

# Science Infos

## Paralysie Cérébrale

N°40 SEPTEMBRE 2017



FONDATION  
PARALYSIE CÉRÉBRALE  
LA FONDATION MOTRICE

### FOCUS

#### *Trois lauréats boursiers retenus par la Fondation Paralysie Cérébrale*

La Fondation Paralysie Cérébrale a souhaité accompagner en 2018 de jeunes chercheurs qui mènent leurs travaux de recherche dans le domaine de la paralysie cérébrale (sa prévention et ses conséquences chez les personnes concernées et leurs familles). Dans cette optique elle a lancé en mai 2017 un appel d'offre en direction de doctorants en fin de thèse et de titulaires d'un doctorat souhaitant réaliser une année de post-doctorat.

Sur recommandation du Conseil Scientifique, le Conseil d'Administration de La Fondation Paralysie Cérébrale a retenu 3 lauréats parmi 15 candidats.

- Une bourse de post-doctorat a été attribuée pour 1 an à Mme Marta Boccazzi qui sera accueillie dans l'unité INSERM 1141 du Pr Pierre Gressens (Paris). Le projet de Marta Boccazzi étudie le rôle des oligodendrocytes dans le développement de lésions cérébrales. Ce projet évaluera si des défauts de la maturation des oligodendrocytes dus à une inflammation systémique périnatale (en cas de prématurité par exemple) sont également accompagnés par des changements de leur métabolisme et de l'expression d'un récepteur le GPR17. Ce travail va également déterminer si les modifications et les défauts de myélinisation peuvent être restaurés par des agents pharmacologiques stimulant ce récepteur.
- Une bourse de post-doctorat a également été attribuée pour 1 an à Mme Maryline Lecointre qui travaillera dans le laboratoire NeoVasc du Docteur Bruno Gonzalez (Rouen). Le projet de Maryline Lecointre porte sur la relation entre placenta et prématurité. Les objectifs de ce projet de recherche pré-clinique visent à rechercher l'impact d'un facteur trophique placentaire sur la mise en place de deux populations cellulaires cérébrales et à déterminer si ces anomalies développementales contribuent à la grande fragilité du cerveau de l'enfant prématuré.
- Une bourse a été attribuée à Mr Jonathan Pierret qui effectue sa dernière année de doctorat au sein du laboratoire Développement, Adaptation, Handicap de l'université de Lorraine, dirigé par le Pr Christian Beyaert (Nancy). Son projet a pour objectif de montrer qu'améliorer le contrôle postural du tronc et de la tête par un protocole de rééducation spécifique associant des exercices ciblant le tronc à la rééducation classique permettrait d'améliorer la locomotion dans la paralysie cérébrale (PC). Ce résultat suggérerait qu'il est important de développer très tôt la contribution des segments axiaux dans la motricité dynamique et constituerait une base de recherche en rééducation.

En apportant une aide financière à ces jeunes chercheurs, La Fondation Paralysie Cérébrale entend permettre la mise en œuvre de projets contribuant à une meilleure connaissance de la paralysie cérébrale, de sa prise en charge et de sa prévention.

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# Manifestations et congrès

## Novembre 2017

### **12th Mediterranean congress og Physical an Rehailitation Medicine**

9-12 Novembre 2017

Malte, Malte

<http://prmcongress2017malta.org/>

### **Journées d'études polyhandicap Paralysie cérébrale 2017**

16-17 Novembre 2017

Paris, France

<https://www.institutmc.org/index.php/annonce-journe-es-polyhandicap-paralysie-ce-re-brale-novembre-2017>

## Décembre 2017

### **24<sup>ème</sup> Congrès de la SOFPEL Société Francophone Posture Equilibre Locomotion**

01-02 Décembre 2017

Montpellier, France

<http://www.posture-equilibre.asso.fr/xxiveme-congres-de-sofpel-montpellier/>

### **Journées d'études annuelles du CDI**

#### **« L'axe corporel du paralysé cérébral dans ses dimensions motrice, perceptives et orthopédiques »**

11-12 décembre 2017

Lyon, France

<https://www.institutmc.org/index.php/24-news-colloques/133-journee-d-etude-du-cdi-2017-a-lyon>

## Mai 2018

### **21st European Congress of Physical and Rehabilitation Medecine**

01-06 mai 2018

Vilnius, Lithanie

<http://www.esprm2018.com/>

## Juillet 2018

### **12 th International Society of Physical and Rehabilitation Medicine ( ISPRM) World Congress**

08-12 juillet 2018

Paris, France

<http://www.isprm2018.com/>



## Publications scientifiques

### Méthodologie de la recherche

Le profil de veille a été mis en place sur Pubmed avec le mot clé "Cerebral Palsy" pour des publications majoritairement en français ou en anglais, avec abstract ou full text

**Free article** indique le lien vers les articles dont le texte intégral est librement disponible

### Epidémiologie

#### ✚ Facteurs de risque – Causes

##### **Chorioamnionitis in the Development of Cerebral Palsy: A Meta-analysis and Systematic Review.**

Shi Z , Ma L , Luo K , Bajaj M , Chawla S , Natarajan G , Hagberg H , Tan S .

*Pediatrics*. 2017 Jun;139(6). pii: e20163781. doi: 10.1542/peds.2016-3781.

CONTEXT: Chorioamnionitis (CA) has often been linked etiologically to cerebral palsy (CP).

OBJECTIVES: To differentiate association from risk of CA in the development of CP.

DATA SOURCES: PubMed, Cochrane Library, Embase, and bibliographies of original studies were searched by using the keywords (chorioamnionitis) AND ((cerebral palsy) OR brain).

STUDY SELECTION: Included studies had to have: (1) controls, (2) criteria for diagnoses, and (3) neurologic follow-up. Studies were categorized based on: (1) finding incidence of CP in a CA population, or risk of CP; and (2) incidence of CA in CP or association with CP. DATA EXTRACTION: Two reviewers independently verified study inclusion and extracted data.

RESULTS: Seventeen studies (125 256 CA patients and 5 994 722 controls) reported CP in CA. There was significantly increased CP in preterm histologic chorioamnionitis (HCA; risk ratio [RR] = 1.34,  $P < .01$ ), but not in clinical CA (CCA). Twenty-two studies (2513 CP patients and 8135 controls) reported CA in CP. There was increased CCA (RR = 1.43,  $P < .01$ ), but no increase in HCA in preterm CP. Increased HCA was found (RR = 4.26,  $P < .05$ ), as well as CCA in term/near-term CP (RR = 3.06,  $P < .01$ ).

CONCLUSIONS: The evidence for a causal or associative role of CA in CP is weak. Preterm HCA may be a risk factor for CP, whereas CCA is not. An association with term and preterm CP was found for CCA, but only with term CP for HCA.

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DOI: 10.1542/peds.2016-3781

PMCID: PMC5470507 [Available on 2018-06-01]

PMID: 28814548 [Indexed for MEDLINE]

##### **Isolated neonatal MRI punctate white matter lesions in very preterm neonates and quality of life at school age.**

Arberet C , Proisy M , Fausser JL , Curt M , Bétrémieux P , Tréguier C , Rozel C , Pladys P .

*J Neonatal Perinatal Med*. 2017 Aug 23. doi: 10.3233/NPM-1691. [Epub ahead of print]

OBJECTIVE: To study the quality of life at school age of very preterm infants presenting isolated punctate periventricular white matter lesions (IPWL) on late-preterm or term magnetic resonance imaging (MRI).

METHODS: In 1996-2000, 16 of the 131 very preterm neonates explored by MRI were found to have IPWL. At the age of 9-14, 12 children from the IPWL group were compared with 54 children born preterm but with a normal MRI (no lesion). Quality of life (Health Status Classification System Pre School questionnaire), school performance, and motor outcome were investigated.

RESULTS: Overall quality of life did not differ between the groups (classified as perfect in 2/12 of the IPWL vs 20/54 in the no-lesion). The sub-items mobility and dexterity differed significantly between the two groups, with impairment in the IPWL group ( $p < 0.001$  and  $p < 0.05$ ). This group also displayed higher levels of motor impairment: they began walking later [20(4) vs. 15(3) months],  $p < 0.01$ , had higher frequencies of cerebral palsy (6/12 vs. 2/54,

p<0.05), and dyspraxia (4/12 vs. 0/54, p<0.001). The rate of grade retention did not differ between the groups (3/12 in the IPWL group vs. 17/54 in the no-lesions group) but, as expected, was higher than that of the French general population (17.4%) during the study period.

**CONCLUSION:** This long-term follow-up study detected no increase in the risk of subsequent cognitive impairment in very preterm infants with IPWL, but suggests that these children may have a significantly higher risk of dyspraxia, and motor impairment.

DOI: 10.3233/NPM-1691

PMID: 28854519

### **[Long term outcome of perinatal stroke].[Article in French]**

Vuillerot C , Marret S , Dinomais M .

*Arch Pediatr.* 2017 Sep;24(9S):9S51-9S60. doi: 10.1016/S0929-693X(17)30332-9.

Neonatal Arterial Ischemic Stroke (NAIS) affects 6-17 newborns on 100 000-birth term neonates, most of these children keeping long-term motor and cognitive impairments. Based on a literature review, the objectives of this paper are to describe motor and cognitive outcomes after a NAIS and to propose a consensual monitoring of these children to improve their management. About 30 % of children after a NAIS will develop a unilateral cerebral palsy requiring a management by a team with expertise in physical medicine and rehabilitation. Unlike adults, especially after a left NAIS, children will not present aphasia but between 50 and 90 % will present disorders of speech and language in expression and/or reception. After NAIS, the global intellectual efficiency is usually preserved except when the size of the lesion is very important or when severe epilepsy occurs. Several studies are also in favor of vulnerability in visuospatial functions. To quantify impairments, activity limitations and participation restrictions resulting from this NAIS, early and at least yearly evaluations with reliable tools must be carried out systematically until puberty. A multidisciplinary team with a longitudinal follow-up, in all the different developmental dimensions, must conduct these evaluations in term of motor skills, cognitive impairment, behavior, autonomy, quality of life, and participation. Consequences on family functioning need to be evaluate in order to help children and family coping with this event.

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DOI: 10.1016/S0929-693X(17)30332-9

PMID: 28867039

### **Neurodevelopmental outcome at the age of 4 years according to the planned mode of delivery in term breech presentation: a nationwide, population-based record linkage study.**

Macharey G , Väisänen-Tommiska M , Gissler M , Ulander VM , Rahkonen L , Nuutila M , Heinonen S .

*J Perinat Med.* 2017 Sep 9. pii: /j/jpme.ahead-of-print/jpm-2017-0127/jpm-2017-0127.xml. doi: 10.1515/jpm-2017-0127. [Epub ahead of print]

**PURPOSE:** To evaluate whether a trial of planned vaginal breech labor affects neurologic development in children.

**METHODS:** This is a nationwide, Finnish, population-based record linkage study. An odds ratio with 95% confidence intervals was used to estimate the relative risk that a child delivered by planned vaginal breech labor would be diagnosed with adverse neurodevelopmental outcome (cerebral palsy, epilepsy, intellectual disability, sensor neural developmental outcome, hyperactivity, speech and language problems) at the age of 4 years. The reference group were children born by planned cesarean section.

**RESULTS:** During a study period of 7 years, 8374 infants were delivered in breech position. Among them, 3907 (46.7%) had an attempted labor and 4467 (53.3%) infants were delivered by planned cesarean section. There were no differences in the neurodevelopmental outcome. In the planned vaginal labor group, 133 (3.4%) children had an abnormal neurodevelopmental outcome at the age of 4 years compared to 142 (3.2%) in the planned cesarean section group.

**CONCLUSION:** The absolute risk of abnormal neurological outcome in breech deliveries at term was low, regardless of planned mode of birth. Planned vaginal breech labor did not increase the risk for abnormal neurological outcome compared to planned cesarean section.

DOI: 10.1515/jpm-2017-0127

PMID: 28888092

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cdoumergue@lafondationmotrice.org

### **Population impact of preterm birth and low birth weight on developmental disabilities in US children.**

Schieve LA , Tian LH , Rankin K , Kogan MD , Yeargin-Allsopp M , Visser S , Rosenberg D .

*Ann Epidemiol. 2016 Apr;26(4):267-74. doi: 10.1016/j.annepidem.2016.02.012. Epub 2016 Mar 22.*

**PURPOSE:** Although previous studies demonstrate associations between adverse perinatal outcomes and developmental disabilities (DDs), study of population impacts is limited.

**METHODS:** We computed relative risks adjusted (aRRs) for sociodemographic factors and component and summary population attributable fractions (PAFs) for associations between very low birth weight (VLBW, all preterm births), moderately low birth weight (MLBW) + Preterm, MLBW at term, and normal birth weight (NBW) + Preterm and seven DDs (cerebral palsy [CP], autism spectrum disorder [ASD], intellectual disability [ID], behavioral-conduct disorders, attention-deficit-hyperactivity disorder [ADHD], learning disability [LD], and other developmental delay) among children aged 3-17 years in the 2011-2012 National Survey of Children's Health.

**RESULTS:** VLBW-Preterm, MLBW-Preterm and NBW-Preterm were strongly to moderately associated with CP (aRRs: 43.5, 10.1, and 2.2, respectively; all significant) and also associated with ID, ASD, LD, and other developmental delay (aRR ranges: VLBW-Preterm 2.8-5.3; MLBW-Preterm 1.9-2.8; and NBW-Preterm 1.6-2.3). Summary PAFs for preterm birth and/or LBW were 55% for CP, 10%-20% for ASD, ID, LD, and other developmental delay, and less than 5% for ADHD and behavioral-conduct disorders. Findings were similar whether we assessed DDs as independent outcomes or within mutually exclusive categories accounting for DD co-occurrence.

**CONCLUSIONS:** Preterm birth has a sizable impact on child neurodevelopment. However, relative associations and population impacts vary widely by DD type.

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DOI: 10.1016/j.annepidem.2016.02.012

PMCID: PMC4978423

PMID: 27085382 [Indexed for MEDLINE]

### **Predictive Factors for Inpatient Falls among Children with Cerebral Palsy.**

Alemdaroğlu E , Özbudak SD , Mandiroğlu S , Biçer SA , Özgirgin N , Uçan H .

*J Pediatr Nurs. 2017 Jan - Feb;32:25-31. doi: 10.1016/j.pedn.2016.08.005. Epub 2016 Sep 12.*

**OBJECTIVE:** Inpatient falls are of significant concern. The aim of this prospective study was to determine the predictors of inpatient falls among children with cerebral palsy in a rehabilitation hospital.

**DESIGN AND METHODS:** A total of 93 patients with cerebral palsy were assessed based on history, physical findings, the Selective Motor Control Test, the Gross Motor Functional Classification System, the Berg Balance Scale and the Manual Ability Classification System. Previous history of falls/frequent falls, and any falls which occurred during hospitalization, were recorded. **RESULTS:** Of all 93 patients, 25 (27%) fell and 68 (73%) did not fall. The mean age of the fallers (6.3±2.0 years) was lower than that of the non-fallers (8.1±3.9 years). Behavioral problems according to the mother's statement (OR 26.454), not being able to maintain a long sitting position (OR 10.807), ability to balance on knees without support (OR 9.810), a history of frequent falls (OR 4.893) and a negative Thomas test (OR 4.192 fold) were found to increase the risk of inpatient falls.

**CONCLUSIONS:** In these children with cerebral palsy, behavioral problems according to the mother's statement, a history of frequent falls, not being able to maintain a long sitting position, a negative Thomas test, and able to balance on knees without support were associated with the risk of inpatient falls. Children with cerebral palsy may experience inpatient falls. Further studies are required in order to develop prevention programs.

**PRACTICE IMPLICATIONS:** For patients diagnosed with cerebral palsy, these results may help identify possible inpatient fallers on hospital admission.

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PMID: 27633845 [Indexed for MEDLINE]

## Lésions - Prévention des lésions- relation structure fonction

### **Early, Accurate Diagnosis and Early Intervention in Cerebral Palsy: Advances in Diagnosis and Treatment.**

Novak I , Morgan C , Adde L , Blackman J , Boyd RN , Brunstrom-Hernandez J , Cioni G , Damiano D , Darrach J , Eliasson AC , de Vries LS , Einspieler C , Fahey M , Fehlings D , Ferriero DM , Fetters L , Fiori S(6) , Forssberg H , Gordon AM , Greaves S , Guzzetta A , Hadders-Algra M , Harbourne R , Kakooza-Mwesige A , Karlsson P , Krumlinde-Sundholm L , Latal B , Loughran-Fowlds A , Maitre N , McIntyre S , Noritz G , Pennington L , Romeo DM , Shepherd R , Spittle AJ , Thornton M , Valentine J , Walker K , White R , Badawi N

*JAMA Pediatr.* 2017 Sep 1;171(9):897-907. doi: 10.1001/jamapediatrics.2017.1689.

Importance: Cerebral palsy describes the most common physical disability in childhood and occurs in 1 in 500 live births. Historically, the diagnosis has been made between age 12 and 24 months but now can be made before 6 months' corrected age.

Objectives: To systematically review best available evidence for early, accurate diagnosis of cerebral palsy and to summarize best available evidence about cerebral palsy-specific early intervention that should follow early diagnosis to optimize neuroplasticity and function.

Evidence Review: This study systematically searched the literature about early diagnosis of cerebral palsy in MEDLINE (1956-2016), EMBASE (1980-2016), CINAHL (1983-2016), and the Cochrane Library (1988-2016) and by hand searching. Search terms included cerebral palsy, diagnosis, detection, prediction, identification, predictive validity, accuracy, sensitivity, and specificity. The study included systematic reviews with or without meta-analyses, criteria of diagnostic accuracy, and evidence-based clinical guidelines. Findings are reported according to the PRISMA statement, and recommendations are reported according to the Appraisal of Guidelines, Research and Evaluation (AGREE) II instrument.

Findings: Six systematic reviews and 2 evidence-based clinical guidelines met inclusion criteria. All included articles had high methodological Quality Assessment of Diagnostic Accuracy Studies (QUADAS) ratings. In infants, clinical signs and symptoms of cerebral palsy emerge and evolve before age 2 years; therefore, a combination of standardized tools should be used to predict risk in conjunction with clinical history. Before 5 months' corrected age, the most predictive tools for detecting risk are term-age magnetic resonance imaging (86%-89% sensitivity), the Prechtl Qualitative Assessment of General Movements (98% sensitivity), and the Hammersmith Infant Neurological Examination (90% sensitivity). After 5 months' corrected age, the most predictive tools for detecting risk are magnetic resonance imaging (86%-89% sensitivity) (where safe and feasible), the Hammersmith Infant Neurological Examination (90% sensitivity), and the Developmental Assessment of Young Children (83% C index). Topography and severity of cerebral palsy are more difficult to ascertain in infancy, and magnetic resonance imaging and the Hammersmith Infant Neurological Examination may be helpful in assisting clinical decisions. In high-income countries, 2 in 3 individuals with cerebral palsy will walk, 3 in 4 will talk, and 1 in 2 will have normal intelligence.

Conclusions and Relevance: Early diagnosis begins with a medical history and involves using neuroimaging, standardized neurological, and standardized motor assessments that indicate congruent abnormal findings indicative of cerebral palsy. Clinicians should understand the importance of prompt referral to diagnostic-specific early intervention to optimize infant motor and cognitive plasticity, prevent secondary complications, and enhance caregiver well-being.

