores in both upper limbs was seen in 3 children with progressive disorders. Grouping the children aetiologically, a significant improvement in the dominant hand was obtained for the primary dystonia/dystonia-plus group at both six (p=0.018) and twelve months (p=0.012). In secondary dystonia due to a static disorder, improvement was also seen at 6 (p=0.043) and 12 months (p=0.046) in the non/dominant hand. No significant change was found in the group of children with progressive disorders.

Interpretation/Conclusion: DBS has the potential to alter upper limb function in children with primary and secondary dystonia. The dominant hand improved most in children with primary dystonias, with greater improvement in the non-dominant hand in secondary-static cases.
WORLD CP REGISTERS, SURVEYS AND NETWORKS DAY

in collaboration with SCPE-NET (Surveillance of Cerebral Palsy in Europe)

THURSDAY, 11TH OCTOBER 2012

10.50 – 12.20 Challenges in describing and classifying children with CP

Christine CANS (moderator)

The aim of the session is to improve consistency around the world in the way children with CP are described. Professionals in charge of registration of children with CP face similar challenges, and harmonisation of collected data can be very helpful in the interpretation of research results.

This symposium will discuss i) how conditions often associated with CP such as birth defects, and conditions excluded from the CP field such as progressive disorders are managed across the world and ii) methodological issues regarding data quality and reliability when including or classifying children with CP.

KEYNOTES ABSTRACTS

CHALLENGES IN CEREBRAL PALSY SURVEILLANCE: SEEKING HARMONY IN INCLUSION AND EXCLUSION CRITERIA.

Badawi N.1, Blair E.2, Cans C.3, Himmelmann K.4, Krägeloh-Mann I.5, McIntyre S. 1, Smithers-Sheedy H. 1, Uldall P.6, Watson L.7,

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Background: Determining the inclusion and exclusion criteria for cerebral palsy (CP) surveillance, presents a complex challenge for CP Surveillance groups. Whilst each group must meet the specific needs of their individual surveillance program, it is advantageous to have consensus across programs wherever possible regarding core inclusion/exclusion criteria. Consensus in criteria provides opportunities to share data and conduct research using participants sourced from different registers and to monitor trends over time. Aim: This symposium seeks to highlight inclusion and exclusion criteria that have been adopted by different surveillance programs and to consider those criteria which are still debated both within and between surveillance programs. Additionally with the increase in the identification of genetic syndromes that will require CP inclusion decisions to be made, we seek to review current practices to seek consistency in this evolving group. Method: Data and information was drawn from the Report of the international survey of cerebral palsy registers, 2009, the NSW CP Register (1993-2003), Western Australian CP Register (1975-2008) and the Surveillance of Cerebral Palsy in Europe (1976-1998). This data was reviewed using the Surveillance of Cerebral Palsy in Europe’s ‘decision tree’ and the groupings described within the Badawi et al, 1998 paper as a framework. Results and discussion: There was general agreement across cerebral palsy surveillance programs regarding what constitutes cerebral palsy and the inclusion and exclusion criteria that should be used. However, further discussion both within and between cerebral palsy surveillance programs is warranted for those areas where a consensus has not been reached, such as the inclusion criteria for (i) the
severity level of motor function (ii) the minimum age of survival and (iii) the maximum age for postneonatal brain injury. Further an updated list of ‘groupings’ regarding the conditions as described in the original Badawi 1998 paper will also be presented.

EXCLUSION OF PROGRESSIVE BRAIN DISORDERS OF CHILDHOOD FOR A CEREBRAL PALSY MONITORING SYSTEM

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Scientific Background: Since cerebral palsy (CP) is defined by its nonprogressive features, a standard definition and list of progressive disorders would be helpful for CP monitoring and epidemiologic studies. Aims and Methods: We reviewed the literature on this topic in order to 1) develop selection criteria for progressive brain disorders of childhood for public health surveillance purposes; 2) identify classes of disorders that were likely to include individual conditions that are progressive; and 3) ascertain information about the relative frequency and natural history of candidate disorders. Results and Discussion: Based on the 19 criteria that we developed, we ascertained a total of approximately 100 progressive brain disorders of childhood, which were almost all single gene disorders. The disorders we identified do not represent a comprehensive catalog of progressive genetic conditions, but will be useful for CP surveillance programs. In addition, the developed criteria for progressive disorders could be applied in the future as more children with very rare disorders are followed and new candidate disorders are identified.

RELIABLE DESCRIPTION OF MOTOR IMPAIRMENTS IN CHILDREN WITH CP

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Background: CP is a heterogeneous condition and sub-classifying this heterogeneity presents a complex challenge for CP Surveillance and Register groups, clinicians and researchers alike. Whilst each group must meet the specific needs of their individual program, the advantages of a mutually agreed vocabulary are self-evident:- consensus in description and classification would provide opportunities to reliably share data and conduct research using participants sourced from different registers and to monitor trends over time. Aim: This paper seeks to (i) describe a system of recording primary observations that has been adopted by the Australian Cerebral Palsy Register, and (ii) to discuss the classifications which are still debated both within and between register and clinical programs. Method: Data and information was drawn from the Western Australian CP Register (1975-2008) and the Surveillance of Cerebral Palsy in Europe (1976-1998) and used to guide the development of questionnaires and workshops aimed at achieving consensus. Clinicians and researchers participated in several studies of the reliability of classification systems. Results and discussion: Whilst there was generally agreement across CP surveillance programs regarding what constitutes CP and its inclusion and exclusion criteria, there was little agreement concerning criteria-driven definitions of sub-types and motor classifications. The use of primary observations affords reliable description of the motor impairments in each individual with CP, and allows all clinicians, researchers and registers to define and group with reliability, according to their individual need.
REPRODUCIBILITY STUDIES OF THE SCPE INCLUSION/CLASSIFICATION SYSTEM FOR CEREBRAL PALSY

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Scientific background: The reliability of the inclusion and classification of children with cerebral palsy (CP) has been little studied though it is one of a fundamental requirement for the quality of CP registries' data.

Aim: To evaluate the reliability of the inclusion and classification of children with CP in the Surveillance of Cerebral Palsy in Europe (SCPE) Network.

Methods and subjects: Two reproducibility studies were conducted. Study 1 included twelve paediatricians who viewed the video/sequences of 12 children with or without CP. Study 2 included nineteen other professionals who had to classify the same 12 children but using information on written vignettes. All participants had to evaluate whether the child had CP, the neurological subtype, and the gross motor function (Gross Motor Function Classification System). They had the possibility to answer that there was not enough information to make a choice. We calculated kappa (k) to measure the reliability of CP diagnosis and intraclass correlation coefficient (ICC) for GMFCS.

Results and discussion: The unknown choice was more frequently observed in study 2 than in study 1 for inclusion and for subtype. Paediatricians viewing video sequences agreed on the diagnosis of CP for 12/12 children (k=1.00) and on neurological subtype for 8/12 children with an overall k coefficient of 0.85 (0.68-0.98). Professionals reading vignettes agreed on the diagnosis of CP for 9/12 children, k=0.73 (0.58-0.87), and on neurological subtype for 5/12 children with an overall k coefficient of 0.78 (0.61-0.91).

Concerning the GMFCS level, ICC was 0.88 (0.78-0.95) in study 1 and 0.80 (0.64-0.91) in study 2.

The results indicate almost perfect reliability for clinicians watching videos and substantial reliability for data abstractors. Moreover, clinicians and data abstractors generally agreed on the classification for a same child.

Acknowledgements: This study was supported by European Commission funds: SCPE Net DG SANCO Contract n°20033131. We thank all SCPE participants.

THE USE OF THE DYSKINESIA IMPAIRMENT SCALE BY LESS EXPERIENCED RATERS: A RELIABILITY STUDY

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5University Hospital Pellenberg, Clinical Motion Analysis Laboratory Leuven, Belgium

SCIENTIFIC BACKGROUND: The Dyskinesia Impairment Scale (DIS) is a new scale for measuring dystonia and choreoathetosis in dyskinetic CP.

OBJECTIVES: Differentiation of dystonia and choreoathetosis is complex and application of the scale may require clinical experience with dyskinetic CP. This study aims to examine the reliability of the DIS in less experienced raters.
METHOD & SUBJECTS: Twenty-five patients (17 males; age range 5-22y; mean age 13y6mo; SD 5y4mo) were included. Two junior physical therapists (PTs) and three senior PTs with limited experience in recognizing and discriminating dystonia and choreothetosis, were trained in scoring the DIS. Afterwards, they independently scored all videotaped patients using the DIS. Reliability was assessed by (1) intraclass correlation coefficient (ICC) (2) standard error of measurement (SEM) and minimal detectable difference (MDD) and (3) Cronbach’s alpha for internal consistency.

RESULTS & DISCUSSION: ICCs for the total scores of the DIS dystonia subscale, the DIS choreoathetosis subscale and the total DIS were 0.82 (95% CI=0.62-0.91), 0.88 (95%CI=0.75-0.95) and 0.88 (95% CI=0.74-0.94) for the junior PTs. For the senior PTs, ICCs were 0.71 (95% CI=0.52-0.85), 0.91 (95% CI=0.83-0.95) and 0.88 (95%CI=0.78-0.94) respectively. SEM and MDD values for the total DIS were 6% and 15% for the junior PTs and 4% and 12% for the senior PTs. Cronbach’s alpha ranged between 0.87 and 0.95 for the junior PTs and between 0.76 and 0.93 for the senior PTs.