DOI: 10.1001/jamapediatrics.2017.1689

PMID: 28715518 [Indexed for MEDLINE]

### **Données fondamentales**

### **Could Perinatal Asphyxia Induce a Synaptopathy? New Highlights from an Experimental Model.**

Herrera MI , Otero-Losada M , Udovin LD , Kusnier C , Kölliker-Frers R , de Souza W , Capani F .

*Neural Plast.* 2017;2017:3436943. doi: 10.1155/2017/3436943. Epub 2017 Feb 23.

Birth asphyxia also termed perinatal asphyxia is an obstetric complication that strongly affects brain structure and function. Central nervous system is highly susceptible to oxidative damage caused by perinatal asphyxia while activation and maturity of the proper pathways are relevant to avoiding abnormal neural development. Perinatal

asphyxia is associated with high morbimortality in term and preterm neonates. Although several studies have demonstrated a variety of biochemical and molecular pathways involved in perinatal asphyxia pathophysiology, little is known about the synaptic alterations induced by perinatal asphyxia. Nearly 25% of the newborns who survive perinatal asphyxia develop neurological disorders such as cerebral palsy and certain neurodevelopmental and learning disabilities where synaptic connectivity disturbances may be involved. Accordingly, here we review and discuss the association of possible synaptic dysfunction with perinatal asphyxia on the basis of updated evidence from an experimental model.

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DOI: 10.1155/2017/3436943

PMCID: PMC5343259

PMID: 28326198 [Indexed for MEDLINE]

### **Magnesium Sulfate Prevents Neurochemical and Long-Term Behavioral Consequences of Neonatal Excitotoxic Lesions: Comparison Between Male and Female Mice.**

Daher I , Le Dieu-Lugon B , Dourmap N , Lecuyer M , Ramet L , Gomila C , Ausseil J , Marret S , Leroux P , Roy V , El Mestikawy S , Daumas S , Gonzalez B , Leroux-Nicollet I , Cleren C .

*J Neuropathol Exp Neurol.* 2017 Oct 1;76(10):883-897. doi: 10.1093/jnen/nlx073.

Magnesium sulfate (MgSO<sub>4</sub>) administration to mothers at risk of preterm delivery is proposed as a neuroprotective strategy against neurological alterations such as cerebral palsy in newborns. However, long-term beneficial or adverse effects of MgSO<sub>4</sub> and sex-specific sensitivity remain to be investigated. We conducted behavioral and neurochemical studies of MgSO<sub>4</sub> effects in males and females, from the perinatal period to adolescence in a mouse model of cerebral neonatal lesion. The lesion was produced in 5-day-old (P5) pups by ibotenate intracortical injection. MgSO<sub>4</sub> (600 mg/kg, i.p.) prior to ibotenate prevented lesion-induced sensorimotor alterations in both sexes at P6 and P7. The lesion increased glutamate level at P10 in the prefrontal cortex, which was prevented by MgSO<sub>4</sub> in males. In neonatally lesioned adolescent mice, males exhibited more sequelae than females in motor and cognitive functions. In the perirhinal cortex of adolescent mice, the neonatal lesion induced an increase in vesicular glutamate transporter 1 density in males only, which was negatively correlated with cognitive scores. Long-term sequelae were prevented by neonatal MgSO<sub>4</sub> administration. MgSO<sub>4</sub> never induced short- or long-term deleterious effect on its own. These results also strongly suggest that sex-specific neuroprotection should be foreseen in preterm infants.

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DOI: 10.1093/jnen/nlx073

PMID: 28922852 [Indexed for MEDLINE]

### **The extent of intrauterine growth restriction determines the severity of cerebral injury and neurobehavioural deficits in rodents.**

Ruff CA , Faulkner SD , Rumajogee P , Beldick S , Foltz W , Corrigan J , Basilious A , Jiang S , Thiyaalingam S , Yager JY , Fehlings MG (6).

*PLoS One.* 2017 Sep 21;12(9):e0184653. doi: 10.1371/journal.pone.0184653. eCollection 2017.

**BACKGROUND:** Cerebral Palsy (CP) is the most common physical pediatric neurodevelopmental disorder and spastic diplegic injury is its most frequent subtype. CP results in substantial neuromotor and cognitive impairments that have significant socioeconomic impact. Despite this, its underlying pathophysiological mechanisms and etiology remain incompletely understood. Furthermore, there is a need for clinically relevant injury models, which a) reflect the heterogeneity of the condition and b) can be used to evaluate new translational therapies. To address these key knowledge gaps, we characterized a chronic placental insufficiency (PI) model, using bilateral uterine artery ligation (BUAL) of dams. This injury model results in intrauterine growth restriction (IUGR) in pups, and animals recapitulate the human phenotype both in terms of neurobehavioural and anatomical deficits.

**METHODS:** Effects of BUAL were studied using luxol fast blue (LFB)/hematoxylin & eosin (H&E) staining, immunohistochemistry, quantitative Magnetic Resonance Imaging (MRI), and Catwalk neurobehavioural tests.

**RESULTS:** Neuroanatomical analysis revealed regional ventricular enlargement and corpus callosum thinning in IUGR animals, which was correlated with the extent of growth restriction. Olig2 staining revealed reductions in

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oligodendrocyte density in white and grey matter structures, including the corpus callosum, optic chiasm, and nucleus accumbens. The caudate nucleus, along with other brain structures such as the optic chiasm, internal capsule, septofimbrial and lateral septal nuclei, exhibited reduced size in animals with IUGR. The size of the pretectal nucleus was reduced only in moderately injured animals. MAG/NF200 staining demonstrated reduced myelination and axonal counts in the corpus callosum of IUGR animals. NeuN staining revealed changes in neuronal density in the hippocampus and in the thickness of hippocampal CA2 and CA3 regions. Diffusion weighted imaging (DWI) revealed regional white and grey matter changes at 3 weeks of age. Furthermore, neurobehavioural testing demonstrated neuromotor impairments in animals with IUGR in paw intensities, swing speed, relative print positions, and phase dispersions.

**CONCLUSIONS:** We have characterized a rodent model of IUGR and have demonstrated that the neuroanatomical and neurobehavioural deficits mirror the severity of the IUGR injury. This model has the potential to be applied to examine the pathobiology of and potential therapeutic strategies for IUGR-related brain injury. Thus, this work has potential translational relevance for the study of CP.

DOI: 10.1371/journal.pone.0184653

PMID: 28934247

## **Données cliniques**

### **A Brain-Region-Specific Neural Pathway Regulating Germinal Matrix Angiogenesis.**

Ma S , Santhosh D , Kumar T P , Huang Z .

*Dev Cell.* 2017 May 22;41(4):366-381.e4. doi: 10.1016/j.devcel.2017.04.014.

Intimate communication between neural and vascular cells is critical for normal brain development and function. Germinal matrix (GM), a key primordium for the brain reward circuitry, is unique among brain regions for its distinct pace of angiogenesis and selective vulnerability to hemorrhage during development. A major neonatal condition, GM hemorrhage can lead to cerebral palsy, hydrocephalus, and mental retardation. Here we identify a brain-region-specific neural progenitor-based signaling pathway dedicated to regulating GM vessel development. This pathway consists of cell-surface sphingosine-1-phosphate receptors, an intracellular cascade including G $\alpha$  co-factor Ric8a and p38 MAPK, and target gene integrin  $\beta$ 8, which in turn regulates vascular TGF- $\beta$  signaling. These findings provide insights into region-specific specialization of neurovascular communication, with special implications for deciphering potent early-life endocrine, as well as potential gut microbiota impacts on brain reward circuitry. They also identify tissue-specific molecular targets for GM hemorrhage intervention.

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PMCID: PMC5492999 [Available on 2018-05-22]

PMID: 28535372 [Indexed for MEDLINE]

### **Antenatal and intrapartum interventions for preventing cerebral palsy: an overview of Cochrane systematic reviews.**

Shepherd E , Salam RA, Middleton P, Makrides M, McIntyre S, Badawi N, Crowther CA.

*Cochrane Database Syst Rev.* 2017 Aug 8;8:CD012077. doi: 10.1002/14651858.CD012077.pub2.

**BACKGROUND:** Cerebral palsy is an umbrella term encompassing disorders of movement and posture, attributed to non-progressive disturbances occurring in the developing fetal or infant brain. As there are diverse risk factors and causes, no one strategy will prevent all cerebral palsy. Therefore, there is a need to systematically consider all potentially relevant interventions for their contribution to prevention.

**OBJECTIVES:** To summarise the evidence from Cochrane reviews regarding the effects of antenatal and intrapartum interventions for preventing cerebral palsy.

**METHODS:** We searched the Cochrane Database of Systematic Reviews on 7 August 2016, for reviews of antenatal or intrapartum interventions reporting on cerebral palsy. Two authors assessed reviews for inclusion, extracted data, assessed review quality, using AMSTAR and ROBIS, and quality of the evidence, using the GRADE approach. We organised reviews by topic, and summarised findings in text and tables. We categorised interventions as effective (high-quality evidence of effectiveness); possibly effective (moderate-quality evidence of effectiveness);

ineffective (high-quality evidence of harm or of lack of effectiveness); probably ineffective (moderate-quality evidence of harm or of lack of effectiveness); and no conclusions possible (low- to very low-quality evidence).

**MAIN RESULTS:** We included 15 Cochrane reviews. A further 62 reviews pre-specified the outcome cerebral palsy in their methods, but none of the included randomised controlled trials (RCTs) reported this outcome. The included reviews were high quality and at low risk of bias. They included 279 RCTs; data for cerebral palsy were available from 27 (10%) RCTs, involving 32,490 children. They considered interventions for: treating mild to moderate hypertension (two) and pre-eclampsia (two); diagnosing and preventing fetal compromise in labour (one); preventing preterm birth (four); preterm fetal maturation or neuroprotection (five); and managing preterm fetal compromise (one). Quality of evidence ranged from very low to high. Effective interventions: high-quality evidence of effectiveness There was a reduction in cerebral palsy in children born to women at risk of preterm birth who received magnesium sulphate for neuroprotection of the fetus compared with placebo (risk ratio (RR) 0.68, 95% confidence interval (CI) 0.54 to 0.87; five RCTs; 6145 children). Probably ineffective interventions: moderate-quality evidence of harm There was an increase in cerebral palsy in children born to mothers in preterm labour with intact membranes who received any prophylactic antibiotics versus no antibiotics (RR 1.82, 95% CI 0.99 to 3.34; one RCT; 3173 children). There was an increase in cerebral palsy in children, who as preterm babies with suspected fetal compromise, were born immediately compared with those for whom birth was deferred (RR 5.88, 95% CI 1.33 to 26.02; one RCT; 507 children). Probably ineffective interventions: moderate-quality evidence of lack of effectiveness There was no clear difference in the presence of cerebral palsy in children born to women at risk of preterm birth who received repeat doses of corticosteroids compared with a single course (RR 1.03, 95% CI 0.71 to 1.50; four RCTs; 3800 children). No conclusions possible: low- to very low-quality evidence Low-quality evidence found there was a possible reduction in cerebral palsy for children born to women at risk of preterm birth who received antenatal corticosteroids for accelerating fetal lung maturation compared with placebo (RR 0.60, 95% CI 0.34 to 1.03; five RCTs; 904 children). There was no clear difference in the presence of cerebral palsy with interventionist care for severe pre-eclampsia versus expectant care (RR 6.01, 95% CI 0.75 to 48.14; one RCT; 262 children); magnesium sulphate for pre-eclampsia versus placebo (RR 0.34, 95% CI 0.09 to 1.26; one RCT; 2895 children); continuous cardiotocography for fetal assessment during labour versus intermittent auscultation (average RR 1.75, 95% CI 0.84 to 3.63; two RCTs; 13,252 children); prenatal progesterone for prevention of preterm birth versus placebo (RR 0.14, 95% CI 0.01 to 3.48; one RCT; 274 children); and betamimetics for inhibiting preterm labour versus placebo (RR 0.19, 95% CI 0.02 to 1.63; one RCT; 246 children). Very low-quality found no clear difference for the presence of cerebral palsy with any antihypertensive drug (oral beta-blockers) for treatment of mild to moderate hypertension versus placebo (RR 0.33, 95% CI 0.01 to 8.01; one RCT; 110 children); magnesium sulphate for prevention of preterm birth versus other tocolytic agents (RR 0.13, 95% CI 0.01 to 2.51; one RCT; 106 children); and vitamin K and phenobarbital prior to preterm birth for prevention of neonatal periventricular haemorrhage versus placebo (RR 0.77, 95% CI 0.33 to 1.76; one RCT; 299 children).

**AUTHORS' CONCLUSIONS:** This overview summarises evidence from Cochrane reviews on the effects of antenatal and intrapartum interventions on cerebral palsy, and can be used by researchers, funding bodies, policy makers, clinicians and consumers to aid decision-making and evidence translation. We recommend that readers consult the included Cochrane reviews to formally assess other benefits or harms of included interventions, including impacts on risk factors for cerebral palsy (such as the reduction in intraventricular haemorrhage for preterm babies following exposure to antenatal corticosteroids). Magnesium sulphate for women at risk of preterm birth for fetal neuroprotection can prevent cerebral palsy. Prophylactic antibiotics for women in preterm labour with intact membranes, and immediate rather than deferred birth of preterm babies with suspected fetal compromise, may increase the risk of cerebral palsy. Repeat doses compared with a single course of antenatal corticosteroids for women at risk of preterm birth do not clearly impact the risk of cerebral palsy. Cerebral palsy is rarely diagnosed at birth, has diverse risk factors and causes, and is diagnosed in approximately one in 500 children. To date, only a small proportion of Cochrane reviews assessing antenatal and intrapartum interventions have been able to report on this outcome. There is an urgent need for long-term follow-up of RCTs of interventions addressing risk factors for cerebral palsy, and consideration of the use of relatively new interim assessments (including the General Movements Assessment). Such RCTs must be rigorous in their design, and aim for consistency in cerebral palsy outcome measurement and reporting to facilitate pooling of data, to focus research efforts on prevention.

DOI: 10.1002/14651858.CD012077.pub2

PMID: 28786098 [Indexed for MEDLINE]

[Indexed for MEDLINE]

### **Biology of Microglia in the Developing Brain.**

Kaur C , Rathnasamy G , Ling EA .

*J Neuropathol Exp Neurol.* 2017 Sep 1;76(9):736-753. doi: 10.1093/jnen/nlx056.

Microglia exist in different morphological forms in the developing brain. They show a small cell body with scanty cytoplasm with many branching processes in the grey matter of the developing brain. However, in the white matter such as the corpus callosum where the unmyelinated axons are loosely organized, they appear in an amoeboid form having a round cell body endowed with copious cytoplasm rich in organelles. The amoeboid cells eventually transform into ramified microglia in the second postnatal week when the tissue becomes more compact with the onset of myelination. Microglia serve as immunocompetent macrophages that act as neuropathology sensors to detect and respond swiftly to subtle changes in the brain tissues in pathological conditions. Microglial functions are broadly considered as protective in the normal brain development as they phagocytose dead cells and sculpt neuronal connections by pruning excess axons and synapses. They also secrete a number of trophic factors such as insulin-like growth factor-1 and transforming growth factor- $\beta$  among many others that are involved in neuronal and oligodendrocyte survival. On the other hand, microglial cells when activated produce a plethora of molecules such as proinflammatory cytokines, chemokines, reactive oxygen species, and nitric oxide that are implicated in the pathogenesis of many pathological conditions such as epilepsy, cerebral palsy, autism, and perinatal hypoxic-ischemic brain injury. Although many studies have investigated the origin and functions of the microglia in the developing brain, in-depth in vivo studies along with analysis of their transcriptome and epigenetic changes need to be undertaken to elucidate their full potential be it protective or neurotoxic. This would lead to a better understanding of their roles in the healthy and diseased developing brain and advancement of therapeutic strategies to target microglia-mediated neurotoxicity.

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DOI: 10.1093/jnen/nlx056

PMID: 28859332 [Indexed for MEDLINE]

### **[Brain plasticity and early rehabilitative care for children after neonatal arterial cerebral infarction].** [Article in French]

Dinomais M , Marret S , Vuillerot C .

*Arch Pediatr.* 2017 Sep;24(9S):9S61-9S68. doi: 10.1016/S0929-693X(17)30333-0.

Currently, in the literature of the evidence based medicine, little data are available to confirm the benefit and the specific procedures of an early intervention for a neonatal arterial ischemic stroke. However, data about the effect of an early physical rehabilitation program on the cerebral plasticity, and preliminary results of clinical studies in children with cerebral palsy strongly suggest the benefit of an early rehabilitation with a multidisciplinary approach. The type of the rehabilitation and its frequency must be determined because a wide variability in the practices exists. A comprehensive care, of the children and his family is necessary to limit the orthopaedics but also the social consequences of a neonatal stroke.

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DOI: 10.1016/S0929-693X(17)30333-0

PMID: 28867040

### **Reactive astrocyte COX2-PGE2 production inhibits oligodendrocyte maturation in neonatal white matter injury.**

Shiow LR , Favrais G , Schirmer L (6), Schang AL , Cipriani S , Andres C , Wright JN , Nobuta H , Fleiss B , Gressens P , Rowitch DH (9).

*Glia.* 2017 Aug 30. doi: 10.1002/glia.23212. [Epub ahead of print]

Inflammation is a major risk factor for neonatal white matter injury (NWMI), which is associated with later development of cerebral palsy. Although recent studies have demonstrated maturation arrest of oligodendrocyte progenitor cells (OPCs) in NWMI, the identity of inflammatory mediators with direct effects on OPCs has been unclear. Here, we investigated downstream effects of pro-inflammatory IL-1 $\beta$  to induce cyclooxygenase-2 (COX2)



and prostaglandin E2 (PGE2) production in white matter. First, we assessed COX2 expression in human fetal brain and term neonatal brain affected by hypoxic-ischemic encephalopathy (HIE). In the developing human brain, COX2 was expressed in radial glia, microglia, and endothelial cells. In human term neonatal HIE cases with subcortical WMI, COX2 was strongly induced in reactive astrocytes with "A2" reactivity. Next, we show that OPCs express the EP1 receptor for PGE2, and PGE2 acts directly on OPCs to block maturation in vitro. Pharmacologic blockade with EP1-specific inhibitors (ONO-8711, SC-51089), or genetic deficiency of EP1 attenuated effects of PGE2. In an IL-1 $\beta$ -induced model of NWMI, astrocytes also exhibit "A2" reactivity and induce COX2. Furthermore, in vivo inhibition of COX2 with Nimesulide rescues hypomyelination and behavioral impairment. These findings suggest that neonatal white matter astrocytes can develop "A2" reactivity that contributes to OPC maturation arrest in NWMI through induction of COX2-PGE2 signaling, a pathway that can be targeted for neonatal neuroprotection.

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DOI: 10.1002/glia.23212

PMID: 28856805

### **[State of the use of magnesium sulfate for prevention of cerebral palsy in pre-term newborn in the Rouen's hospital].**

[Article in French]

Millochau JC , Marret S , Oden S , Verspyck E .

*Gynecol Obstet Fertil.* 2016 Jul-Aug;44(7-8):446-9. doi: 10.1016/j.gyobfe.2016.05.008. Epub 2016 Jul 15.