The less experienced raters, both junior and senior PTs showed sufficient reliability. Still lower reliability, in particular for the dystonia subscale, and internal consistency was found compared to experienced raters. SEM and MDD values were also higher. This indicates that the scale can be used by less experienced physical therapists but good acquaintance of the operational definitions of dystonia and choreothetosis is crucial to enhance the reliability.

SYSTEMATIC REVIEW OF INTELLIGENCE ASSESSMENTS FOR CHILDREN WITH CEREBRAL PALSY

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Scientific background
Although cerebral palsy (CP) is defined as a primary disorder of posture and movement, estimates suggest that 45% of children also have an intellectual impairment.1 Estimates are vague however due to lack of clinical guidelines for intelligence testing in children with CP.

Aim
This systematic review examined intelligence assessments reported for children with CP to identify appropriate tools for this population.

Methods and subjects
Five electronic databases were searched: PubMed, PsycINFO, Web of Science, CINAHL, and EMBASE to identify assessments that: (i) measured intellectual function as described by ICF category b117; (ii) in children aged four to 18 years; (iii) with CP; and (iv) had clinimetrics for this population. Articles prior to 1970 were excluded.

Results and discussion
Searches yielded 3247 articles of which 267 met the inclusion criteria. These papers reported 31 intelligence assessments, of which 10 had clinimetric data for children with CP. Included tests were: Wechsler Preschool and Primary Scale of Intelligence (WPPSI-III), Wechsler Intelligence Scale for Children (WISC—IV), Wechsler Adult Intelligence Scale (WAIS-IV), Stanford-Binet (SB5), Leiter International Performance Scale (Leiter-R), Test of Nonverbal Intelligence (TONI-3), Columbia Mental Maturity Scale (CMMS), Pictorial Test of Intelligence (PTI-2), Peabody Picture Vocabulary Test (PPVT-III), and Raven’s Coloured Progressive Matrices (RCPM). While the Weschler scales had the most psychometric information, lack of motor and communication adaptations means most are unsuitable for children with significant motor and/or communication impairments. Five scales were appropriate for children with motor and/or communication impairments (Leiter-R, TONI-3, CMMS, PTI-2, PPVT-III, RCPM). Due to the heterogeneity of CP, multiple test options are required to appropriately assess intelligence across this population. Further research is required to establish clinimetrics of tests for children with CP with significant motor and/or communication difficulties.

Mary Jane PLATT (moderator)

The aim of the session is i) to provide a forum to discuss the current challenges associated with measuring and interpreting estimates of prevalence and trends of CP, and ii) to summarise data on estimates of prevalence and trends around the world.

Some examples of challenges include: “in” and “out” migration from the geographical area under study, neonatal survival and/or death of young children with signs of CP who die before age at registration, changes in environmental/social systems and health care on the likelihood of case ascertainment, impact of requiring consent for registration.

KEYNOTES ABSTRACTS

CHALLENGES IN ESTIMATING CEREBRAL PALSY PREVALENCE AND TRENDS

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The terms prevalence, trend and cerebral palsy (CP) will be defined emphasising the non/diagnostic nature of the CP label. The many factors that may affect estimates of numerator and denominator, from which prevalence is calculated, will be discussed. The value in comparing prevalence estimates depends on the proximity of their unmeasurable ascertainment fractions - a fraction which at best may only be guessed at. In view of this potential for variability in ascertainment fraction, a necessary criterion for obtaining valid estimates of trend is that all factors affecting prevalence estimates must be kept constant over time. The challenges for developed countries in meeting this criterion concern primarily the numerator. In addition to maintaining criteria under in-house control (such as necessary duration of survival, severity of motor impairment and age of injury), constant levels of ascertainment also need to be maintained in the face of changing concepts of privacy, indications for service and even what constitutes CP as well as increasing personal mobility and knowledge of medical and alternative treatments. These challenges in meeting the criterion for constant ascertainment fractions are compounded in developing countries by changing sophistication in ascertaining denominators.

ROLE OF MIGRATION AND CHOICE OF DENOMINATOR ON THE PREVALENCE OF CEREBRAL PALSY

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Scientific background: It has been hypothesized that differential migration and choice of denominator have contributed to differences between period and birth prevalence of cerebral palsy (CP) in metropolitan Atlanta.

Aim: The aim of this study was to evaluate the effects of migration and choice of denominator on CP prevalence.

Subjects and methods: Data from the Metropolitan Atlanta Developmental Disabilities Surveillance Program, United States Census Public Use Microdata Sample, and birth certificate files were used to calculate various CP prevalence estimates for 2000.

Results: The overall period prevalence of CP was 3.2 (95% confidence interval [CI] 2.7, 3.8) per 1,000 8-year-olds and was similar for those born in Atlanta who resided there at age 8 (3.3, 95% CI 2.7, 4.1) and those born outside Atlanta who moved into Atlanta by age 8 (3.0, 95% CI 2.3, 3.9). CP prevalence in these two migration strata was similar by sex and race/ethnicity. Among case children there were no significant differences by select demographic, socioeconomic, or clinical characteristics.

Discussion: The authors found no evidence to support the hypothesis that period prevalence was higher than birth prevalence in Atlanta due to in-migration.

**ORAL PRESENTATIONS**

**ACHIEVING MANDATORY NOTIFICATION OF CEREBRAL PALSY IN WESTERN AUSTRALIA - A SUCCESS STORY**

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Background

Western Australia has one of the longest-standing Cerebral Palsy Registers in the world. It was established in the late 1970s alongside the Birth Defects Register, both of which operated successfully for more than three decades as non-consent-based registers relying on voluntary notification from multiple sources. Privacy concerns led to the introduction of national privacy legislation in 1988, extended further in 2000, discouraging the disclosure of personal information by private medical practitioners, and thereby challenging the ongoing feasibility of voluntary notification.

Aims

The aim of the ensuing process was to garner community support for mandatory notification of birth defects and cerebral palsy.

Methods

The process was lengthy, commencing in the mid-1990s with a request to the Health Commissioner to implement mandatory notification to ensure the two registers would continue to be complete and unbiased. This led to extensive community consultation during which consumers were asked to consider and reach a consensus regarding three possible options: (1) voluntary notification as previously, (2) the requirement for consent to notify, or (3) mandatory notification.

Results and Discussion

By 2006 community participants had unanimously opted for mandatory notification, on the condition that dissemination of information to the public would be a priority and consumers would continue to be involved. A Community Reference Group was formed to provide ongoing input, from drafting of the Health Regulations and information materials, to the consideration of research proposals. The Health Regulations were finally enacted in January 2011 with the Cerebral Palsy and Birth Defects Registers combining under the new name of the WA Register of Developmental Anomalies.

Lessons gained from our experience are (1) consumers want to be informed and involved, (2) their involvement can lead to better research conditions, and (3) they offer an important perspective that enhances every aspect of the research process.
RATES OF CEREBRAL PALSY IN VICTORIA, AUSTRALIA, 1970-2004: HAS THERE BEEN A CHANGE?

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³University of Melbourne

Scientific background: Monitoring trends in cerebral palsy (CP) is largely undertaken by geographically-defined CP registries. It requires long-term investment of resources, consistent methodologies, and large enough numbers to minimise yearly variability so that true change can be more readily differentiated from random variation. Where trends in the rates of CP have been reported, the results have often been inconsistent.

Aim: In view of the substantial changes in societal trends and obstetric and neonatal care in recent decades, and the important relationship that exists between causal pathways and gestational age, the aims of this study were to assess overall and gestational age-specific trends in the rate of congenitally/acquired CP in Victoria, and to compare these findings with those from other populations.

Methods and subjects: Individuals born in Victoria, 1970/2004, with non post-neonatally/acquired CP were identified from a population register; 3491 were included in the study (1963 males). Following a literature review, comparison data were extracted from publications using previously devised inclusion criteria. Rates were calculated per 1000 live births for all CP and by gestational age group, and these were tabulated and plotted by year of birth.

Results and discussion: Data from nine registries, including the Victorian register, showed an increase in the rates of CP over the 1970s and 1980s. This increase was particularly seen in relation to extremely preterm (<28 weeks) survivors but also in individuals born at term (37+ weeks). Since the early 1990s, CP rates either stabilised or decreased, particularly for children born extremely preterm. Our findings suggest that increases in the rates of CP during the 1970s and 1980s were in part due to the increasing survival of extremely preterm infants which occurred without a concomitant improvement in neurological outcomes. Evidence from population samples now suggests a reversal of this trend since the mid to late 1990s.

16. 40 – 18.10: Harmonisation in neuro-imaging

Ingeborg Krägeloh-Mann (moderator)

The aim of the session is to provide a forum for exchange of ideas on how to deal with imaging finding in CP registers, and to discuss suggestions for classification of neuro-imaging results by CP registers. Neuro-imaging, neonatal and post-neonatal, is often abnormal in children with CP and helps to understand aetiology or at least pathogenesis of the underlying brain disorder. MRI has become an important diagnostic step after history taking, classifying CP subtype and the additional conditions.

In preparation for this symposium, a survey on neuro-imaging practice and findings will be performed with CP registers around the world; results of this survey will be presented during this session.