**OBJECTIVES:** Although the benefit of magnesium sulfate to prevent cerebral palsy in antenatal on very preterm infants has been shown, there is still reluctance to use it. The aim of this study was to conduct an assessment of our practice using magnesium sulfate to prevent cerebral palsy at Rouen University Hospital to report its feasibility and safety in order to spread its use.

**METHODS:** Unicentric and retrospective study, at the University Hospital of Rouen, between January and June 2014. All patients who delivered before 33 weeks or considered at risk of imminent delivery before 33 weeks were included (n=86).

**RESULTS:** Among the patients who delivered before 33 weeks (n=82), a magnesium sulfate loading dose was administrated in 91.5% of cases. Treatment was mainly established and monitored by midwives (98.6%), usually in the delivery room (82.4%), and with an average duration of administration of 8.9 $\pm$ 17.5hours. The treatment had to be stopped in a patient who presented bradypnea associated with impaired consciousness. **CONCLUSION:** Our study shows that magnesium sulfate can easily be prescribed in clinical practice.

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DOI: 10.1016/j.gyobfe.2016.05.008

PMID: 27426688 [Indexed for MEDLINE]

### **Surface-Based fMRI-Driven Diffusion Tractography in the Presence of Significant Brain Pathology: A Study Linking Structure and Function in Cerebral Palsy.**

Reid LB , Cunnington R , Boyd RN , Rose SE . Erratum in PLoS One. 2016;11 :e0162271.

*PLoS One.* 2016 Aug 3;11 :e0159540. doi: 10.1371/journal.pone.0159540. eCollection 2016.

Diffusion MRI (dMRI) tractography analyses are difficult to perform in the presence of brain pathology. Automated methods that rely on cortical parcellation for structural connectivity studies often fail, while manually defining regions is extremely time consuming and can introduce human error. Both methods also make assumptions about structure-function relationships that may not hold after cortical reorganisation. Seeding tractography with functional-MRI (fMRI) activation is an emerging method that reduces these confounds, but inherent smoothing of fMRI signal may result in the inclusion of irrelevant pathways. This paper describes a novel fMRI-seeded dMRI-analysis pipeline based on surface-meshes that reduces these issues and utilises machine-learning to generate task specific white matter pathways, minimising the requirement for manually-drawn ROIs. We directly compared this new strategy to a standard voxelwise fMRI-dMRI approach, by investigating correlations between clinical scores and dMRI metrics of thalamocortical and corticomotor tracts in 31 children with unilateral cerebral palsy. The surface-based approach successfully processed more participants (87%) than the voxel-based approach (65%), and provided significantly more-coherent tractography. Significant correlations between dMRI metrics and five clinical

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scores of function were found for the more superior regions of these tracts. These significant correlations were stronger and more frequently found with the surface-based method (15/20 investigated were significant;  $R^2 = 0.43-0.73$ ) than the voxelwise analysis (2 sig. correlations; 0.38 & 0.49). More restricted fMRI signal, better-constrained tractography, and the novel track-classification method all appeared to contribute toward these differences.

#### [Free PMC Article](#)

DOI: 10.1371/journal.pone.0159540

PMCID: PMC4972431

PMID: 27487011 [Indexed for MEDLINE]

#### **Therapeutic Hypothermia Following Perinatal Asphyxia [Internet].**

Swedish Council on Health Technology Assessment. Stockholm: Swedish Council on Health Technology Assessment (SBU); 2009 Feb. SBU

Alert Report No. 2009-01.

SBU Systematic Review Summaries.

**Background** During birth, asphyxia occurs when the child suffers a combination of oxygen deficiency and reduced blood supply. In serious cases of asphyxia, the infant can develop symptoms of brain damage shortly following birth, i.e., hypoxic ischemic encephalopathy (HIE). In moderate to severe asphyxia the lack of oxygen can cause serious damage to the brain and other organs, and some of the infants die. Children who survive are at higher risk for moderate or severe functional impairments, e.g., cerebral palsy (CP) or impaired vision and hearing. Therapeutic hypothermia is a new method for treating HIE following birth asphyxia and is used to complement standard treatment. In full-term newborns affected by moderate or severe symptoms of brain injury (HIE) due to severe birth asphyxia, therapeutic hypothermia reduces the risk of death or severe functional impairment in the child. However, the scientific evidence is insufficient to appraise the method's effect beyond 18 months. The scientific evidence is insufficient to draw firm conclusions on the adverse effects and complications related to therapeutic hypothermia. No serious adverse effects or complications have been identified in the studies reviewed for this report, but the studies were not specifically designed to investigate this. The scientific evidence is insufficient to draw firm conclusions on the cost-effectiveness of the method. However, the fact that the extra costs for this method are relatively moderate and the outcomes are good would suggest that the method is cost-effective. The optimum way (best practice) to deliver treatment is not clear. Hence, it is important to monitor the experiences and outcomes of treatment, e.g., via a central quality register. Also, continued research is essential to gain knowledge about best practices as well as the potential complications and adverse effects.

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PMID: 28876761

## **Détection – Diagnostic**

### **+Données cliniques**

#### **Development of the quality of reaching in infants with cerebral palsy: a kinematic study.**

Boxum AG , La Bastide-Van Gemert S , Dijkstra LJ , Hamer EG , Hielkema T , Reinders-Messelink HA , Hadders-Algra M  
*Dev Med Child Neurol.* 2017 Sep 6. doi: 10.1111/dmcn.13538. [Epub ahead of print]

**AIM:** To assess development of reaching and head stability in infants at very high risk (VHR-infants) of cerebral palsy (CP) who did and did not develop CP.

**METHOD:** This explorative longitudinal study assessed the kinematics of reaching and head sway in sitting in 37 VHR-infants (18 CP) one to four times between 4.7 months and 22.6 months corrected age. Developmental trajectories were calculated using linear mixed effect models. Motor function was evaluated with the Infant Motor Profile (IMP) around 13 months corrected age.

**RESULTS:** Throughout infancy, VHR-infants with CP had a worse reaching quality than infants without CP, reflected for example by more movement units (factor 1.52, 95% CI 1.16-1.99) and smaller transport movement units (factor 1.86, 95% CI 1.20-2.90). Total head sway of infants with and without CP was similar, but infants with CP used more

head movement units to achieve stability. The rate of developmental change in infants with and without CP was similar. Around 13 months, head control and reaching quality were interrelated; both were associated with IMP-scores.

INTERPRETATION: Infants with CP showed a worse kinematic reaching quality and head stability throughout infancy from early age onwards than VHR-infants without CP, implying that kinematically they do not grow into a deficit, but exhibit deficits from early infancy on.

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DOI: 10.1111/dmcm.13538

PMID: 28877349

## **Motricité - Mobilité – Posture -Spasticité**

### **A new approach in the clinical decision-making for cerebral palsy using three-dimensional subject-specific musculoskeletal reconstructions.**

Massaad A, Assi A, Bakouny Z, Skalli W, Ghanem I.

*J Med Liban.* 2016 Jul-Sep;64(3):152-9.

Cerebral palsy (CP) is a neurological disorder which can cause muscular spasticity. Children with this condition suffer from a combination of gait deviations, skeletal deformities and muscular abnormalities. Precise evaluation of each of these three components is crucial for management planning in children with CP. The aim of this study is to review the latest innovative methods used for three-dimensional (3D) gait analysis and musculoskeletal modeling in children with cerebral palsy. 3D gait analysis is a quantitative objective method based on the use of infrared cameras. It allows the evaluation of dynamic joint angles, forces and moments applied on joints and is usually coupled with dynamic electromyography. Skeletal evaluation is usually based on two-dimensional X-rays and physical examination in clinical practice. However, a novel method based on stereoradiographic 3D reconstruction of biplanar low dose X-rays allows a more thorough evaluation of skeletal deformities, and in particular torsional anomalies. Muscular evaluation of children with CP is most commonly based on magnetic resonance imaging, whereby delimitation of lower limb muscles on axial slices allows 3D reconstruction of these muscles. Novel innovative techniques allow similar reconstructions by extrapolation, thus limiting the necessary quantity of axial slices that need to be manually delimited.

PMID: 28850203 [Indexed for MEDLINE]

### **Bimanual Capacity of Children With Cerebral Palsy: Intra- and Interrater Reliability of a Revised Edition of the Bimanual Fine Motor Function Classification.**

Elvrum AG, Beckung E, Sæther R, Lydersen S, Vik T, Himmelmann K(6).

*Phys Occup Ther Pediatr.* 2017 Aug;37(3):239-251. doi: 10.1080/01942638.2016.1185507. Epub 2016 Aug 26.

AIMS: To develop a revised edition of the Bimanual Fine Motor Function (BFMF 2), as a classification of fine motor capacity in children with cerebral palsy (CP), and establish intra- and interrater reliability of this edition.

METHODS: The content of the original BFMF was discussed by an expert panel, resulting in a revised edition comprising the original description of the classification levels, but in addition including figures with specific explanatory text. Four professionals classified fine motor function of 79 children (3-17 years; 45 boys) who represented all subtypes of CP and Manual Ability Classification levels (I-V). Intra- and inter-rater reliability was assessed using overall intra-class correlation coefficient (ICC), and Cohen's quadratic weighted kappa.

RESULTS: The overall ICC was 0.86. Cohen's weighted kappa indicated high intra-rater ( $\kappa_w$ : >0.90) and inter-rater ( $\kappa_w$ : >0.85) reliability. CONCLUSIONS: The revised BFMF 2 had high intra- and interrater reliability. The classification levels could be determined from short video recordings (<5 minutes), using the figures and precise descriptions of the fine motor function levels included in the BFMF 2. Thus, the BFMF 2 may be a feasible and useful classification of fine motor capacity both in research and in clinical practice.

DOI: 10.1080/01942638.2016.1185507

PMID: 27563732 [Indexed for MEDLINE]

### **Contractile behavior of the medial gastrocnemius in children with bilateral spastic cerebral palsy during forward, uphill and backward-downhill gait.**

Hösl M , Böhm H , Arampatzis A , Keymer A , Döderlein L .

*Clin Biomech (Bristol, Avon)*. 2016 Jul;36:32-9. doi: 10.1016/j.clinbiomech.2016.05.008. Epub 2016 May 10.

**BACKGROUND:** Plantarflexor tightness due to muscle degenerations has been frequently documented in children with spastic cerebral palsy but the contractile behavior of muscles during ambulation is largely unclear. Especially the adaptability of gastrocnemius muscle contraction on sloped surface could be relevant during therapy.

**METHODS:** Medial gastrocnemius contractions were measured during flat-forward, uphill (+12% incline) and backward-downhill (-12% decline) treadmill gait in 15 children with bilateral cerebral palsy, walking in crouch, and 17 typically developing controls (age: 7-16years) by means of ultrasound and motion analysis. Tracked fascicle and calculated series elastic element length during gait were normalized on seated rest length. Additionally electromyography of the medial gastrocnemius, soleus and tibialis anterior was collected. **FINDINGS:** During forward gait spastic gastrocnemii reached 10% shorter relative fascicle length, 5% shorter series elastic element length and showed 37% less concentric fascicle excursion than controls. No difference in eccentric fascicle excursion existed. Uphill gait increased concentric fascicle excursion in children with cerebral palsy and controls (by 23% and 41%) and tibialis anterior activity during swing (by 33% and 48%). Backward downhill gait more than doubled (+112%) eccentric fascicle excursion in cerebral palsy patients.

**INTERPRETATION:** Apart from having innately shorter fascicles at rest, flat-forward walking showed that spastic gastrocnemius fascicles work at shorter relative length than those of controls. Uphill gait may be useful to concentrically train push-off skills and foot lift. During backward-downhill gait the gastrocnemius functions as a brake and displays more eccentric excursion which could potentially stimulate sarcomere-genesis in series with repeated training.

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DOI: 10.1016/j.clinbiomech.2016.05.008

PMID: 27208665 [Indexed for MEDLINE]

### **Development and psychometric properties of the Hand-Use-at-Home questionnaire to assess amount of affected hand-use in children with unilateral paresis.**

Geerdink Y , Aarts P , van der Holst M , Lindeboom R , Van Der Burg J , Steenbergen B , Geurts AC(6) .

*Dev Med Child Neurol*. 2017 Sep;59(9):919-925. doi: 10.1111/dmcn.13449. Epub 2017 May 29.

**AIM:** To describe the development of the parent-rated Hand-Use-at-Home questionnaire (HUH) assessing the amount of spontaneous use of the affected hand in children with unilateral paresis, and to test its internal structure, unidimensionality, and validity.

**METHOD:** Parents of children with unilateral cerebral palsy (CP) and professionals participated in the development of the HUH. To examine internal validity, data of 322 children (158 males, 164 females; mean age 6y 7mo, standard deviation [SD] 2y 1mo) with unilateral CP (n=131) or neonatal brachial plexus palsy (NBPP) (n=191) were collected. Rasch analysis was used to examine discriminative capacity of the 5-category rating scale as well as unidimensionality and hierarchy of the item set. Additionally, data of 55 children with typical development (24 males, 31 females; 6y 9mo, SD 2y 5mo) were used to examine construct validity. **RESULTS:** The 5-category rating scale was disordered in all items and was collapsed to obtain the best discriminating sum score. Ten misfitting or redundant items were removed. Eighteen hierarchically ordered bimanual items fitted the unidimensional model within acceptable range. The HUH significantly discriminated between the three groups (children with typical development, NBPP, unilateral CP;  $H = 118.985$ ,  $p < 0.001$ ), supporting its construct validity.

**INTERPRETATION:** The HUH is a valid instrument to assess the amount of spontaneous use of the affected hand in children with unilateral upper-limb paresis.

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PMID: 28555780 [Indexed for MEDLINE]

### **Does expert knowledge improve automatic probabilistic classification of gait joint motion patterns in children with cerebral palsy?**

De Laet T , Papageorgiou E , Nieuwenhuys A , Desloovere K .

Science Infos Paralysie Cérébrale, Septembre 2017, **FONDATION PARALYSIE CEREBRALE** 67 rue Vergniaud 75013 Paris - tel +33 1 45 54 03 03 contact: Christine Doumergue  
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**BACKGROUND:** This study aimed to improve the automatic probabilistic classification of joint motion gait patterns in children with cerebral palsy by using the expert knowledge available via a recently developed Delphi-consensus study. To this end, this study applied both Naïve Bayes and Logistic Regression classification with varying degrees of usage of the expert knowledge (expert-defined and discretized features). A database of 356 patients and 1719 gait trials was used to validate the classification performance of eleven joint motions.

**HYPOTHESES:** Two main hypotheses stated that: (1) Joint motion patterns in children with CP, obtained through a Delphi-consensus study, can be automatically classified following a probabilistic approach, with an accuracy similar to clinical expert classification, and The inclusion of clinical expert knowledge in the selection of relevant gait features and the discretization of continuous features increases the performance of automatic probabilistic joint motion classification.

**FINDINGS:** This study provided objective evidence supporting the first hypothesis. Automatic probabilistic gait classification using the expert knowledge available from the Delphi-consensus study resulted in accuracy (91%) similar to that obtained with two expert raters (90%), and higher accuracy than that obtained with non-expert raters (78%). Regarding the second hypothesis, this study demonstrated that the use of more advanced machine learning techniques such as automatic feature selection and discretization instead of expert-defined and discretized features can result in slightly higher joint motion classification performance. However, the increase in performance is limited and does not outweigh the additional computational cost and the higher risk of loss of clinical interpretability, which threatens the clinical acceptance and applicability.

[Free PMC Article](#)

DOI: 10.1371/journal.pone.0178378

PMCID: PMC5453476

PMID: 28570616 [Indexed for MEDLINE]

**Effect of diagnosis, body site and experience on text entry rate of individuals with physical disabilities: a systematic review.**

Koester HH , Arthanat S .

*Disabil Rehabil Assist Technol. 2017 Aug 28;1-11. doi: 10.1080/17483107.2017.1369588. [Epub ahead of print]*

**OBJECTIVE:** This study systematically reviewed the research on computer text entry by people with physical disabilities, and conducted a quantitative synthesis of text entry rates associated with individuals' diagnosis, body site used with the interface and their level of experience.

**METHOD:** We searched 10 databases and included studies in which: typing speed was reported; the access interface was available for public use; and individuals with physical impairments were in the study population. For quantitative synthesis, we used only the text entry rates (TER) reported for individuals with physical impairments; studies also had to report the sample size, and the average and standard deviation for the text entry rates.

**RESULTS:** Thirty-nine studies involving 248 subjects met the criteria for quantitative synthesis. Cerebral palsy was associated with significantly slower TER, at 5.5 wpm, than muscular dystrophy (12.5 wpm), spina bifida (10.4 wpm), SCI high cervical (10.1 wpm) and SCI low cervical (13.3 wpm). Among the 19 body sites represented, the Fingers bilateral category had the highest average, at 17.72 wpm. Head (2.92 wpm) and Hand (non-typing) (3.95 wpm) were each associated with significantly slower TER than Hands unspecified, Fingers bilateral, Hand with control enhancer, Voice and Mouth. The three levels of experience examined, LowPlus, Medium and High, provided very similar TER.

**CONCLUSION:** This study contributes external evidence for service providers who provide computer access interventions for individuals with disabilities. The analyzed text entry performances serve as benchmarks to be used as guidelines during interface selection and training. Implications for Rehabilitation The median text entry rate (TER) across the literature for individuals with physical disabilities is 7.0 wpm. TER is affected by a user's diagnosis and the body site used for typing. These TER data can serve as diagnostic norms and benchmarks to be used as guidelines during interface selection and training. We recommend that practitioners measure text entry rate with clients, to place their performance in the context of these results and provide a baseline against which to measure effectiveness of an intervention.

DOI: 10.1080/17483107.2017.1369588

PMID: 28845735

### **Effects of inter-synergistic mechanical interactions on the mechanical behaviour of activated spastic semitendinosus muscle of patients with cerebral palsy.**

Kaya CS, Temelli Y, Ates F, Yucesoy CA.

*J Mech Behav Biomed Mater.* 2017 Sep 3;77:78-84. doi: 10.1016/j.jmbbm.2017.08.040. [Epub ahead of print]

Previous physiological experiments and finite element modelling indicate that inter-synergistic epimuscular myofascial force transmission (EMFT) between co-activated muscles has a potential to affect healthy muscle's contribution to joint moment and joint range of movement. This is quite relevant for patients with cerebral palsy (CP) since, amplitude of spastic muscle's force and the joint range of force exertion are central to the joint movement limitation. Stiffness of activated spastic muscle is also a determinant for pathological joint movement. However, assessments of effects of inter-synergistic EMFT on the mechanical behaviour of spastic muscle are lacking. Those assessments require measurement during surgery of activated spastic muscle's forces directly at its tendon and as a function of joint angle. Employing this methodology, the aim was to test the following study hypotheses: added activation of semimembranosus (SM) and gracilis (GRA) muscles of patients with CP changes (1) force, (2) stiffness and (3) joint range of force exertion of activated spastic semitendinosus (ST) due to inter-synergistic EMFT. Isometric spastic ST forces were measured intraoperatively (12 limbs of 7 patients (mean age 8 years 9 months) for knee angles from flexion (120°) to full extension (0°). Conditions I and II: spastic ST was activated alone, and simultaneously with its synergists SM and GRA muscles, respectively. Condition II did increase activated spastic ST's forces significantly (by 33.3%), but did not change its stiffness and joint range of force exertion, confirming only study hypothesis 1. Therefore, we conclude that inter-synergistic EMFT affects forces exerted at spastic ST tendon, but not other characteristics of its angle-force relationship.