KEYNOTES ABSTRACTS

HOW TO REGISTER NEUROIMAGING FINDINGS IN CHILDREN WITH CP - A CLASSIFICATION SUGGESTED BY THE SCPE

Horber V., Krägeloh-Mann I., on behalf of the SCPE Collaboration
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Scientific background
Although neuroimaging is not part of the CP definition, neuroimaging results are in more than 80% abnormal in children with CP, disclosing the pathogenetic pattern responsible for the CP; therefore, a need was expressed for the description and classification of neuroimaging findings in CP.

Aim
To systematically describe neuroimaging findings in CP and suggest a classification, which could be introduced into the standard CP evaluation form to be prospectively used in registers.

Methods
A survey of the literature was done on MRI findings in CP with the aim to identify specific patterns and their distribution. A survey on neonatal imaging techniques and classifications was made in centres related to SCPE registers. A chapter on neuroimaging (imaging in the older child with CP and neonatal neuroimaging) for the R&TM was drafted and consent on a classification scheme was reached. The classification for neonatal neuroimaging results was examined in a reliability exercise for its applicability in CP registers.

Results and discussions
Neuroimaging seems relevant for registers in two situations:
- to describe the brain compromise when the diagnosis of CP is established
- to describe cerebral pathology in the neonatal period

Sue Reid
Classification of MRI in cerebral palsy: findings from an Australian study and review
Authors: Susan Reid, Charuta Dagia, Michael Ditchfield, John Carlin, Dinah Reddihough.
Scientific background: With consensus on specific guidelines for classification, brain imaging has the potential to significantly increase our understanding of cerebral palsy (CP) aetiology.

Aim: The aim of this study was to classify the pattern of abnormality on magnetic resonance imaging (MRI) scans of all children with nonpostneonatally/acquired CP who were born in the Australian state of Victoria between 1999 and 2006. A secondary aim was to compare the classifications, definitions, and proportions of each pattern reported internationally from population cohorts, and identify areas where more specific classification guidelines are required.

Methods: The most recent MRI scan of good quality was assessed by one of two paediatric radiologists who were blinded to clinical information and previous reports. Following a literature search and selection of comparable studies, the distribution of imaging patterns was examined for each included study for all CP, and for subgroups based on gestational age, subtype, and GMFCS level.

Results and discussion: Scans were classified for 593 children (67%) in Victoria, the remaining 33% had no available scan. The majority (82%) of assessed scans showed a single pattern of abnormality, 13% had no observable abnormality, and 5% had dual abnormalities (these were excluded from distributions). Periventricular white matter injury was the most common MRI pattern, occurring in 45.3% scans encompassing all CP subtypes. Grey matter injuries, malformations, focal vascular insults, and other/nonspecific abnormalities were seen in 14.4%, 10.3%, 9.4% and 7.5% of scans, respectively. Distributions of MRI patterns representative of all CP were obtained for two additional cohorts from Europe and Quebec, and an additional four studies reported the distribution for particular subgroups. Identified classification issues included imaging modality, blinding, multiple scans, age at imaging, and dual abnormalities. The study suggested a need for clarification around classification of the sequelae of intraventricular and intracranial haemorrhage, hydrocephalus, differentiating grey matter injury in periventricular white matter patterns from white matter injury in grey matter patterns, and focal infarcts not in a specific vascular territory.
CLASSIFICATION OF MRI IN CEREBRAL PALSY: FINDINGS FROM AN AUSTRALIAN STUDY AND REVIEW

Reid S.
Murdoch Childrens Research Institute

Scientific background: With consensus on specific guidelines for classification, brain imaging has the potential to significantly increase our understanding of cerebral palsy (CP) aetiology.

Aim: The aim of this study was to classify the pattern of abnormality on magnetic resonance imaging (MRI) scans of all children with non postneonatally-acquired CP who were born in the Australian state of Victoria between 1999 and 2006. A secondary aim was to compare the classifications, definitions, and proportions of each pattern reported internationally from population cohorts, and identify areas where more specific classification guidelines are required.

Methods: The most recent MRI scan of good quality was assessed by one of two paediatric radiologists who were blinded to clinical information and previous reports. Following a literature search and selection of comparable studies, the distribution of imaging patterns was examined for each included study for all CP, and for subgroups based on gestational age, subtype, and GMFCS level.

Results and discussion: Scans were classified for 593 children (67%) in Victoria; the remaining 33% had no available scan. The majority (82%) of assessed scans showed a single pattern of abnormality, 13% had no observable abnormality, and 5% had dual abnormalities (these were excluded from distributions). Periventricular white matter injury was the most common MRI pattern, occurring in 45.3% scans encompassing all CP subtypes. Grey matter injuries, malformations, focal vascular insults, and other/non-specific abnormalities were seen in 14.4%, 10.3%, 9.4% and 7.5% of scans, respectively. Distributions of MRI patterns representative of all CP were obtained for two additional cohorts from Europe and Quebec, and an additional four studies reported the distribution for particular subgroups. Identified classification issues included imaging modality, blinding, multiple scans, age at imaging, and dual abnormalities. The study suggested a need for clarification around classification of the sequelae of intraventricular and intracranial haemorrhage, hydrocephalus, differentiating grey matter injury in periventricular white matter patterns from white matter injury in grey matter patterns, and focal infarcts not in a specific vascular territory.