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DOI: 10.1016/j.jmbbm.2017.08.040

PMID: 28892760

### **Estimation of gait parameter using sonoelastography in children with cerebral palsy.**

Mansouri M, Birgani PM, Kharazi MR, Lotfian M, Naeimipoor M, Mirbagheri MM.

*Conf Proc IEEE Eng Med Biol Soc.* 2016 Aug;2016:1729-1732. doi: 10.1109/EMBC.2016.7591050.

We aimed to study the relationship between neuromuscular abnormalities associated with spasticity and gait impairments in spastic children with hemiplegia cerebral palsy (CP). Neuromuscular abnormalities of the tibialis anterior and medial gastrocnemius muscles of the spastic ankle were quantified using sonoelastography with two major features; i.e. entropy and histogram ratio of sonoelastography images. Gait impairments were evaluated in the gait laboratory using motion capture system, and the spatial and temporal features were extracted. The correlation analysis showed a significant relation between both the entropy and histogram ratio of sonoelastography images with walking speed and step time. The findings demonstrate that the neuromuscular abnormalities associated with spasticity may contribute to gait impairments in children with CP.

DOI: 10.1109/EMBC.2016.7591050

PMID: 28268660 [Indexed for MEDLINE]

### **Evaluation of the Reliability of the Challenge when used to Measure Advanced Motor Skills of Children with Cerebral Palsy.**

Wright FV, Lam CY, Mistry B, Walker J.

*Phys Occup Ther Pediatr.* 2017 Sep 18:1-13. doi: 10.1080/01942638.2017.1368765. [Epub ahead of print]

AIMS: The Challenge was designed as an extension to the GMFM-66 to assess advanced motor skills of children with cerebral palsy (CP) who walk/run independently. This study evaluated the Challenge's inter-rater and test-retest reliability.

METHODS: Thirty children with CP (GMFCS level I [n = 24] and II [n = 6]) completed the Challenge, with re-testing one to two weeks later. Seven physiotherapist assessors passed the Challenge criterion test pre-administration. A single assessor administered and scored test and retest sessions (test-retest reliability). A second assessor independently scored one of these sessions (inter-rater reliability).

RESULTS: Inter-rater reliability was excellent (ICC = 0.97, 95%CI 0.94-0.99, CoV < 10%), with no bias (Bland-Altman plot). Test-retest ICC was excellent (ICC = 0.94, 95% CI 0.88-0.97. CoV < 10%, and Minimum Detectable Change (MDC90) was 4.47 points. Many participants indicated practising at home pre-retest session. CONCLUSIONS: There was strong rating consistency between assessors. While test-retest ICC estimates were also high, Challenge scores were higher at retest. The MDC90 was still in a range (>4.5 points) that seems clinically viable for change detection. Test-retest reliability could be reassessed with children instructed not to practice between assessments to determine the extent to which between-session practice influenced scores.

DOI: 10.1080/01942638.2017.1368765

PMID: 28922044

### **Experience with jumping mechanography in children with cerebral palsy.**

Duran I , Martakis K, Stark C, Alberg E, Bossier C, Semler O, Schoenau E.

*J Musculoskelet Neuronal Interact.* 2017 Sep 1;17(3):237-245.

OBJECTIVES: Jumping mechanography provides robust motor function indicators among healthy children. The aim of the study was to assess the reproducibility and validity of jumping mechanography conducted as single two-legged jump (S2LJ) in children with cerebral palsy (CP).

METHODS: 215 S2LJ investigations from a sample of 75 children with CP were eligible for evaluation. For the estimation of the reproducibility, only the baseline set of data per patient were used. Gross motor function was evaluated by the Gross Motor Function Measure (GMFM-66). In 135 S2LJ investigations, GMFM-66 was assessed within a week in the same child. This data was used for validity assessment.

RESULTS: Coefficients of variation for the main outcome parameters ranged between 6.15-9.71%, except for jump height (CV%=27.3%). The intraclass correlation coefficients for peak velocity (Vmax) and peak power relative to body weight (Pmax/mass) was 0.927 and 0.931. Vmax and Pmax/mass were also the test parameters with the strongest correlation to the GMFM-66 score (>0.7).

CONCLUSIONS: S2LJ assessed in the present study provided reproducible outcome measures particularly for Vmax and Pmax/mass in children with CP. Further, Vmax and Pmax/mass showed the strongest correlation with the GMFM-66 score and seem to be the most relevant evaluation criteria.

### **[Free PMC Article](#)**

PMCID: PMC5601269

PMID: 28860426

### **Gastrocnemius muscle-tendon interaction during walking in typically-developing adults and children, and in children with spastic cerebral palsy.**

Kalsi G , Fry NR , Shortland AP .

*J Biomech.* 2016 Oct 3;49(14):3194-3199. doi: 10.1016/j.jbiomech.2016.07.038. Epub 2016 Aug 8.

BACKGROUND: Our understanding of the interaction of muscle bellies and their tendons in individuals with muscle pathology is limited. Knowledge of these interactions may inform us of the effects of musculoskeletal pathologies on muscle-tendon dynamics and the subsequent neurological control strategies used in gait. Here, we investigate gastrocnemius muscle-tendon interaction in typically-developing (TD) adults and children, and in children with spastic cerebral palsy (SCP).

METHODS: We recruited six TD adults (4 female; mean age: 34 yrs. (24-54)), eight TD children (5 female; mean age: 10 yrs. (6-12)) and eight independently ambulant children with SCP (5 female; mean age 9 yrs. (6-12); 3 unilaterally-affected). A combination of 3D motion capture and 2D real-time ultrasound imaging were used to compute the gastrocnemius musculo-tendinous unit (MTU) length and estimate muscle belly and tendon lengths during walking. For the TD subjects, the measurements were made for heel-toe walking and voluntary toe-walking.

RESULTS: The gastrocnemius muscle bellies of children with SCP lengthened during single support (p = 0.003). In contrast, the muscle bellies of TD subjects did not demonstrate an increase in length over the period of single support under heel-toe or toe-walking conditions.

CONCLUSION: We observed lengthening of the gastrocnemius muscle bellies in children with SCP during single support, a phase of the gait cycle in which the muscle is reported consistently to be active. Repeated lengthening of

muscle bellies while they are active may lead to muscle damage and have implications for the natural history of gait in this group.

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DOI: 10.1016/j.jbiomech.2016.07.038

PMID: 27545082 [Indexed for MEDLINE]

### **Guided Growth of the Proximal Femur for the Management of Hip Dysplasia in Children With Cerebral Palsy.**

Portinaro N , Turati M, Cometto M, Bigoni M, Davids JR, Panou A.

*J Pediatr Orthop.* 2017 Sep 8. doi: 10.1097/BPO.0000000000001069. [Epub ahead of print]

**BACKGROUND:** Progressive hip displacement is one of the most common and debilitating deformities seen in children with cerebral palsy (CP). The aim of this study was to evaluate the results of temporary medial hemiepiphyodesis of the proximal femur (TMH-PF) using a transphyseal screw to control hip migration during growth in children with CP.

**METHODS:** This was a retrospective study of children with CP and hip dysplasia, age 4 to 11 years and GMFCS levels III-V. There were 28 patients with 56 hips that underwent TMH-PF surgery between 2007 and 2010. Clinical and radiologic evaluation was performed preoperatively, at 6, 12, and 60 months following the index surgery. Acetabular index (AI), neck-shaft angle (NSA) and migration percentage (MP) were measured. All complications were recorded.

**RESULTS:** All radiographic measurements were significantly improved at the final follow-up. Positive correlations were found between NSA, MP, and AI. Multiple regression analysis revealed that MP, time from surgery, and age were influenced by the decrease of the NSA. The femoral physis grew off the screw in 9 hips within 36 months. The screw head broke during attempted screw exchange in 1 hip. The remain cases (4 hips) were treated by placing a second screw parallel to the existing one. Finally, progressive subluxation occurred in 3 hips when the physis grew off the screw and were treated by skeletal reconstruction.

**CONCLUSIONS:** TMH-PF was effective in controlling progressive subluxation of the hip in the majority of cases, obviating the need for major reconstructive surgery in these children with CP.

**LEVEL OF EVIDENCE:** Level IV.

DOI: 10.1097/BPO.0000000000001069

PMID: 28902001

### **Hip Surveillance for Children With Cerebral Palsy: A Survey of the POSNA Membership.**

Shore BJ , Shrader MW, Narayanan U, Miller F, Graham HK, Mulpuri K.

*J Pediatr Orthop.* 2017 Oct/Nov;37(7):e409-e414. doi: 10.1097/BPO.0000000000001050.

**BACKGROUND:** Currently, hip surveillance programs for children with cerebral palsy exist in Europe, Australasia, and parts of Canada, but a neuromuscular hip surveillance program has yet to be adopted in the United States. The purpose of this study was to report the current orthopaedic practice of hip surveillance in children with cerebral palsy, identify areas of practice variation, and suggest steps moving forward to generate guidelines for national neuromuscular hip surveillance.

**METHODS:** The entire membership of the Pediatric Orthopaedic Society of North America (POSNA) was surveyed in 2016 for information regarding their practice for hip surveillance in children with cerebral palsy. Detailed information regarding timing, frequency, and practice of hip surveillance was obtained in answers to 26 different questions.

**RESULTS:** A survey response rate of 27% was obtained (350/1300 members) during the study period. The majority of respondents treated pediatric patients exclusively (97%), worked in an academic practice (70%), and was affiliated with a university (76%). In total, 18% (69/350) of respondents followed a regular cerebral palsy hip surveillance program, about half of whom (44%, 30/69) had adopted the Australian guidelines. Respondents agreed that a dislocated hip in a child with cerebral palsy was painful (90% agreement) and should be prevented by hip surveillance (93% agreement). Furthermore, 93% of respondents indicated they would follow a national surveillance program if one was in place. Age (79%), Gross Motor Function Classification System (81%), and migration percentage (MP) (78%) were all identified as critical elements to a hip surveillance program. The majority of respondents felt that a hip "at risk" for hip displacement had a MP between 20% and 30% (57% of respondents), whereas surgery should be utilized once the MP exceeded 40% (50% of respondents). **CONCLUSIONS:** Results from this survey

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demonstrate 90% of respondents agree that a dislocated hip could be painful and 93% would follow a national surveillance program if available. At a societal level, we have the ability to standardize cerebral palsy hip surveillance, thereby decreasing practice variation and improving quality of care delivery.

LEVELS OF EVIDENCE: Level V.

DOI: 10.1097/BPO.0000000000001050

PMID: 28877095

### **Impairments, activity limitations, and participation restrictions of the international classification of functioning, disability, and health model in children with ambulatory cerebral palsy.**

Mutlu A , Būğūşan S, Kara ÖK.

*Saudi Med J. 2017 Feb;38(2):176-185. doi: 10.15537/smj.2017.2.16079.*

**OBJECTIVES:** To examine the impairments, activity limitations, and participation restrictions in children with spastic unilateral and bilateral cerebral palsy (CP). We investigated the relationship between these factors according to the international classification of functioning, disability, and health (ICF) model. **Methods:** This prospective cross sectional study included 60 children aged between 4-18 years with spastic CP (30 unilateral, 30 bilateral involvement) classified as Levels I and II on the gross motor function classification system. Children had been referred to the Pediatric Rehabilitation Unit in the Department of Physiotherapy and Rehabilitation, Hacettepe University, Ankara, Turkey between March 2014 and March 2015. The Physician Rating scale was used to assess body functions and structures. The Gillette Functional Assessment Questionnaire 22-item skill set, Pediatric Functional Independence Measure, and Pediatric Outcomes Data Collection Instrument were used to assess activity and participation levels. **Results:** There was a significant positive correlation between impairments and activity limitations ( $r=0.558$ ;  $p=0.000$ ), as well as between activity limitations and participation restrictions ( $r=0.354$ ,  $p=0.005$ ). **Conclusion:** These results show that activity limitations in children with unilateral and bilateral ambulatory CP may be related to their impairments and participation restrictions, although the sample size of our study is not large enough for generalizations. Overall, our study highlights the need for up-to-date, practical evaluation methods according to the ICF model.

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PMCID: PMC5329630

PMID: 28133691 [Indexed for MEDLINE]

### **Infant Discovery Learning and Lower Extremity Coordination: Influence of Prematurity.**

Sargent B , Kubo M , Fetters L .

*Phys Occup Ther Pediatr. 2017 Sep 8:1-16. doi: 10.1080/01942638.2017.1357065. [Epub ahead of print]*

**AIMS:** Preterm infants at increased risk for neurodevelopmental disabilities, including cerebral palsy, demonstrate reduced selective leg joint coordination. Full-term infants demonstrate more selective hip-knee coordination when specific leg actions are reinforced using an overhead infant mobile. The purpose of this pilot study was to determine the ability of preterm infants to: (1) perform and learn through discovery, the contingency between leg action and mobile activation, and (2) demonstrate more selective hip-knee coordination when leg actions are reinforced with mobile activation.

**METHODS:** At both 3 and 4-months corrected age, ten infants born very preterm and with very low birth weight participated in 2 sessions of mobile reinforcement on consecutive days.

**RESULTS:** The preterm group at 4-months, but not 3-months, learned the contingency between leg action and mobile activation. Preterm infants at 4-months were separated into those that learned ( $n = 6$ ) and did not learn ( $n = 4$ ) the contingency. As a group, preterm infants at 4-months who learned the contingency, did not demonstrate more selective hip-knee coordination when interacting with the mobile on Day 2 as compared to spontaneous kicking on Day 1.

**CONCLUSIONS:** Preterm infants, as compared to full-term infants, may have difficulty producing more selective hip-knee coordination during task-specific leg action.

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PMID: 28885092

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### **Influence of patellar position on the knee extensor mechanism in normal and crouched walking.**

Lenhart RL , Brandon SC , Smith CR , Novacheck TF , Schwartz MH , Thelen DG .

*J Biomech.* 2017 Jan 25;51:1-7. doi: 10.1016/j.jbiomech.2016.11.052. Epub 2016 Nov 22.

Patella alta is common in cerebral palsy, especially in patients with crouch gait. Correction of patella alta has been advocated in the treatment of crouch, however the appropriate degree of correction and the implications for knee extensor function remain unclear. Therefore, the goal of this study was to assess the impact of patellar position on quadriceps and patellar tendon forces during normal and crouch gait. To this end, a lower extremity musculoskeletal model with a novel 12 degree of freedom knee joint was used to simulate normal gait in a healthy child, as well as mild (23 deg min knee flexion in stance), moderate (41 deg), and severe (67 deg) crouch gait in three children with cerebral palsy. The simulations revealed that quadriceps and patellar tendon forces increase dramatically with crouch, and are modulated by patellar position. For example with a normal patellar tendon position, peak patellar tendon forces were 0.7 times body weight in normal walking, but reached 2.2, 3.2 and 5.4 times body weight in mild, moderate and severe crouch. Moderate patella alta acted to reduce quadriceps and patellar tendon loads in crouch gait, due to an enhancement of the patellar tendon moment arms with alta in a flexed knee. In contrast, patella baja reduced the patellar tendon moment arm in a flexed knee and thus induced an increase in the patellar tendon loads needed to walk in crouch. Functionally, these results suggest that patella baja could also compromise knee extensor function for other flexed knee activities such as chair rise and stair climbing. The findings are important to consider when using surgical approaches for correcting patella alta in children who exhibit crouch gait patterns. Copyright © 2016 Elsevier Ltd. All rights reserved.

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PMCID: PMC5204307 [Available on 2018-01-25]

PMID: 27939752 [Indexed for MEDLINE]

### **Influence of trunk control and lower extremity impairments on gait capacity in children with cerebral palsy.**

Balzer J , Marsico P , Mitteregger E , van der Linden ML , Mercer TH , van Hedel HJA .

*Disabil Rehabil.* 2017 Sep 24;1-7. doi: 10.1080/09638288.2017.1380719. [Epub ahead of print]

**PURPOSE:** We investigated the combined impact of trunk control and lower extremities impairments on predicting gait capacity in children with cerebral palsy (CP) and evaluated relationships between trunk control and lower extremities impairments.

**METHODS:** Data of 52 children with CP [29 boys, mean age 11 years 9 months ( $\pm 4$  years 6 months)] were included in this observational study. Gait capacity was measured by the "modified Time Up and Go test". Experienced therapists performed the "Modified Ashworth Scale", "Manual Muscle Test", the "Selective Control Assessment of the Lower Extremity", and the "Trunk Control Measurement Scale". We calculated Spearman correlations coefficients ( $\rho$ ) and performed regression analyses.

**RESULTS:** Trunk control was the strongest predictor ( $\beta = -0.624$ ,  $p < 0.001$ ) when explaining the variance of gait capacity and remained in the model together with spasticity ( $R(2) = 0.67$ ). Muscle strength and selectivity correlated moderately to strongly with the trunk control and gait capacity ( $-0.68 \leq \rho \leq -0.78$ ), but correlations for the spasticity were low ( $p < -0.3$ ).

**CONCLUSIONS:** The interconnection between trunk control, leg muscle strength and selectivity for gait capacity in children with CP was shown. It indicates the significance of these impairments in gait assessment and, potentially, rehabilitation. Implications for Rehabilitation Trunk control was the strongest predictor for gait capacity in a regression model with lower extremity spasticity, muscle strength and selectivity and age as independent variables. Lower extremity muscle strength, selectivity, and trunk control explained a similar amount of gait capacity variance which is higher than that explained by lower extremity spasticity. Lower extremity muscle strength and selectivity correlated strongly with trunk control. Therefore, we cautiously suggest that a combined trunk control and lower extremity training might be promising for improving gait capacity in children with CP (Gross Motor Function Classification

System level I-III), which needed to be tested in future intervention-studies.

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PMID: 28944697

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### **Inter- and intra-rater reliability of the head-shaft angle in children with cerebral palsy.**

Hermanson M , Hägglund G , Riad J , Rodby-Bousquet E .

*J Child Orthop.* 2017 Aug 1;11(4):256-262. doi: 10.1302/1863-2548.11.170008.

**PURPOSE:** Children with cerebral palsy (CP) are at increased risk for hip dislocation. This can be prevented in most cases using surveillance programmes that include radiographic examinations. Known risk factors for hip dislocation include young age, high Gross Motor Function Classification System (GMFCS) level and high migration percentage (MP). The head-shaft angle (HSA) has recently been described as an additional risk factor. The study aim was to determine inter- and intra-rater reliability of the HSA in a surveillance programme for children with CP.

**METHODS:** We included hip radiographs from the CP surveillance programme CPUP in southern Sweden during the first half of 2016. Fifty radiographs were included from children at GMFCS levels II-V, with a mean age of 6.6 (SD 3.2) years. Three raters measured the HSA of one hip (left or right) at baseline and four weeks later; intraclass correlation coefficient (ICC) was used to estimate inter- and intra-rater reliability.

**RESULTS:** Inter- and intra-rater reliability were excellent for the HSA, with ICC 0.92 (95% CI 0.87-0.96) and ICC 0.99 (95% CI 0.98-0.99), respectively.