HOW DO CP REGISTERS RECORD NEONATAL NEUROIMAGING INFORMATION: A SURVEY

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NOT RECEIVED
THE DIAGNOSIS OF CEREBRAL PALSY WITH A NORMAL BRAIN MRI. HOW FAR DO WE FEEL CONFIDENT?

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Background: Large recent epidemiological neuroimaging studies on cerebral palsy (CP) point out 10 to 15% of normal brain MRI; these cases must be investigated for other diagnosis, as inborn errors of metabolism and/or genetic conditions.

Aim: To verify if a sample of adolescents diagnosed, in their childhood, as CP with normal brain MRI, fit in the clinical CP diagnosis following the diagnosis fluxogram of Surveillance of Cerebral Palsy in Europe (SCPE).

Methods and subjects: From a group of 100 Portuguese children born 1996-1998 and diagnosed as CP at 3 to 5 years of age (included in a multicenter European Cerebral Palsy Study), 11 had a normal brain MRI. Their clinical files were reviewed under present SCPE standards by a team of CP experts, doubtful cases were clinically reevaluated.

Results and discussion: Two cases were meanwhile diagnosed as Rett and Angelman syndromes. A third case couldn’t fit in the diagnosis tree of SCPE because of persistent hypotonia. The remaining 8 adolescents maintained clinical features of CP. One must presently admit that, in a small percentage of CP cases, MRI may look normal. However these patients deserve a careful lifelong neurological follow-up to exclude very slowly progressive hereditary disorders which can masquerade as CP, an extremely important fact both for prognosis and for genetic counseling.

TRENDS OF SEVERE INTRAVENTRICULAR HAEOMORRHAGE AND PARENCHYMAL LESION IN VERY LOWBIRTHWEIGHT NEONATES

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Scientific background: Population base data provided evidence that the prevalence of cerebral palsy in children of birthweight (BW) less than 1500 g has fallen. Part of this reduction is a result of general improvements in obstetrical and neonatal care. Cranial ultrasound findings are the main neonatal prognostic factor of CP in VLBW neonates.

Aim: To estimate trends over time in severe cranial ultrasound findings in very low birth weight neonates.

Methods and subjects: Survivors from a single NICU, inborn between 1991 and 2010 with a birthweight under 1500 g. Cranial ultrasound exams were protocolised. Brain injury was defined after its full evolution. Three types of severe brain lesions were described: intraventricular haemorrhage (IVH) grade III, ventriculomegaly grade III, and parenchymal lesion (PL) grade III/IV. Time trends over five 4 year periods for brain injuries, neonate characteristics and clinical practice features were explored with regression analysis.

Results and discussion: 1298 neonates were included in the 20 year study period; 33% were BW<1000g. HIV-III was in the range 3 to 4 % between 1991 and 2006. It increased to 6.8% (95%CI, 3-9%), p=0.04, in the period 2007-10. Parenchymal lesion decreased from 6% in 1991-98 to 3% in 1999-2006, p=0.019, and then increased to 7.5% (4-10) in 2007-10, p= 0.01. The increase in both severe IVH and PL was mainly observed in BW<1000g (both rates up to 12%).

This study confirms a stable occurrence of severe intraventricular haemorrhage and a decrease in severe parenchymal lesions at the end of the 90’s. The recent increase in severe brain injury observed may be related to improved ultrasound accuracy and changes in characteristics of neonates such as increased...
survival at lower gestational age in recent years. A comprehensive interpretation of hospital-based data on neonatal morbidity requires birth and mortality data at the population level.

18.10 – 19.40: Quality of care, including transition to adulthood: how can registers help?

Allan Colver (moderator)

The aim of this session is to understand better how registers can be used to monitor and to improve quality of care for children and young people and their families.

Using registers to improve quality of care has three important benefits: care is improved, data quality on the register is improved through regular two-way exchange of data between register and clinical teams, and care is monitored and improved for all children in a geographical area, not just those attending a particular service or hospital.

KEYNOTES ABSTRACTS

LIFE EXPECTANCY IN CEREBRAL PALSY

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DEVELOPMENT OF A CLINICAL RESEARCH PROGRAMME AROUND A CP REGISTER - IMPROVING QUALITY OF CARE

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Scientific background: The CP register of western Sweden is one of the longest running cerebral palsy (CP) registers in the world, starting in birth year 1954. Several reports on prevalence and origin of CP have been published. Many functional aspects and accompanying impairments of CP have attracted increasing attention in the last decades.