**CONCLUSION:** The HSA showed excellent inter- and intra-rater reliability for children with CP, providing further evidence for use of the HSA as an additional factor for identifying risk for further hip displacement or dislocation.

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DOI: 10.1302/1863-2548.11.170008

PMCID: PMC5584493

PMID: 28904630

### **Kinematic and EMG Responses to Pelvis and Leg Assistance Force during Treadmill Walking in Children with Cerebral Palsy.**

Wu M , Kim J , Arora P , Gaebler-Spira DJ , Zhang Y .

*Neural Plast.* 2016;2016:5020348. doi: 10.1155/2016/5020348. Epub 2016 Aug 29.

Treadmill training has been used for improving locomotor function in children with cerebral palsy (CP), but the functional gains are relatively small, suggesting a need to improve current paradigms. The understanding of the kinematic and EMG responses to forces applied to the body of subjects during treadmill walking is crucial for improving current paradigms. The objective of this study was to determine the kinematics and EMG responses to the pelvis and/or leg assistance force. Ten children with spastic CP were recruited to participate in this study. A controlled assistance force was applied to the pelvis and/or legs during stance and swing phase of gait through a custom designed robotic system during walking. Muscle activities and spatial-temporal gait parameters were measured at different loading conditions during walking. In addition, the spatial-temporal gait parameters during overground walking before and after treadmill training were also collected. Applying pelvis assistance improved step height and applying leg assistance improved step length during walking, but applying leg assistance also reduced muscle activation of ankle flexor during the swing phase of gait. In addition, step length and self-selected walking speed significantly improved after one session of treadmill training with combined pelvis and leg assistance.

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DOI: 10.1155/2016/5020348

PMCID: PMC5019900

PMID: 27651955 [Indexed for MEDLINE]

### **Predictive Factors for Inpatient Falls among Children with Cerebral Palsy.**

Alemdaroğlu E , Özbudak SD , Mandiroğlu S , Biçer SA , Özgirgin N , Uçan H .

*J Pediatr Nurs.* 2017 Jan - Feb;32:25-31. doi: 10.1016/j.pedn.2016.08.005. Epub 2016 Sep 12.

**OBJECTIVE:** Inpatient falls are of significant concern. The aim of this prospective study was to determine the predictors of inpatient falls among children with cerebral palsy in a rehabilitation hospital.

**DESIGN AND METHODS:** A total of 93 patients with cerebral palsy were assessed based on history, physical findings, the Selective Motor Control Test, the Gross Motor Functional Classification System, the Berg Balance Scale and the

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Manual Ability Classification System. Previous history of falls/frequent falls, and any falls which occurred during hospitalization, were recorded.

RESULTS: Of all 93 patients, 25 (27%) fell and 68 (73%) did not fall. The mean age of the fallers ( $6.3 \pm 2.0$  years) was lower than that of the non-fallers ( $8.1 \pm 3.9$  years). Behavioral problems according to the mother's statement (OR 26.454), not being able to maintain a long sitting position (OR 10.807), ability to balance on knees without support (OR 9.810), a history of frequent falls (OR 4.893) and a negative Thomas test (OR 4.192 fold) were found to increase the risk of inpatient falls.

CONCLUSIONS: In these children with cerebral palsy, behavioral problems according to the mother's statement, a history of frequent falls, not being able to maintain a long sitting position, a negative Thomas test, and able to balance on knees without support were associated with the risk of inpatient falls. Children with cerebral palsy may experience inpatient falls. Further studies are required in order to develop prevention programs.

PRACTICE IMPLICATIONS: For patients diagnosed with cerebral palsy, these results may help identify possible inpatient fallers on hospital admission.

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PMID: 27633845 [Indexed for MEDLINE]

### **Quantitative assessment of muscular stiffness in children with cerebral palsy using acoustic radiation force impulse (ARFI) ultrasound elastography.**

Bilgici MC , Bekci T , Ulus Y , Ozyurek H , Aydin OF , Tomak L , Selcuk MB .

*J Med Ultrason* (2001). 2017 Sep 12. doi: 10.1007/s10396-017-0824-3. [Epub ahead of print]

PURPOSE: To evaluate the feasibility of quantitative analysis of muscle stiffness in the medial gastrocnemius muscle (GCM) by acoustic radiation force impulse (ARFI) ultrasound elastography in children with spastic cerebral palsy (CP).

METHODS: Seventeen children with spastic CP and 25 healthy children participated in the study between the years 2016-2017. The medial GCM in the CP group was assessed using the Modified Ashworth Scale (MAS) by a physiatrist. ARFI was used to measure the shear-wave velocities (SWVs) of the medial GCM. The mean SWV value for each MAS score was calculated and used for statistics.

RESULTS: The mean SWV values of the medial GCM in the CP and healthy groups were  $3.17 \pm 0.81$  m/s (mean  $\pm$  SD) and  $1.45 \pm 0.25$  m/s (mean  $\pm$  SD), respectively. The SWV of the medial GCM significantly increased in the CP patients when compared with controls ( $p < 0.001$ ). In addition, the SWV values were correlated with the MAS scores ( $p < 0.001$ ). The interobserver agreement expressed as the interclass correlation coefficient was 0.65 (95% CI 0.33-0.84,  $p < 0.001$ ).

CONCLUSIONS: ARFI imaging demonstrated a difference in muscle stiffness in the medial GCM between the CP and healthy groups. This method is a feasible imaging modality for the noninvasive assessment of contracting muscles in children with CP.

DOI: 10.1007/s10396-017-0824-3

PMID: 28900767

### **Reliability of patellar height indices in children with cerebral palsy and spina bifida.**

Rethlefsen SA , Barrett KK , Wren TAL , Blumstein G , Gargiulo D , Ryan DD , Kay RM .

*J Child Orthop*. 2017 Aug 1;11(4):249-255. doi: 10.1302/1863-2548.11.170014.

BACKGROUND: The Koshino (KI) and Caton-Deschamps (CDI) indices are used to measure patellar height in children, with the CDI showing excellent reliability in typically developing (TD) children. Reliability of such measures in children with cerebral palsy (CP) and spina bifida (SB) is unknown.

METHODS: Lateral knee radiographs were reviewed retrospectively for children with TD ( $n = 49$ ), CP ( $n = 48$ ) and SB ( $n = 42$ ). Five raters took measurements from radiographs twice, at least two weeks apart. Measurements included the CDI, Insall-Salvati Index (ISI) and KI. Systematic variability (bias) and random variability were examined using repeated measures ANOVA, 95% limits of agreement (LOA) and coefficients of variation (CV).

RESULTS: Mean values of all three indices differed among raters ( $p < 0.0001$ ). A significant difference was seen between the first and second measurements for CDI and KI indicating a learning effect. LOA ranges were large for the CDI (intra-rater: 0.37-0.95, inter-rater: 0.60-1.04) and ISI (intra-rater: 0.25-0.49, inter-rater: 0.51-0.57) for all

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patient groups. The KI showed a clinically acceptable range for TD participants (intra-rater: 0.14-0.16, inter-rater: 0.11-0.14) with larger ranges for CP (intra-rater: 0.26-0.33, inter-rater 0.02-0.35) and SB patients (intra-rater: 0.23-0.27, inter-rater: 0.19-0.25). CVs were lowest (best) for KI (3.8% to 7.4%) and highest (worst) for CDI (14.7% to 23.1%) for all three groups. Results were similar for patients with both open and closed physes.

**CONCLUSIONS:** The KI is the most reliable patellar height measure for paediatric patients with TD, CP and SB, with either open or closed physes. The KI is more complex and experience may be important for valid, reliable measurement.

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DOI: 10.1302/1863-2548.11.170014

PMCID: PMC5584492

PMID: 28904629

### **Squat test performance and execution in children with and without cerebral palsy.**

Eken MM , Harlaar J , Dallmeijer AJ , de Waard E , van Bennekom CA , Houdijk H .

*Clin Biomech (Bristol, Avon)*. 2017 Jan;41:98-105. doi: 10.1016/j.clinbiomech.2016.12.006. Epub 2016 Dec 18.

**BACKGROUND:** Knowledge on lower extremity strength is imperative to informed decision making for children with cerebral palsy (CP) with mobility problems. However, a functional and clinically feasible test is not available. We aimed to determine whether the squat test is suitable for this purpose by investigating test performance and execution in children with cerebral palsy and typically developing (TD) peers.

**METHODS:** Squat test performance, defined by the number of two-legged squats until fatigue (max 20), was assessed in twenty children with bilateral CP (6-19years; gross motor function classification system I-III) and sixteen TD children (7-16years). Muscle fatigue was assessed from changes in electromyography (EMG). Joint range-of-motion and net torque were calculated for each single squat, to investigate differences between groups and between the 2nd and last squat.

**FINDINGS:** Fifteen children with CP performed <20 squats (median=13, IQR=7-19), while all TD children performed the maximum of 20 squats. Median EMG frequency decreased and amplitude increased in mm. quadriceps of both groups. Ankle and knee range-of-motion were reduced in children with CP during a single squat by 10 to 15°. No differences between 2nd and last squat were observed, except for knee range-of-motion which increased in TD children and decreased in children with CP.

**INTERPRETATION:** Squat test performance was reduced in children with CP, especially in those with more severe CP. Muscle fatigue was present in both children with CP and TD peers, confirming that endurance of the lower extremity was tested. Minor execution differences between groups suggest that standardized execution is important to avoid compensation strategies. It is concluded that the squat test is feasible to test lower extremity strength in children with CP in a clinically meaningful way. Further clinimetric evaluation is needed before clinical implementation.

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### **What is the price for the Duchenne gait pattern in patients with cerebral palsy?**

Salami F , Niklasch M , Krautwurst BK , Dreher T , Wolf SI .

*Gait Posture*. 2017 Sep 7;58:453-456. doi: 10.1016/j.gaitpost.2017.09.006. [Epub ahead of print]

Duchenne gait is characterized by trunk lean towards the affected stance limb with the pelvis stable or elevated on the swinging limb side during single limb stance phase. We assessed the relationship between hip abduction moments and trunk kinetics in patients with cerebral palsy showing excessive lateral trunk motion. Data of 18 subjects with bilateral spastic cerebral palsy (CP) and 20 aged matched typically developing subjects (TD) were collected retrospectively. Criteria for patient selection were barefoot walking without aid presenting with excessive lateral trunk motion. Subjects had been monitored by conventional 3D gait analysis of the lower extremity including four markers for monitoring trunk motion. Post-hoc, a generic musculoskeletal full body model (OpenSim 3.3) assuming a rigid trunk articulated to the pelvis by a single ball joint was applied for analyzing joint kinematics and kinetics of the lower limb joints including this spine joint. Joint angle ranges of motion, maximum joint moments and powers in the frontal plane as well as mechanical work were calculated and averaged within groups showing

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prominent differences between groups in all parameters. To the best of our knowledge, this is the first work explicitly looking into the kinetics of Duchenne gait in patients with CP, clinically known as compensation for unloading hip abductor muscles. The results show that excessive lateral trunk motion may indeed be an extremely effective compensation mechanism to unload the hip abductors in single limb stance but for the price of a drastic increase in demand on trunk muscle effort and work.

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DOI: 10.1016/j.gaitpost.2017.09.006

PMID: 28918356

## Traitement - Rééducation motrice et cognitive

### Pharmacologie Efficacite Tolérance

#### **Clinical presentation and management of dyskinetic cerebral palsy.**

Monbaliu E , Himmelmann K , Lin JP , Ortibus E , Bonouvrié L , Feys H(6), Vermeulen RJ , Dan B .

*Lancet Neurol.* 2017 Sep;16(9):741-749. doi: 10.1016/S1474-4422(17)30252-1.

Cerebral palsy is the most frequent cause of severe physical disability in childhood. Dyskinetic cerebral palsy (DCP) is the second most common type of cerebral palsy after spastic forms. DCP is typically caused by non-progressive lesions to the basal ganglia or thalamus, or both, and is characterised by abnormal postures or movements associated with impaired tone regulation or movement coordination. In DCP, two major movement disorders, dystonia and choreoathetosis, are present together most of the time. Dystonia is often more pronounced and severe than choreoathetosis, with a major effect on daily activity, quality of life, and societal participation. The pathophysiology of both movement disorders is largely unknown. Some emerging hypotheses are an imbalance between indirect and direct basal ganglia pathways, disturbed sensory processing, and impaired plasticity in the basal ganglia. Rehabilitation strategies are typically multidisciplinary. Use of oral drugs to provide symptomatic relief of the movement disorders is limited by adverse effects and the scarcity of evidence that the drugs are effective. Neuromodulation interventions, such as intrathecal baclofen and deep brain stimulation, are promising options.

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#### **Dopa-responsive Dystonia in a Child Misdiagnosed as Cerebral Palsy.**

Kulshreshtha D , Maurya PK , Singh AK , Thacker AK .

*J Pediatr Neurosci.* 2017 Apr-Jun;12(2):172-173. doi: 10.4103/jpn.JPN\_123\_16.

Dopa-responsive dystonia also known as "Segawa's syndrome" was first described in 1976. The dystonia typically shows diurnal variations and is more marked toward the end of the day and improves in sleep. This entity is often misdiagnosed in the clinical setting, mostly due to the lack of awareness, and these patients are exposed to various treatment regimens and nonpharmacological measures. We present a boy being treated as dystonic cerebral palsy who showed significant improvement in dystonic symptoms with L-dopa therapy.

#### **Free PMC Article**

DOI: 10.4103/jpn.JPN\_123\_16

PMCID: PMC5588646

PMID: 28904579

#### **Effects of Botulinum Toxin-A and Goal-Directed Physiotherapy in Children with Cerebral Palsy GMFCS Levels I & II.**

Löwing K , Thews K , Haglund-Åkerlind Y , Gutierrez-Farewik EM .

*Phys Occup Ther Pediatr.* 2017 Aug;37(3):268-282. doi: 10.3109/01942638.2016.1150384. Epub 2016 Apr 8.

AIMS: To evaluate short and long-term effects of botulinum toxin-A combined with goal-directed physiotherapy in children with cerebral palsy (CP).

**METHOD:** A consecutive selection of 40 children, ages 4-12 years, diagnosed with unilateral or bilateral CP, and classified in GMFCS levels I-II. During the 24 months, 9 children received one BoNT-A injection, 10 children two injections, 11 children three injections, and 10 children received four injections. 3D gait analysis, goal-attainment scaling, and body function assessments were performed before and at 3, 12, and 24 months after initial injections.

**RESULTS:** A significant but clinically small long-term improvement in gait was observed. Plantarflexor spasticity was reduced after three months and remained stable, while passive ankle dorsiflexion increased after 3 months but decreased slightly after 12 months. Goal-attainment gradually increased, reached the highest levels at 12 months, and levels were maintained at 24 months.

**CONCLUSION:** The treatments' positive effect on spasticity reduction was identified, but did not relate to improvement in gait or goal-attainment. No long-term positive change in passive ankle dorsiflexion was observed. Goal attainment was achieved in all except four children. The clinical significance of the improved gait is unclear. Further studies are recommended to identify predictors for positive treatment outcome.

DOI: 10.3109/01942638.2016.1150384

PMID: 27058177 [Indexed for MEDLINE]

### **Efficacy of oral pharmacological treatments in dyskinetic cerebral palsy: a systematic review.**

Masson R , Pagliano E , Baranello G .

*Dev Med Child Neurol.* 2017 Sep 5. doi: 10.1111/dmcn.13532. [Epub ahead of print]

**AIM:** To evaluate the actual evidence of efficacy of oral pharmacological treatments in the management of dyskinetic cerebral palsy (CP).

**METHOD:** A systematic review was performed according to the American Academy for Cerebral Palsy and Developmental Medicine (AAPDM) and Preferred Reporting Items for Systematic Reviews and Meta-Analyses methodology. Articles were searched for in PubMed/MEDLINE, Scopus, Web of Science, Cochrane Library, Database of Reviews of Effectiveness, OTSeeker, Physiotherapy Evidence Database, REHABDATA, and ClinicalTrials.gov.

**RESULTS:** Sixteen articles met the eligibility criteria. Eight studies on trihexyphenidyl and two on levodopa showed contradictory results. Low efficacy was reported for diazepam, dantrolene sodium, perphenazine, and etybenzotropine. Tetrabenazine, gabapentin and levetiracetam should be studied in more detail. The updated available evidence does not support any therapeutic algorithm for the management of dyskinetic CP.

**INTERPRETATION:** This lack of evidence is partially owing to the inconsistency of classifications of patients and of outcome measures used in the reviewed studies. Further randomized, double-blind, placebo-controlled pharmacological trials, optimized for different age groups, based on valid, reliable, and disease-specific rating scales are strongly needed. Outcome measures should be selected within the framework of the International Classification of Functioning, Disability and Health.

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PMID: 28872668

### **Guided Growth of the Proximal Femur for the Management of Hip Dysplasia in Children With Cerebral Palsy.**

Portinaro N , Turati M, Cometto M, Bigoni M, Davids JR, Panou A.

*J Pediatr Orthop.* 2017 Sep 8. doi: 10.1097/BPO.0000000000001069. [Epub ahead of print]

**BACKGROUND:** Progressive hip displacement is one of the most common and debilitating deformities seen in children with cerebral palsy (CP). The aim of this study was to evaluate the results of temporary medial hemiepiphyodesis of the proximal femur (TMH-PF) using a transphyseal screw to control hip migration during growth in children with CP.

**METHODS:** This was a retrospective study of children with CP and hip dysplasia, age 4 to 11 years and GMFCS levels III-V. There were 28 patients with 56 hips that underwent TMH-PF surgery between 2007 and 2010. Clinical and radiologic evaluation was performed preoperatively, at 6, 12, and 60 months following the index surgery. Acetabular index (AI), neck-shaft angle (NSA) and migration percentage (MP) were measured. All complications were recorded.

**RESULTS:** All radiographic measurements were significantly improved at the final follow-up. Positive correlations were found between NSA, MP, and AI. Multiple regression analysis revealed that MP, time from surgery, and age were influenced by the decrease of the NSA. The femoral physis grew off the screw in 9 hips within 36 months. The

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screw head broke during attempted screw exchange in 1 hip. The remain cases (4 hips) were treated by placing a second screw parallel to the existing one. Finally, progressive subluxation occurred in 3 hips when the physis grew off the screw and were treated by skeletal reconstruction.

CONCLUSIONS: TMH-PF was effective in controlling progressive subluxation of the hip in the majority of cases, obviating the need for major reconstructive surgery in these children with CP.

LEVEL OF EVIDENCE: Level IV.

DOI: 10.1097/BPO.0000000000001069

PMID: 28902001

### **Improvement of upper trunk posture during walking in hemiplegic patients after injections of botulinum toxin into the arm.**

Hefter H , Rosenthal D .

*Clin Biomech (Bristol, Avon)*. 2017 Mar;*43*:15-22. doi: 10.1016/j.clinbiomech.2017.01.018. Epub 2017 Jan 26.

BACKGROUND: It has been hypothesized that altered trunk movements during gait in post-stroke patients or children with cerebral palsy are compensatory to lower limb impairment. Improvement of trunk movements and posture after injections of botulinum toxin into the affected arm would be at variance with this hypothesis and hint towards a multifactorial trunk control deficit.