Aim: To describe the development of a research programme around the epidemiological register, to meet new demands on CP research and care, and to describe interactions between the register, clinical reality and research and those who are involved, as subjects and professionals.

Methods and subjects: An overview of ongoing research in the CP register of western Sweden now based on data from 1908 individuals with CP, born 1954-2002. The process of research questions arising from the epidemiological study, giving rise to further studies and dissemination of results to patients, patient organisations and professionals, and the benefit of feedback is described.

Results and discussion: The study of epidemiology in CP gives rise to clinical research questions, and clinical challenges produce even more research questions. The interaction between register and clinic has led to a variety of studies regarding function and accompanying impairments in addition to the study of prevalence and origin of CP. Linking for example development of motor function over time, survival, growth deviation, or communication disorders, to epidemiological trends, neuroimaging findings or risk factors in a population-based context may highlight important problems in specific patient groups. In

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interaction with stakeholders, this provides a possibility to improve quality of care, as well as keeping the variables surveyed by the register relevant to clinical needs.

**USING THE NORTH OF ENGLAND COLLABORATIVE CEREBRAL PALSY SURVEY (NECCPS) TO AUDIT QUALITY OF CARE**

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Quality of care matters for families and influences outcomes.

**Aims:**
To establish whether there is variation in health care for children and young people with cerebral palsy across north England.

**Methods:**
Retrospective care note review of 389 children and young people registered on the NECCPS living in 15 districts, born 1995-2002, with subsequent data validation by clinicians. Data was collected on cranial magnetic resonance imaging [MRI] (marker of aetiological assessment), hips, spines, pain, growth and nutrition.

**Results:**
The audit sample was representative of all on the NECCPS across a range of clinical and demographic factors.
221/389 (56.8%) children and young people had an MRI overall, with significant variation (p<0.001) in MRI rates between districts.
259/389 (66.6%) had a discussion about pain recorded within the last two years, of which 87.3% had a management plan. Those from the socio/economically most deprived quintile were significantly (p<0.05) less likely to have had a discussion about pain than those in the least deprived quintile.
There was significant (p<0.01) variation between districts in recording of status of spine; there was no record in 24.4% of the sample.
31/66 (47%) of those with a spinal curvature were monitored by a spinal surgeon and 54/353 (33.1%) had their hips monitored by an orthopaedic surgeon, with an inter/district variation in access to spinal and orthopaedic surgeons.
35/383 (9.1%) had received gastrostomy for feeding but there was no difference in Body Mass Index between this groups and the rest of the sample.
Most recent weight was recorded within the last year for 60%.
119/389 (31%) had weight percentiles ascertained and recorded with a significant (p<0.001) inter-district variation.

**Conclusion:**
There is variation in important aspects of health care for children and young people with cerebral palsy across north England. There is a need to work towards more equitable health care for the best health outcomes.

**ORAL PRESENTATIONS**

**HOW IS GROWTH AND NUTRITION ASSESSED IN EUROPEAN CHILDREN WITH CEREBRAL PALSY?**

Hollung S.\(^1\), Andersen G.L.\(^1\), Torstein V.\(^2\)

\(^1\)The Cerebral Palsy Register of Norway, Vestfold Hospital Trust, Tønsberg Norway
Scientific background:
A significant proportion of children with cerebral palsy (CP) have feeding difficulties. The most severely affected are at risk of malnourishment, impaired growth and a poor prognosis for survival. Body mass index (BMI) is considered an unreliable assessment of nutritional status due to inaccurate height measurements. During the last two decades researchers have proposed both segmental measurements as proxies for height, and skinfold thickness measurements to assess nutritional status.

Aim:
To see if segmental measures like knee height, leg and upper arm length are commonly used for children with CP, who are not able to stand.

Methods and subjects:
A cross-sectional survey was made using a web based tool and sent to participants by email. The survey included eight questions regarding growth and nutrition, specifically how height and weight were measured in children with CP.

Pediatric clinicians in Europe were contacted through the SCPE-NET as well as various organizations. In all, 88 clinicians in 30 countries were contacted. A total of 37 (42%) clinicians, representing 17 countries responded. Only one response per clinic was allowed.

Results and discussion:
Approximately 90% of the clinics reported that the height and weight of children who were able to stand were measured with standard equipment. 27 (73%) clinics reported that they used a standard scale for children who were not able to stand. Only 7 (19%) used a caliper to obtain segmental measurements for height, while only 8 (22%) clinics used standard equipment to assess nutritional status.

Only a fifth of the clinics used standard equipment to measure height and assess the nutritional status of children with CP who were not able to stand. The results suggest that there is significant potential for improvement in the quality of linear growth measurements and nutritional status assessments of children with severe CP.