PATIENTS AND METHODS: Clinical gait analysis was performed in 11 consecutively recruited hemiplegic patients immediately before and 4weeks after a botulinum toxin type A-injection into the affected arm. Kinematic data were collected using an 8 camera optical motion-capturing system and reflective skin-markers were attached according to a standard plug-in-gait model. Deviation of the trunk in lateral and forward direction and the trajectory of the C7-marker in a sacrum-fixed horizontal plane were analyzed in addition to classical gait parameters. The Wilson-signed-rank test was used for pre/post-botulinum toxin comparisons.

FINDINGS: After botulinum toxin injections a significant improvement of forearm flexion scores from 2.57 to 2.0 ( $p<0.014$ ), and a reduced lateral deviation of the upper trunk from 3.5degrees to 2.5degrees ( $p<0.014$ ) were observed. Free-walkers tended to walk faster ( $p<0.046$ , 1-sided), with reduced pre-swing duration of both legs and an increased step length of the non-affected leg. The C7-marker trajectory was shifted towards the midline.

INTERPRETATION: Injections of botulinum toxin into the affected arm of hemiplegic patients improve abnormal trunk lateral flexion. This shift of the center of mass of the upper body towards the midline improves various gait parameters including gait speed.

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PMID: 28187305 [Indexed for MEDLINE]

### **Intrathecal Baclofen Pump Implantation for Type 2 Gaucher Disease.**

Hori YS , Fukuhara T, Aoi M, Ochi M, Furujo M.

*Pediatr Neurosurg*. 2017;*52*(5):331-335. doi: 10.1159/000479324. Epub 2017 Aug 24.

Gaucher disease (GD) is the most common type of lysosomal storage disease, with type 2 being the most severe subtype. Type 2 GD patients suffer significant progressive neurological impairment, including spasticity, opisthotonus, seizure, and apnea. The recently developed enzyme replacement therapy (ERT) has shown therapeutic benefit for GD. However, as the enzymes do not cross the blood-brain barrier, ERT does not ameliorate neurological impairment in GD. Intrathecal baclofen therapy (IBT) is indicated for spastic neurological diseases, such as cerebral palsy, and studies have shown its therapeutic benefit in improving several manifestations of GD, such as scoliosis caused by muscle spasticity and respiratory function. To date, the potential benefits of IBT for treating lysosomal storage diseases such as GD have not been examined. Here we provide the first report of a patient with type 2 GD treated with IBT, and demonstrate its therapeutic benefit in ameliorating the neurological aspects of this disease. © 2017 S. Karger AG, Basel.

DOI: 10.1159/000479324

PMID: 28848108

### **Outcomes of intrathecal baclofen therapy in patients with cerebral palsy and acquired brain injury.**

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Yoon YK , Lee KC, Cho HE, Chae M, Chang JW, Chang WS, Cho SR.  
*Medicine (Baltimore)*. 2017 Aug;96(34):e7472. doi: 10.1097/MD.0000000000007472.

Intrathecal baclofen (ITB) has been known to reduce spasticity which did not respond to oral medications and botulinum toxin treatment. However, few results have been reported comparing the effects of ITB therapy in patients with cerebral palsy (CP) and acquired brain injury. This study aimed to investigate beneficial and adverse effects of ITB bolus injection and pump therapy in patients with CP and to compare outcomes to patients with acquired brain injury such as traumatic brain injury and hypoxic brain injury. ITB test trials were performed in 37 patients (19 CP and 18 acquired brain injury). Based on ambulatory function, CP patients were divided into 2 groups: 11 patients with nonambulatory CP and 8 patients with ambulatory CP. Change of spasticity was evaluated using the Modified Ashworth Scale. Additional positive or negative effects were also evaluated after ITB bolus injection. In patients who received ITB pump implantation, outcomes of spasticity, subjective satisfaction and adverse events were evaluated until 12 months post-treatment. After ITB bolus injection, 32 patients (86.5%) (CP 84.2% versus acquired brain injury 88.9%) showed a positive response of reducing spasticity. However, 8 patients with CP had negative adverse effects. Particularly, 3 ambulatory CP patients showed standing impairment and 1 ambulatory CP patient showed impaired gait pattern such as foot drop because of excessive reduction of lower extremity muscle tone. Ambulatory CP patients received ITB pump implantation less than patients with acquired brain injury after ITB test trials ( $P = .003$  by a chi-squared test). After the pump implantation, spasticity was significantly reduced within 1 month and the effect maintained for 12 months. Seventeen patients or their caregivers (73.9%) were very satisfied, whereas 5 patients (21.7%) suffered from adverse events showed no subjective satisfaction. In conclusion, ITB therapy was effective in reducing spasticity in patients with CP and acquired brain injury. Before ITB pump implantation, it seems necessary to perform the ITB bolus injection to verify beneficial effects and adverse effects especially in ambulatory CP.

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DOI: 10.1097/MD.0000000000007472

PMCID: PMC5571990

PMID: 28834868 [Indexed for MEDLINE]

#### **Pharmacogenomic Variability of Oral Baclofen Clearance and Clinical Response in Children with Cerebral Palsy.**

McLaughlin MJ , He Y , Brunstrom-Hernandez J , Thio LL , Carleton BC , Ross CJD , Gaedigk A , Lewandowski A , Dai H , Jusko WJ , Leeder JS .

*PM R*. 2017 Aug 31. pii: S1934-1482(17)30089-8. doi: 10.1016/j.pmrj.2017.08.441. [Epub ahead of print]

**BACKGROUND:** Pharmacogenomic variability can contribute to differences in pharmacokinetics and clinical responses. Pediatric patients with cerebral palsy (CP) with genetic variations have not been studied for these potential differences.

**OBJECTIVE:** To determine the genetic sources of variation in oral baclofen clearance and clinical responses.

**DESIGN:** Pharmacogenomic add-on study to determine variability in oral baclofen clearance and clinical responses.

**SETTING:** Multicenter study based in academic pediatric cerebral palsy clinics.

**PARTICIPANTS:** 49 patients with CP who had participated in an oral baclofen Pharmacokinetic/Pharmacodynamic (PK/PD) study.

**METHODS:** or Interventions: From 53 participants in a PK/PD trial, 49 underwent genetic analysis of 307 key genes and 4,535 single-nucleotide polymorphisms (SNPs) involved in drug absorption, distribution, metabolism and excretion. Associations between genotypes and phenotypes of baclofen disposition (weight-corrected and allometrically scaled clearance) and clinical endpoints (improvement from baseline in mean hamstring Modified Tardieu Scale (MTS) scores from baseline for improvement of R1 spastic catch) were determined by univariate analysis with correction for multiple testing by false discovery rate (FDR).

**MAIN OUTCOME MEASUREMENTS:** Primary outcome measures were the genotypic and phenotypic variability of oral baclofen in allometrically scaled clearance and change in the MTS angle compared to baseline.

**RESULTS:** After univariate analysis of the data, the SNP of ABCC9 (rs11046232, heterozygous AT vs. the reference TT genotype) was associated with a 2-fold increase in oral baclofen clearance (Mean  $0.51 \pm$  Standard Deviation  $0.05$  L/hr/kg for the AT genotype vs.  $0.25 \pm 0.07$  L/hr/kg for the TT genotype, adjusted  $p < .001$ ). Clinical responses were associated with decreased spasticity by MTS in allelic variants with SNPs ABCC12, SLC28A1, and PPARD.

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CONCLUSIONS: Genetic variation in ABCC9 impacting oral baclofen clearance highlights the need for continued studies of genetic polymorphisms to better characterize variable drug response in children with CP. Single nucleotide polymorphisms in ABCC12, SLC28A1, and PPARD were associated with varied responses, which warrants further investigation to determine their effect on spasticity.

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PMID: 28867665

### **Regional anesthesia for a total knee arthroplasty on an adult patient with spastic diplegia and an intrathecal baclofen pump.**

Bojaxhi E , Salek DR , Sherman CE , Greengrass RA .

*Rom J Anaesth Intensive Care. 2017 Apr;24(1):69-72. doi: 10.21454/rjaic.7518.241.dip.*

We describe the clinical presentation of a patient with spastic diplegia, and its unique perioperative challenges. Opioids and antispasmodic medications are the primary therapy for managing pain and spasticity in the perioperative setting. However, such combination results in several side-effects and their sedative properties are synergistic. A 64-year-old woman with a history of spastic diplegia and an intrathecal baclofen pump for the treatment of her lower extremity spasticity was scheduled for a third elective left knee arthroplasty. She requested a regional anesthetic for the anticipated surgery and an opioid sparing postoperative analgesic regiment. We describe the successful use of a lumbar plexus and a sciatic nerve block as the primary anesthetic for the surgery and the use of a continuous lumbar plexus catheter for the postoperative course. Based on our patient's past anesthetic history, a regional anesthetic/analgesic technique is the ideal strategy in controlling perioperative pain and spasticity.

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DOI: 10.21454/rjaic.7518.241.dip

PMCID: PMC5555432

PMID: 28913502

### **Safety and Efficacy of Repeat Open-Label AbobotulinumtoxinA Treatment in Pediatric Cerebral Palsy.**

Delgado MR , Bonikowski M , Carranza J , Dabrowski E , Matthews D , Russman B , Tilton A , Velez JC , Grandoulier AS(9), Picaut P(9).

*J Child Neurol. 2017 Jan 1:883073817729918. doi: 10.1177/0883073817729918. [Epub ahead of print]*

This was a prospective, repeat-treatment, open-label study (NCT01251380) of abobotulinumtoxinA for the management of lower limb spasticity in children who had completed a double-blind study. Children (2-17 years) received injections into the gastrocnemius-soleus complex, and other distal and proximal muscles as required (maximum total dose per injection cycle: 30 U/kg or 1000U). A total of 216 of the 241 double-blind patients entered the extension study and 207 received  $\geq 1$  open label injection into the gastrocnemius-soleus; 17-24% of patients also had injections into the hamstrings. The most frequent adverse events were related to common childhood infections and the most frequent treatment-related adverse event was injection site pain (n = 10). There was no evidence of a cumulative effect on adverse events. Sustained significant clinical improvements in muscle tone (Modified Ashworth Scale), spasticity (Tardieu Scale), overall clinical benefit (Physicians Global Assessment), and goal attainment (Goal Attainment Scale) were also observed across treatment cycles.

DOI: 10.1177/0883073817729918

PMID: 28914131

### **Safety, Tolerability, and Sensorimotor Effects of Extended-release Dalfampridine in Adults With Cerebral Palsy: A Pilot Study.**

Bethoux F , Fatemi A , Fowler E , Marciniak C , Mayadev A , Waksman J , Zackowski K , Suarez G , Blight AR , Rabinowicz AL , Carrazana E .

*Clin Ther. 2017 Feb;39(2):337-346. doi: 10.1016/j.clinthera.2016.12.015. Epub 2017 Jan 25.*

**PURPOSE:** The goal of this study was to evaluate the safety and tolerability of dalfampridine extended release (D-ER) in a pilot study of adults with cerebral palsy (CP) and limited ambulatory ability, and to explore drug effects on sensorimotor function.

**METHODS:** An initial double-blind, single-dose crossover study was performed in 11 individuals randomized 1:1 to receive D-ER (10 mg) or placebo, followed by a 2-day washout period and the opposite treatment, with evaluation for safety and tolerability. A twice daily dosing, double-blind, placebo-controlled, crossover study was then performed. Participants were randomized in a 1:1 ratio to 1 of 2 sequences: 1 week of D-ER (10 mg BID) or placebo, followed by a 1-week washout and 1 week of the opposite treatment. Key inclusion criteria were age 18 to 70 years, body mass index 18.0 to 30.0 kg/m<sup>2</sup>, diagnosis of CP, and ability to perform all study procedures. Key exclusion criteria were severe CP, moderate or severe renal impairment, history of nonfebrile seizures, and prior dalfampridine use. Primary outcomes were safety profile and tolerability. Exploratory functional outcomes comprised changes in upper and lower extremity sensorimotor function (grip and pinch strength tests), manual dexterity (Box and Block Tests), and walking speed (Timed 25-Foot Walk). The most pronounced measured functional deficit in each individual was defined as the exploratory primary functional end point. Full crossover data were analyzed by using a mixed effects model. **FINDINGS:** Among the 24 total participants who were randomized to treatment and completed the twice daily dosing phase study, their mean age was 38.6 years (range, 20-62 years), 54% were women, and 83% had spastic CP. Adverse events were consistent with previous D-ER trials, most commonly headache (13% D-ER, 4% placebo), fatigue (13% D-ER, 0% placebo), insomnia (8% D-ER, 4% placebo), diarrhea (4% D-ER, 4% placebo), and nausea (4% D-ER, 4% placebo). The mixed model analysis of full crossover data identified no significant difference between D-ER and placebo in the primary functional analysis (the most pronounced deficit;  $P = 0.70$ ) or in the secondary analyses (hand strength [ $P = 0.48$ ], manual dexterity [ $P = 0.13$ ], or walking speed [ $P = 0.42$ ]).

**IMPLICATIONS:** In this preliminary study of adults with CP, a BID dose of 10-mg D-ER was generally safe and well tolerated. The exploratory functional assessments for upper and lower sensorimotor deficits did not establish that the study population was markedly responsive to D-ER relative to placebo. These findings do not provide the proof-of-concept that would support further evaluation of D-ER as a potential intervention to improve function in adults with CP. ClinicalTrials.gov identifier: NCT01468350.

#### [Free Article](#)

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DOI: 10.1016/j.clinthera.2016.12.015

PMID: 28131322 [Indexed for MEDLINE]

#### **The resurgence of botulinum toxin injection for strabismus in children.**

Mahan M, Engel JM.

*Curr Opin Ophthalmol.* 2017 Sep;28(5):460-464. doi: 10.1097/ICU.0000000000000408.

**PURPOSE OF REVIEW:** The present review discusses recent advances in the use of botulinum toxin for the management of strabismus in children.

**RECENT FINDINGS:** Botulinum toxin injection produces similar results compared to surgery for certain subtypes of strabismus, especially acute onset esotropia. It may be more effective in many subtypes of esotropia where surgery has been less reliable, including partially accommodative esotropia, esotropia associated with cerebral palsy, and thyroid eye disease.

**SUMMARY:** Small retrospective studies have demonstrated the efficacy of botulinum toxin in the treatment of many types of pediatric strabismus, providing some guidance for clinicians to determine which patients would benefit most from this intervention. Although administration of botulinum toxin is generally accepted as a reasonable option in select cases, many strabismus surgeons have not fully embraced the treatment, in part because of perceived disadvantages compared to surgery and difficulty in identifying subsets with the highest potential for therapeutic success. A recent study compared the administration of botulinum toxin in children with acute-onset esotropia to surgical correction and found botulinum toxin had a statistically equal success rate, but with the advantage of significantly less time under general anesthesia. In addition, botulinum toxin has been recently tried in patients with partially accommodative esotropia, esotropia associated with cerebral palsy, cyclic esotropia, and in

patients with thyroid eye disease. The present review will discuss current clinical recommendations based on recent studies on the use of botulinum toxin in children with strabismus.

DOI: 10.1097/ICU.0000000000000408

PMID: 28650877 [Indexed for MEDLINE]

### **Value of botulinum toxin injections preceding a comprehensive rehabilitation period for children with spastic cerebral palsy: a cost-effectiveness study.**

Schasfoort F, Dallmeijer A, Pangalila R, Catsman C, Stam H, Becher J, Steyerberg E, Polinder S, Bussmann J.

*J Rehabil Med.* 2017 Sep 26. doi: 10.2340/16501977-2267. [Epub ahead of print]

**OBJECTIVE:** Despite the widespread use of botulinum toxin in ambulatory children with spastic cerebral palsy, its value prior to intensive physiotherapy with adjunctive casting/orthoses remains unclear.

**DESIGN:** A pragmatically designed, multi-centre trial, comparing the effectiveness of botulinum toxin + intensive physiotherapy with intensive physiotherapy alone, including economic evaluation.

**SUBJECTS/PATIENTS:** Children with spastic cerebral palsy, age range 4-12 years, cerebral palsy-severity Gross Motor Function Classification System levels I-III, received either botulinum toxin type A + intensive physiotherapy or intensive physiotherapy alone and, if necessary, ankle-foot orthoses and/or casting.

**METHODS:** Primary outcomes were gross motor function, physical activity levels, and health-related quality-of-life, assessed at baseline, 12 (primary end-point) and 24 weeks (follow-up). Economic outcomes included healthcare and patient costs. Intention-to-treat analyses were performed with linear mixed models.

**RESULTS:** There were 65 participants (37 males), with a mean age of 7.3 years (standard deviation 2.3 years), equally distributed across Gross Motor Function Classification System levels. Forty-one children received botulinum toxin type A plus intensive physiotherapy and 24 received intensive physiotherapy treatment only. At primary end-point, one statistically significant difference was found in favour of intensive physiotherapy alone: objectively measured percentage of sedentary behaviour (-3.42, 95% confidence interval 0.20-6.64, p=0.038). Treatment costs were significantly higher for botulinum toxin type A plus intensive physiotherapy (8,963 vs 6,182 euro, p=0.001). No statistically significant differences were found between groups at follow-up.

**CONCLUSION:** The addition of botulinum toxin type A to intensive physiotherapy did not improve the effectiveness of rehabilitation for ambulatory children with spastic cerebral palsy and was also not cost-effective. Thus botulinum toxin is not recommended for use in improving gross motor function, activity levels or health-related quality-of-life in this cerebral palsy age- and severity-subgroup.

#### [Free Article](#)

DOI: 10.2340/16501977-2267

PMID: 28949368

### **Vector-field statistics for the analysis of time varying clinical gait data.**

Donnelly CJ, Alexander C, Pataky TC, Stannage K, Reid S, Robinson MA.

*Clin Biomech (Bristol, Avon).* 2017 Jan;41:87-91. doi: 10.1016/j.clinbiomech.2016.11.008. Epub 2016 Dec 3.

**BACKGROUND:** In clinical settings, the time varying analysis of gait data relies heavily on the experience of the individual(s) assessing these biological signals. Though three dimensional kinematics are recognised as time varying waveforms (1D), exploratory statistical analysis of these data are commonly carried out with multiple discrete or OD dependent variables. In the absence of an a priori OD hypothesis, clinicians are at risk of making type I and II errors in their analysis of time varying gait signatures in the event statistics are used in concert with preferred subjective clinical assessment methods. The aim of this communication was to determine if vector field waveform statistics were capable of providing quantitative corroboration to practically significant differences in time varying gait signatures as determined by two clinically trained gait experts.

**METHODS:** The case study was a left hemiplegic Cerebral Palsy (GMFCS I) gait patient following a botulinum toxin (BoNT-A) injection to their left gastrocnemius muscle.

**FINDINGS:** When comparing subjective clinical gait assessments between two testers, they were in agreement with each other for 61% of the joint degrees of freedom and phases of motion analysed. For tester 1 and tester 2, they were in agreement with the vector-field analysis for 78% and 53% of the kinematic variables analysed. When the subjective analyses of tester 1 and tester 2 were pooled together and then compared to the vector-field analysis,

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they were in agreement for 83% of the time varying kinematic variables analysed. INTERPRETATION: These outcomes demonstrate that in principle, vector-field statistics corroborates with what a team of clinical gait experts would classify as practically meaningful pre- versus post time varying kinematic differences. The potential for vector-field statistics to be used as a useful clinical tool for the objective analysis of time varying clinical gait data is established. Future research is recommended to assess the usefulness of vector-field analyses during the clinical decision making process.