GASTROSTOMY TUBE FEEDING OF CHILDREN WITH CEREBRAL PALSY: VARIATION ACROSS SIX EUROPEAN COUNTRIES

Dahlseng M. O., Horridge K., Arnaud C., Uldall P., Da Graça Andrada M., Sigurdardottir S., Himmelmann K., De la Cruz J., Andersen G., Torstein V., on behalf of the Surveillance of Cerebral Palsy in Europe Network (SCPE-NET)

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5The Cerebral Palsy Registry of Portugal, Federação das Associações Portuguesas de Paralisia Cerebral
6State Diagnostic and Counseling Centre, Kopavogur, Iceland
7Department of Pediatrics, Institute of Clinical Sciences, Queen Silvia Children’s Hospital, Sahlgrenska Academy at the University of Gothenburg, Göteborg, Western Sweden
8Clinical Research Unit, Imas12-Ciberesp, Hospital 12 Octubre, Madrid, Spain
9The Cerebral Palsy Registry of Norway, Vestfold Hospital Trust, Tønsberg, Norway.

Scientific background
Feeding difficulties and poor growth are common among children with cerebral palsy (CP).

Aim
To compare the prevalence of feeding difficulties, gastrostomy tube feeding (GTF) and growth of children with CP in six European countries.
Subjects and methods
Children with all CP subtypes and Gross Motor Function Classification System (GMFCS) levels were eligible. Data on 1295 children with CP born 1999-2001 were collected from geographically defined areas in six European countries; Western Sweden, Northern England, Norway, Denmark, Portugal and Iceland.
Outcome measures were GTF, age at placement of GTF, feeding difficulties and the children’s height and weight for age standard deviation scores (z-scores).

Results and discussion
The prevalence of feeding difficulties could not be compared due to lack of standardized feeding ability scales. Use of GTF among all children with CP ranged from 6% (CI: 3-9) to 22% (CI: 16-29) (p < 0.001). The difference between areas was greater among children with GMFCS levels IV and V (non-walkers) ranging from 12% (CI: 7-21) to 67% (CI: 53-80). Median age at placement of gastrostomy varied from 16 (range 5-108) months to 70 (range 12-120) months in (p < 0.002). In the total population mean z-scores for weight was -0.86 (SD: 1.71) and for height -0.87 (SD: 1.50). No differences were found between the six areas. Among children with GMFCS level IV/V lower height z-scores were more present in the areas with lower prevalence of GTF.

Conclusion/Significance
The observed differences in age at placement and use of GTF may reflect differences in access to treatment or clinical practice, or both. Our results suggest that use of GTF may improve growth in height and weight among children with more severely affected motor function - the group most likely to have associated feeding difficulties. There is a lack of consistent reporting of feeding abilities in children with CP.

COST OF MEDICAL & ALLIED HEALTH RESOURCE USE IN PRESCHOOL AGE CHILDREN WITH CEREBRAL PALSY

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Objective: To analyse the relationship between costs of Medical and Allied Health resource use over 12mths and functional abilities in pre-school children with cerebral palsy.

Design: Economic evaluation of a longitudinal, prospective population based cohort study.

Participants & Setting: 111 children (n=73 males, 66%) including GMFCS I=57(51%), II=13(12%), III=14(12%), IV=14(12%), V=13(12%) assessed at 30 & 36mths corrected age (c.a.)

Methods: Caregivers were interviewed regarding frequency and duration of therapy (traditional and alternative), hospital admissions, GP and specialist visits, equipment (including orthoses) and medications (including BoNT-A). The frequency and cost ($1AUD=0.78EUR) of Medical and Allied Health resource utilization were analysed according to functional severity (GMFCS).

Results: There is a strong, positive correlation between GMFCS level and overall cost per child (r=0.646, p<0.001). As GMFCS level increases, the cost per child increases. Over 12mths the total cost of care was $1.6M for the cohort with average cost $14.8K/child varying from $8.4K for GMFCS I to $30.2K for GMFCS V. Traditional therapy was accessed by 95% of children classified GMFCS I ($2.3K/child) and 100% of GMFCS II ($4.2K/child), III ($3.1K/child), IV ($5.4K/child) and V ($4.3K/child). Alternative therapy was accessed by 75% of children (total $235K; $2.8K/child). Conductive Education was accessed by 12% of children who were predominantly GMFCS V (total $112K; $8K/child). The highest average cost for hospital stay and equipment were GMFCS V ($4.5K, $11.9K respectively) compared to GMFCS I ($2K, $2K respectively) related to the state-wide intramuscular BoNT-A injection program and orthoses.

Discussion: Our prospective cohort study of health resource use and costs of care is based on a public health system and national costing guidelines in preschool age children with cerebral palsy. Our study has confirmed the cost of medical and allied health resource use increases as functional severity (GMFCS) increases.
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