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PMID: 28024228 [Indexed for MEDLINE]

## Chirurgie

### **A Comparative Study of Sagittal Balance in Patients with Neuromuscular Scoliosis.**

Borges PA , Zelada FGB , Dos Santos Barros TF , Letaif OB , da Rocha ID , Marcon RM , Cristante AF , Barros-Filho TEP . *Clinics (Sao Paulo)*. 2017 Aug;72(8):481-484. doi: 10.6061/clinics/2017(08)05.

**OBJECTIVES::** Spinopelvic alignment has been associated with improved quality of life in patients with vertebral deformities, and it helps to compensate for imbalances in gait. Although surgical treatment of scoliosis in patients with neuromuscular spinal deformities promotes correction of coronal scoliotic deformities, it remains poorly established whether this results in large changes in sagittal balance parameters in this specific population. The objective of this study is to compare these parameters before and after the current procedure under the hypothesis is that there is no significant modification.

**METHODS::** Sampling included all records of patients with neuromuscular scoliosis with adequate radiographic records treated at Institute of Orthopedics and Traumatology of Clinics Hospital of University of São Paulo (IOT-HCFMUSP) from January 2009 to December 2013. Parameters analyzed were incidence, sacral inclination, pelvic tilt, lumbar lordosis, thoracic kyphosis, spinosacral angle, spinal inclination and spinopelvic inclination obtained using the iSite-Philips digital display system with Surgimap and a validated method for digital measurements of scoliosis radiographs. Comparison between the pre- and post-operative conditions involved means and standard deviations and the t-test.

**RESULTS::** Based on 101 medical records only, 16 patients met the inclusion criteria for this study, including 7 males and 9 females, with an age range of 9-20 and a mean age of 12.9±3.06; 14 were diagnosed with cerebral palsy. No significant differences were found between pre and postoperative parameters.

**CONCLUSIONS::** Despite correction of coronal scoliotic deformity in patients with neuromuscular deformities, there were no changes in spinopelvic alignment parameters in the group studied.

#### [Free PMC Article](#)

DOI: 10.6061/clinics/2017(08)05

PMCID: PMC5577618

PMID: 28954007

### **Bony reconstruction of hip in cerebral palsy children Gross Motor Function Classification System levels III to V: a systematic review.**

El-Sobky TA , Fayyad TA, Kotb AM, Kaldas B.

*J Pediatr Orthop B*. 2017 Sep 25. doi: 10.1097/BPB.0000000000000503. [Epub ahead of print]

Hip dislocation is a common source of disability in cerebral palsy children. It has been remedied by various reconstructive procedures. This review aims at providing the best evidence for bony reconstructive procedures in cerebral palsy hip migration. The literature extraction process yielded 36 articles for inclusion in this review. There is fair evidence to indicate that the comparative effectiveness of femoral versus combined pelvifemoral reconstruction favours pelvifemoral reconstruction. All except one were retrospective articles with a significant degree of selection and performance bias and confounding variables that limited the validity and generalizability of the conclusions. The findings of this systematic review provide fair evidence for the use of adequate soft tissue and combined pelvifemoral reconstruction in the management of hip migration in none and minimally ambulatory cerebral palsy children in the short and long term. This has been shown in studies with a summed sizable patient population. There

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is limited evidence available that would support the use of soft-tissue and isolated femoral reconstruction. In the context of these retrospective and biased studies, it is extremely difficult to identify, with great precision, predictors of surgical success. Future studies should consider prospective designs that allow for bias control, strict patient selection criteria and incorporation of validated quality-of-life scales.

DOI: 10.1097/BPB.0000000000000503

PMID: 28953164

### **Changes in hip abductor moment 3 or more years after femoral derotation osteotomy among individuals with cerebral palsy.**

Boyer ER , Novacheck TF , Schwartz MH .

*Dev Med Child Neurol.* 2017 Sep;59(9):912-918. doi: 10.1111/dmcn.13494. Epub 2017 Jun 29.

**AIM:** To examine the effect of femoral derotation osteotomy (FDO) on dimensionless hip abductor moment during gait in children with cerebral palsy.

**METHODS:** We retrospectively analyzed data from independent ambulators within our database. Postoperative visits 1 year (short-term) and at least 3 years (mid-term) were analyzed. We estimated the coronal plane hip abductor moment arm based on musculoskeletal modeling that accounted for anteversion and hip rotation.

**RESULTS:** There were 140 individuals with a short-term analysis (77 males, 63 females; age at surgery 9y 11mo [range 4y 5mo-17y 5mo]) and 29 with mid-term analysis (15 males, 14 females; age at surgery 8y 7mo [range 4y 5mo-13y 1mo]). At short-term, anteversion and internal hip rotation decreased 35° and 13° respectively, which increased median (IQR) moment arms from 20 (23) per cent below normal to 2 (12) per cent above normal. Dimensionless mean hip abductor moment remained unchanged at short-term. Mid-term anteversion did not change but hip rotation increased 8° and hip abductor moment increased to 0.040 (0.029). There was no change in pelvic and trunk obliquity, although hip abductor strength increased and walking velocity decreased at mid-term.

**INTERPRETATION:** The unexpected lack of improvement in hip abductor moment from pre- to short-term may be caused by gait compensations that unload the hip. The increase in hip abductor moment beyond 3 years postoperatively underscores the benefits of an FDO into adolescence for independent ambulating individuals with cerebral palsy.

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DOI: 10.1111/dmcn.13494

PMID: 28660621 [Indexed for

### **Clinical Outcomes of Correcting Cervical Deformity in Cerebral Palsy Patients.**

Lee CK , Jeon HR , Yoon DH , Kim KN , Yi S , Shin DA , Hosogane N , Cao K , Cho SR , Ha Y .

*World Neurosurg.* 2016 Dec;96:500-509. doi: 10.1016/j.wneu.2016.08.101. Epub 2016 Sep 1. Erratum in *World Neurosurg.* 2017 Sep;105:1028.

**OBJECTIVE:** To assess several different cervical alignment parameters to determine the clinical relationship between cerebral palsy (CP) with cervical spondylotic myelopathy (CSM) and cervical deformity.

**METHODS:** This study included consecutive patients (N = 31) with CP CSM who underwent cervical operation between January 2006 and January 2014 and who had cervical deformities, such as angular and translational deformities. Cervical spine alignment was assessed with the following parameters: C2-7 Cobb angle, C2-7 sagittal vertical axis (SVA), and T1 slope minus C2-7 Cobb angle. Other clinical values were the manual muscle test, spasticity, grip and pinch test, Box and Block test, and Jebsen-Taylor Hand Function Test. Outcome assessments (Oswestry Neck Disability Index [NDI] and modified Barthel Index) were obtained for all patients pre- and postoperatively.

**RESULTS:** Mean follow-up duration was 3.5 years. There were 13 patients in the corrected group and 18 in the not corrected group. Angular and translational correction were 19.0° (C2-7 Cobb angle), 19.8° (T1 slope minus C2-7 Cobb angle), and 16 mm (C2-7 SVA). Postoperative NDI scores showed greater improvement in the corrected group than the uncorrected group (P = 0.049). In the corrected group, grip power increased postoperatively (8.9 ± 8.9 vs 15.5 ± 8.3; P = 0.021). **CONCLUSIONS:** Surgical treatment for patients with CP CSM deformity helped alleviate symptoms. Postoperative NDI scores and hand function improved in patients with CP CSM deformity, especially those in the corrected group. Clinicians should consider correcting the deformity in patients with CP CSM.

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PMID: 27593721 [Indexed for MEDLINE]

### **Comparison of efficacy between dorsal root entry zone lesioning and selective dorsal rhizotomy for spasticity of cerebral origin.**

Sitthinamsuwan B , Phonwijit L(2), Khampalikit I , Nitising A , Nunta-Aree S , Suksompong S .  
*Acta Neurochir (Wien)*. 2017 Sep 17. doi: 10.1007/s00701-017-3322-x. [Epub ahead of print]

**BACKGROUND:** Severe spasticity adversely affects patient functional status and caregiving. No previous study has compared efficacy between dorsal root entry zone lesioning (DREZL) and selective dorsal rhizotomy (SDR) for reduction of spasticity. This study aimed to investigate the efficacy of DREZL and SDR for attenuating spasticity, and to compare efficacy between these two methods.

**METHODS:** All patients who underwent DREZL, SDR, or both for treatment of intractable spasticity caused by cerebral pathology at Siriraj Hospital during 2009 to 2016 were recruited. Severity of spasticity was assessed using Modified Ashworth Scale (MAS) and Adductor Tone Rating Scale (ATRS). Ambulatory status was also evaluated.

**RESULTS:** Fifteen patients (13 males) with a mean age of  $30.3 \pm 17.5$  years were included. Eight, six, and one patient underwent DREZL, SDR, and combined cervical DREZL and lumbosacral SDR, respectively. Eight of ten patients with preoperative bed-bound status had postoperative improvement in ambulatory status. Spasticity was significantly reduced in the DREZL group ( $p < 0.001$ ), the SDR group ( $p < 0.001$ ), and in overall analysis ( $p < 0.001$ ). SDR was effective in both pediatric and adult spasticity patients. A significantly greater reduction in spasticity as assessed by MAS score ( $p < 0.001$ ) and ATRS score ( $p = 0.015$ ) was found in the DREZL group. Transient lower limb weakness was found in a patient who underwent SDR.

**CONCLUSIONS:** DREZL is more effective for reducing spasticity, but is more destructive than SDR. DREZL should be preferred for bed-ridden patients, and SDR for ambulatory patients. Both operations are helpful for improving ambulatory status. Gait improvement was observed only in patients who underwent SDR. Adult patients with spasticity of cerebral origin benefit from SDR.

DOI: 10.1007/s00701-017-3322-x

PMID: 28920167

### **Effects of multilevel surgery on a flexed knee gait in adults with cerebral palsy.**

Putz C , Wolf SI , Mertens EM , Geisbüsch A , Gantz S , Braatz F , Döderlein L , Dreher T .

*Bone Joint J*. 2017 Sep;99-B(9):1256-1264. doi: 10.1302/0301-620X.99B9.BJJ-2016-1155.R1.

**AIMS:** A flexed knee gait is common in patients with bilateral spastic cerebral palsy and occurs with increased age. There is a risk for the recurrence of a flexed knee gait when treated in childhood, and the aim of this study was to investigate whether multilevel procedures might also be undertaken in adulthood.

**PATIENTS AND METHODS:** At a mean of 22.9 months (standard deviation 12.9), after single event multi level surgery, 3D gait analysis was undertaken pre- and post-operatively for 37 adult patients with bilateral cerebral palsy and a fixed knee gait.

**RESULTS:** There was a significant improvement of indices and clinical and kinematic parameters including extension of the hip and knee, reduction of knee flexion at initial contact, reduction of minimum and mean knee flexion in the stance phase of gait, improved range of movement of the knee and a reduction of mean flexion of the hip in the stance phase. Genu recurvatum occurred in two patients ( $n = 3$  legs, 4%) and an increase of pelvic tilt ( $> 5^\circ$ ) was found in 12 patients ( $n = 23$  legs, 31%).

**CONCLUSION:** Adult patients with bilateral cerebral palsy and a flexed knee gait benefit from multilevel surgery including hamstring lengthening. The risk of the occurrence of genu recurvatum and increased pelvic tilt is lower than has been previously reported in children. Cite this article: *Bone Joint J* 2017;99-B:1256-64.

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DOI: 10.1302/0301-620X.99B9.BJJ-2016-1155.R1

PMID: 28860409 [Indexed for MEDLINE]

### **Electromagnetic bone segment tracking to control femoral derotation osteotomy-A saw bone study.**

Science Infos Paralysie Cérébrale, Septembre 2017, **FONDATION PARALYSIE CEREBRALE** 67 rue Vergniaud 75013 Paris - tel +33 1 45 54 03 03 contact: Christine Doumergue  
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Geisbüscher A , Auer C , Dickhaus H , Niklasch M , Dreher T .  
*J Orthop Res.* 2017 May;35(5):1106-1112. doi: 10.1002/jor.23348. Epub 2016 Jul 4.

Correction of rotational gait abnormalities is common practice in pediatric orthopaedics such as in children with cerebral palsy. Femoral derotation osteotomy is established as a standard treatment, however, different authors reported substantial variability in outcomes following surgery with patients showing over- or under-correction. Only 60% of the applied correction is observed postoperatively, which strongly suggests intraoperative measurement error or loss of correction during surgery. This study was conducted to verify the impact of error sources in the derotation procedure and assess the utility of a newly developed, instrumented measurement system based on electromagnetic tracking aiming to improve the accuracy of rotational correction. A supracondylar derotation osteotomy was performed in 21 artificial femur sawbones and the amount of derotation was quantified during the procedure by the tracking system and by nine raters using a conventional goniometer. Accuracy of both measurement devices was determined by repeated computer tomography scans. Average derotation measured by the tracking system differed by  $0.1^\circ \pm 1.6^\circ$  from the defined reference measurement. In contrast, a high inter-rater variability was found in goniometric measurements (range:  $10.8^\circ \pm 6.9^\circ$ , mean interquartile distance:  $6.6^\circ$ ). During fixation of the osteosynthesis, the tracking system reliably detected unintentional manipulation of the correction angle with a mean absolute change of  $4.0^\circ \pm 3.2^\circ$ . Our findings show that conventional control of femoral derotation is subject to relevant observer bias whereas instrumental tracking yields accuracy better than  $\pm 2^\circ$ . The tracking system is a step towards more reliable and safe implementation of femoral correction, promising substantial improvements of patient safety in the future. © 2016 Orthopaedic Research Society. Published by Wiley Periodicals, Inc. *J Orthop Res* 35:1106-1112, 2017.  
© 2016 Orthopaedic Research Society. Published by Wiley Periodicals, Inc.  
DOI: 10.1002/jor.23348  
PMID: 27325569 [Indexed for MEDLINE]

#### **Influence of patellar position on the knee extensor mechanism in normal and crouched walking.**

Lenhart RL , Brandon SC , Smith CR , Novacheck TF , Schwartz MH , Thelen DG .  
*J Biomech.* 2017 Jan 25;51:1-7. doi: 10.1016/j.jbiomech.2016.11.052. Epub 2016 Nov 22.

Patella alta is common in cerebral palsy, especially in patients with crouch gait. Correction of patella alta has been advocated in the treatment of crouch, however the appropriate degree of correction and the implications for knee extensor function remain unclear. Therefore, the goal of this study was to assess the impact of patellar position on quadriceps and patellar tendon forces during normal and crouch gait. To this end, a lower extremity musculoskeletal model with a novel 12 degree of freedom knee joint was used to simulate normal gait in a healthy child, as well as mild (23 deg min knee flexion in stance), moderate (41 deg), and severe (67 deg) crouch gait in three children with cerebral palsy. The simulations revealed that quadriceps and patellar tendon forces increase dramatically with crouch, and are modulated by patellar position. For example with a normal patellar tendon position, peak patellar tendon forces were 0.7 times body weight in normal walking, but reached 2.2, 3.2 and 5.4 times body weight in mild, moderate and severe crouch. Moderate patella alta acted to reduce quadriceps and patellar tendon loads in crouch gait, due to an enhancement of the patellar tendon moment arms with alta in a flexed knee. In contrast, patella baja reduced the patellar tendon moment arm in a flexed knee and thus induced an increase in the patellar tendon loads needed to walk in crouch. Functionally, these results suggest that patella baja could also compromise knee extensor function for other flexed knee activities such as chair rise and stair climbing. The findings are important to consider when using surgical approaches for correcting patella alta in children who exhibit crouch gait patterns.

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PMID: 27939752 [Indexed for MEDLINE]

#### **Iterative approach for 3D reconstruction of the femur from un-calibrated 2D radiographic images.**

Youn K , Park MS , Lee J .



*Med Eng Phys.* 2017 Sep 15. pii: S1350-4533(17)30237-0. doi: 10.1016/j.medengphy.2017.08.016. [Epub ahead of print]

Three-dimensional reconstruction of the femur is important for surgical planning in patients with cerebral palsy. This study aimed to reconstruct the three-dimensional femur shape from un-calibrated bi-planar radiographic images using self-calibration to allow for low-dose preoperative planning. The existing self-calibration techniques require anatomical landmarks that are clearly visible on bi-planar images, which are not available on the femur. In our newly developed method, the self-calibration is performed so that the contour of the statistical shape matches the image contour while the statistical shape is concomitantly optimized. The proposed approach uses conventional radiograph systems and can be easily incorporated into existing clinical protocols, as compared to other reconstruction methods.

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DOI: 10.1016/j.medengphy.2017.08.016

PMID: 28927642

### **Long-term follow-up after tibialis anterior tendon shortening in combination with Achilles tendon lengthening in spastic equinus in cerebral palsy.**

Kläusler M , Speth BM , Brunner R , Tirosh O , Camathias C , Rutz E .

*Gait Posture.* 2017 Aug 30;58:457-462. doi: 10.1016/j.gaitpost.2017.08.028. [Epub ahead of print]

Using Tibialis Anterior Shortening (TATS) in combination with Achilles Tendon Lengthening (TAL) to treat spastic equinus in children with cerebral palsy (CP) was described in 2011. Short-term results have indicated a good outcome, especially an improvement of the drop foot in swing phase and the correction of equinus in stance phase. The aim of this study was to analyse the results of the long-term follow-up and to determine the relapse rate of TATS and TAL. The kinematics of the sagittal, frontal and transversal planes were measured by using instrumented 3D gait analysis at three defined time points and then described using the Gait Profile Score (GPS) and Movement Analysis Profile (MAP). The data was exported into Gaitabase and then the preoperative (T0), short-term (T1) and long-term (T2) follow-up data was statistically compared. 23 patients (mean age at index-surgery=14.9years) were included, there was a mean follow-up time of 5.8 years. 3 children (13%) have shown a relapse. The data of 12 children with spastic hemiplegia (12 legs), as well as 8 children with spastic diplegia (10 legs) has been analysed. There has been a significant ( $p<0.05$ ) improvement in GPS and MAP for ankle dorsiflexion (describes equinus and drop foot) of the operated legs versus not operated legs. TATS in combination with TAL shows a satisfactory long-term result after 5.8 years in the correction of fixed equinus and drop foot in children with CP. Postoperatively all subjects were able to walk without an AFO.

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PMID: 28918357

### **Long-term impact of childhood selective dorsal rhizotomy on pain, fatigue, and function: a case-control study.**

Dauanter AK , Kratz AL , Hurvitz EA .

*Dev Med Child Neurol.* 2017 Oct;59(10):1089-1095. doi: 10.1111/dmcn.13481. Epub 2017 Jun 15.

AIM: Selective dorsal rhizotomy (SDR) is a surgical treatment for spasticity in children with cerebral palsy (CP). Studies suggest long-lasting effects of SDR on spasticity; long-term effects on symptoms and function are not clear. This study tested whether adults with CP (average 22y after SDR) report less pain, fatigue, and functional decline than a retrospectively assessed non-surgical comparison group.

METHOD: This was a case-control study. Eighty-eight adults with CP (mean age 27y; SDR=38 male/female/missing=20/16/2; non-surgical [comparison]=50, male/female=19/31) recruited from a tertiary care center and the community completed a battery of self-reported outcome measures. Regression models were used to test whether SDR status predicted pain, fatigue, functional change, and hours of assistance (controlling for Gross Motor Function Classification System level).

RESULTS: SDR status did not significantly predict pain interference ( $p=0.965$ ), pain intensity ( $p=0.512$ ), or fatigue ( $p=0.404$ ). SDR related to lower decline in gross motor functioning ( $p=0.010$ ) and approximately 6 fewer hours of daily assistance than for those in the comparison group ( $p=0.001$ ).

INTERPRETATION: Adults with CP who had SDR in childhood reported less gross motor decline and fewer daily assistance needs than non-surgically treated peers, suggesting the functional impact of SDR persists long after surgery.

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### **Perioperative complications and outcomes in children with cerebral palsy undergoing scoliosis surgery.**

Bendon AA , George KA , Patel D .

*Paediatr Anaesth.* 2016 Oct;*26(10):970-5.* doi: 10.1111/pan.12981. Epub 2016 Aug 8.

INTRODUCTION: Neuromuscular scoliosis is a known risk factor for postoperative complications after corrective spine surgery. Few studies have looked at the preoperative factors affecting postoperative complications in children with cerebral palsy.

AIM: The aim of this study was to examine the factors that might influence postoperative course in patients with cerebral palsy undergoing spine surgery for scoliosis.

METHODS: Nineteen case notes of children with cerebral palsy who had spine surgery (2008-2014) were reviewed retrospectively. Preoperative comorbidities and postoperative complications were noted and complications were classified as major and minor.

RESULTS: Thirteen out of 19 (68.4%) patients had two or more systemic comorbidities. Most common comorbidities included reflux and seizure disorder. Nine patients (49%) had at least one major complication. About 5/19 patients had respiratory complications requiring ventilation and 4/19 had massive blood loss. A higher incidence of postoperative major complication was recorded in the group with two systemic comorbidities as compared to those with less than two systemic comorbidities (47% vs 16%). Both patients who had a single-stage anterior release and posterior fixation had a major complication.

CONCLUSION: Presence of two or more comorbidities and thoracotomy are risk factors for perioperative complications in children with cerebral palsy undergoing surgery for scoliosis correction.

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PMID: 27501478 [Indexed for MEDLINE]

### **Peripheral nerve intersectional repair by bi-directional induction and systematic remodelling: biodegradable conduit tubulization from basic research to clinical application.**

Peixun Z , Na H , Kou Y , Xiaofeng Y , Jiang B .

*Artif Cells Nanomed Biotechnol.* 2017 Sep 8;*1-3.* doi: 10.1080/21691401.2017.1373658. [Epub ahead of print]

In terms of the clinical effect of peripheral nerve injury repair, the biological degradable conduit 2 mm small gap tubulization is far better than the traditional epineurial or perineurium neuroorrhaphy. The assumption of the bi-directional induction between the central system and the terminal effector during peripheral nerve regeneration is purposed and proved in clinical by our group. The surgical approach of transferring a portion of or the whole contralateral C7 nerve to repair a part of or the whole ipsilateral brachial plexus injury is clinically promoted, in which the most important idea and practice is to use the cone conduit designed by the group to repair thick nerves with fine nerves. Some of the patients suffering from cerebral palsy or cerebral haemorrhage and those who got cerebral infarction yet have not reached recovery after 3-6 months could regain some functions of the ipsilateral upper limb and improve the life quality by transfer of a portion of or the whole contralateral C7 nerve and connection by cone conduit.

DOI: 10.1080/21691401.2017.1373658

PMID: 28884592

### **Pre-surgery evaluations by telephone decrease travel and cost for families of children with cerebral palsy.**

Robinson JD , Prochaska JD , Yngve DA .

*SAGE Open Med.* 2017 Jul 23;5:2050312117720046. doi: 10.1177/2050312117720046. eCollection 2017.

**INTRODUCTION:** Children with cerebral palsy need highly specialized care. This can be very burdensome for families, particularly in large rural states, due to the need for long-distance travel to appointments. In this study, children undergoing the selective percutaneous myofascial lengthening surgery utilized a telephone-based telemedicine evaluation to assess for surgical eligibility. The goal was to avoid a separate preoperative clinic visit weeks before the surgery. If possible, eligibility was determined by telephone, and then, the patient could be scheduled for a clinic visit and possible surgery the next day, saving the family a trip. The purposes of the study were to calculate estimated reductions in miles traveled, in travel expenses, and in carbon emissions and to determine whether the telephone assessment was accurate and effective in determining eligibility for surgery.

**METHODS:** From 2010 to 2012, 279 patients were retrospectively reviewed, and of those, 161 mailed four-page questionnaire and anteroposterior pelvis X-ray followed by a telephone conference. Geographic information system methods were used to geocode patients by location. Savings in mileage and travel costs were calculated. From 2014 to 2015, 195 patients were additionally studied to determine accuracy and effectiveness.

**RESULTS:** The telephone prescreening method saved 106,070 miles in transportation over 3 years, a 38% reduction with US\$55,326 in savings. Each family saved an average of 658 (standard deviation = 340) miles of travel and US\$343.64 (standard deviation = US\$178) in travel expenses. For each increase of 10 miles in distance from the health center, the odds of a patient utilizing telephone screening increased by 10% (odds ratio: 1.101, 95% confidence interval: 1.073-1.129,  $p < 0.001$ ). After the telephone prescreening, 86% were determined to be likely candidates for the procedure. For 14%, a clinic visit only was scheduled, and they were not scheduled for surgery.

**CONCLUSION:** Families seeking specialized surgical care for their disabled children particularly benefited from this approach.

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PMCID: PMC5528192

PMID: 28839936

### **Role of Anesthesiologist in the Management of a Child with Cerebral Palsy.**

Shaikh SI , Hegade G .

*Anesth Essays Res.* 2017 Jul-Sep;11(3):544-549. doi: 10.4103/0259-1162.194569.

Cerebral palsy (CP) refers to a spectrum of nonprogressive neurological disorders with disturbances in posture and movement, resulting from perinatal intrauterine insult to developing infant brain. Many conditions associated with CP require surgery. Such cases pose important gastrointestinal, respiratory, and other perioperative considerations. Anesthetic management in these cases is delicate. Intraoperative complications including hypovolemia, hypothermia, muscle spasms, seizures, and delayed recovery might complicate the anesthetic management. A thorough preanesthetic evaluation allows for a better intra- and post-operative care. Postoperative analgesia is important, particularly in orthopedic surgeries one for pain relief. This review highlights the clinical manifestations in CP and anesthetic considerations in such child presenting for various surgeries.

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DOI: 10.4103/0259-1162.194569

PMCID: PMC5594763

PMID: 28928544

### **Sacral-Alar-Iliac Fixation in Children with Neuromuscular Scoliosis: Minimum 5-Year Follow-Up.**

Jain A , Sullivan BT , Kuwabara A , Kebaish K , Sponseller PD .

*World Neurosurg.* 2017 Sep 5. pii: S1878-8750(17)31479-1. doi: 10.1016/j.wneu.2017.08.169. [Epub ahead of print]

**OBJECTIVE:** The aim of our study was to investigate the 5-year outcomes of children with neuromuscular scoliosis treated with sacral-alar-iliac screws.

**METHODS:** We reviewed clinical and radiographic records of patients  $\leq 18$  years old treated by 1 pediatric orthopaedic surgeon for neuromuscular scoliosis with spinal fusion using sacral-alar-iliac pelvic anchors. Thirty-eight patients, with a minimum 5-year radiographic follow-up ( $6.0 \pm 1.2$  years), were studied. Mean patient age was  $13 \pm 2.0$  years and 47% were female. The mean number of levels fused was  $18 \pm 0.7$ . The diagnosis was cerebral palsy in 66% of patients.

**RESULTS:** Between the preoperative period and final follow-up there was a mean 79% correction of the major coronal curve ( $85^\circ$  to  $18^\circ$ ) and 57% correction of the pelvic obliquity ( $16^\circ$  to  $7^\circ$ ). Patients maintained correction of mean pelvic obliquity from the early postoperative period ( $6^\circ$ ) to final follow-up ( $7^\circ$ ). Preoperatively, 76% of patients had pelvic obliquity of  $>10^\circ$  compared with 26% after surgery. There were no cases of neurologic or vascular complications or pseudarthrosis. Radiographs revealed bilateral sacral-alar-iliac screw lucency in 8 patients; 4 of these patients had deep wound infections, and the other 4 were asymptomatic. Unilateral screw fracture was found in 1 patient with an 8-mm screw diameter (1.3%, 1 of 76 screws); the patient was observed and remained asymptomatic. There were no cases of set screw displacement, screw back-out, or rod dislodgement.

**CONCLUSIONS:** Sacral-alar-iliac screws are safe and effective pelvic anchors for use in children with neuromuscular scoliosis.

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PMID: 28887279

### **Should Proximal Femoral Implants be Removed Prophylactically or Reactively in Children With Cerebral Palsy?**

Truong WH, Novotny SA, Novacheck TF, Shin EJ, Howard A, Narayanan UG.

*J Pediatr Orthop.* 2017 Sep 22. doi: 10.1097/BPO.0000000000001082. [Epub ahead of print]

**BACKGROUND:** Implants are commonly used to stabilize proximal femoral osteotomies in children with cerebral palsy (CP). Removal of implants is common practice and believed to avoid infection, fracture, or pain that might be associated with retained hardware. There is little evidence to support a prophylactic strategy over a reactive approach based on symptoms. The aim of this study was to compare the outcomes of prophylactic and reactive approaches to removal of proximal femoral implants in children with CP.

**METHODS:** An intention-to-treat model was used to compare 2 institutions that followed a prophylactic (within  $\sim 1$  y) and reactive (following complication/symptoms) approach to hardware removal, respectively. Patients with CP who had femoral implants placed at or before age 16, and had  $\geq 2$ -year postsurgical follow-up were included. Demographics, surgical details, reasons for removal, and complications were recorded.  $\chi$  and t tests were used.

**RESULTS:** Six hundred twenty-one patients (prophylactic=302, reactive=319) were followed for an average of 6 years (range, 2 to 17 y). Two hundred eighty-seven (95%) implants were removed in the prophylactic group at 1.2 years. In the reactive group, 64 (20%) implants were removed at an average of 4.2 years. Reasons for removal included pain; infection; fracture; or for repeat reconstruction. The rate of unplanned removals due to fracture or infection was higher in the reactive group (4.7% vs. 0.7%,  $P=0.002$ ), but there was no difference in the rate of complications during/after removal between the 2 groups (1.7% vs. 3.1%;  $P=0.616$ ). No specific risk factor associated with unplanned removal could be identified; but children under 8 years old seemed more likely to undergo later removal (odds ratio 1.98; 95% confidence interval, 0.99-3.99).

**CONCLUSIONS:** Eighty percent of patients in the reactive removal strategy avoided surgery. This group did have a 4% higher rate of fracture or infection necessitating unplanned removal but these were successfully treated at time of removal with no difference in complication rates associated with removal between both groups. One would need to remove implants from 25 patients to avoid 1 additional complication, providing some support for a reactive approach to removal of proximal femoral implants in this population.

**LEVEL OF EVIDENCE:** Level III-therapeutic.

DOI: 10.1097/BPO.0000000000001082

PMID: 28945691

### **Soft Tissue Surgery for Adults With Nonfunctional, Spastic Hands Following Central Nervous System Lesions: A Retrospective Study.**

Gatin L, Schnitzler A, Calé F, Genêt G, Denormandie P, Genêt F.

**PURPOSE:** Soft tissue surgery for upper extremity contractures can improve hygiene, pain, and appearance in adults with central nervous system lesions. The goal of such interventions is highly individual; thus, goal attainment scaling (GAS; a method of scoring the extent to which patient's individual goals are achieved [5 levels] in the course of intervention and using T score values) is pertinent to evaluate outcome. The objective of this study was to assess the effect of soft tissue surgery for upper extremity muscle contractures in patients with central nervous system lesions using GAS.

**METHODS:** Retrospective data from 70 interventions were included (63 patients; 23 women). The mean age was 51.3 ± 16.2 years (range, 24.2-87.0 years). The primary goal was to improve hygiene (n = 58), pain (n = 10), or appearance (n = 2). The etiologies were stroke (n = 35), traumatic brain injury (n = 16), cerebral anoxia (n = 4), neurodegenerative disease (n = 6), and cerebral palsy (n = 2). The GAS score was calculated before surgery and 3 months after surgery.

**RESULTS:** The T score (which took into account the weight of each goal) was 52.3 at 3 months (38.5 before surgery), corresponding to a "better than expected" outcome. The mean of the differences of the GAS score for each goal before and after surgery increased by 1.27 for hygiene, 1.06 for pain, and 1.00 for appearance.

**CONCLUSIONS:** Soft tissue surgery can safely and effectively improve hygiene, pain, and appearance in adults with cerebral damage. The preoperative evaluation should be multidisciplinary. The GAS is a useful tool to assess the effectiveness of orthopedic surgery for these patients.

**TYPE OF STUDY/LEVEL OF EVIDENCE:** Therapeutic IV.

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PMID: 28935338

### **The effect of plantar flexor lengthening on foot pressure in ambulatory children with cerebral palsy.**

Abousamra O , Schwartz J, Church C, Lennon N, Henley J, Niiler T, Miller F.

*J Pediatr Orthop B. 2017 Sep 25. doi: 10.1097/BPB.0000000000000501. [Epub ahead of print]*

This study aimed to assess the effects of plantar flexor lengthening (PFL) on dynamic foot pressures of children with cerebral palsy using pedobarographs. Of 97 enrolled, 13 children with 18 legs had PFL. Age at surgery was 4.7 (2.8-8.8) years. A significant increase in ankle dorsiflexion and heel impulse was achieved postoperatively and was maintained at 5 years. The coronal plane pressure index increased postoperatively, but reverted to preoperative levels at the 5-year follow-up. Children tend to have more valgus after PFL. In young children, there caution should be exercised to avoid over treating varus at the time of equinus correction to avoid overcorrection.

DOI: 10.1097/BPB.0000000000000501

PMID: 28953163

### **Tibial derotational osteotomies in two neuromuscular populations: comparing cerebral palsy with myelomeningocele.**

Thompson RM , Ilnow S , Dias L , Swaroop V .

*J Child Orthop. 2017 Aug 1;11(4):243-248. doi: 10.1302/1863-2548.11.170037.*

**PURPOSE:** To review the outcomes of tibial derotational osteotomies (TDOs) as a function of complication and revision surgery rates comparing a cohort of children with myelodysplasia to a cohort with cerebral palsy (CP).

**METHODS:** A chart review was completed on TDOs performed in a tertiary referral centre on patients with myelodysplasia or CP between 1985 and 2013 in patients aged > 5 years with > 2 years follow-up. Charts were reviewed for demographics, direction/degree of derotation, complications and need for re-derotation. Two-sample T-tests were used to compare the characteristics of the two groups. Two-tailed chi-square tests were used to compare complications. Generalised linear logit models were used to identify independent risk factors for complication and re-rotation.

**RESULTS:** The 153 patients (217 limbs) were included. Average follow-up was 7.83 years. Overall complication incidence was 10.14%, including removal of hardware for any reason, with a 4.61% major complication incidence (fracture, deep infection, hardware failure). After adjusting for gender and age, the risk of complication was not

statistically significantly different between groups ( $p = 0.42$ ) nor was requiring re-derotation ( $p = 0.09$ ). The probability of requiring re-derotation was 31.9% less likely per year increase in age at index surgery ( $p = 0.005$ ).

**CONCLUSION:** With meticulous operative technique, TDO in children with neuromuscular disorders is a safe and effective treatment for tibial torsion, with an acceptable overall and major complication rate. The risk of re-operation decreases significantly in both groups with increasing age. The association between age at initial surgery and need for re-derotation should help guide the treatment of children with tibial torsion.

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DOI: 10.1302/1863-2548.11.170037

PMCID: PMC5584491

PMID: 28904628

**Réadaptation fonctionnelle**

**A Novel Mobility Device to Improve Walking for a Child With Cerebral Palsy.**

Fergus A .

*Pediatr Phys Ther.* 2017 Oct;29(4):E1-E7. doi: 10.1097/PEP.0000000000000451.

**PURPOSE:** To describe the use and outcomes associated with the Upsee in conjunction with Kinesiotape for a child with cerebral palsy.

**DESCRIPTIONS:** The Upsee and Kinesiotaping were implemented for 24 weeks with a 31-month-old child with cerebral palsy, Gross Motor Function Classification System level III.

**OUTCOMES:** She progressed from walking with maximal assistance and extensive gait deviations to walking with supervision with a walker on level surfaces with improved gait. Genu recurvatum, heel strike, scissoring, hip extension, foot placement, step length, and stiff knee in swing improved on the basis of videotaped analyses. The Gross Motor Function Measure-66 improved by 11.4.

**CONCLUSIONS AND WHAT THIS CASE ADDS:** The Upsee is a clinically feasible approach for gait impairments in children through providing increased opportunities for walking while supporting biomechanical alignment. Upsee effectiveness with and without taping is an area for future study.

DOI: 10.1097/PEP.0000000000000451

PMID: 28953186

**Alleviation of Motor Impairments in Patients with Cerebral Palsy: Acute Effects of Whole-body Vibration on Stretch Reflex Response, Voluntary Muscle Activation and Mobility.**

Krause A , Schönau E , Gollhofer A , Duran I , Ferrari-Malik A , Freyler K , Ritzmann R .

*Front Neurol.* 2017 Aug 16;8:416. doi: 10.3389/fneur.2017.00416. eCollection 2017.

**INTRODUCTION:** Individuals suffering from cerebral palsy (CP) often have involuntary, reflex-evoked muscle activity resulting in spastic hyperreflexia. Whole-body vibration (WBV) has been demonstrated to reduce reflex activity in healthy subjects, but evidence in CP patients is still limited. Therefore, this study aimed to establish the acute neuromuscular and kinematic effects of WBV in subjects with spastic CP.

**METHODS:** 44 children with spastic CP were tested on neuromuscular activation and kinematics before and immediately after a 1-min bout of WBV (16-25 Hz, 1.5-3 mm). Assessment included (1) recordings of stretch reflex (SR) activity of the triceps surae, (2) electromyography (EMG) measurements of maximal voluntary muscle activation of lower limb muscles, and (3) neuromuscular activation during active range of motion (aROM). We recorded EMG of m. soleus (SOL), m. gastrocnemius medialis (GM), m. tibialis anterior, m. vastus medialis, m. rectus femoris, and m. biceps femoris. Angular excursion was recorded by goniometry of the ankle and knee joint.

**RESULTS:** After WBV, (1) SOL SRs were decreased ( $p < 0.01$ ) while (2) maximal voluntary activation ( $p < 0.05$ ) and (3) angular excursion in the knee joint ( $p < 0.01$ ) were significantly increased. No changes could be observed for GM SR amplitudes or ankle joint excursion. Neuromuscular coordination expressed by greater agonist-antagonist ratios during aROM was significantly enhanced ( $p < 0.05$ ).

**DISCUSSION:** The findings point toward acute neuromuscular and kinematic effects following one bout of WBV. Protocols demonstrate that pathological reflex responses are reduced (spinal level), while the execution of voluntary movement (supraspinal level) is improved in regards to kinematic and neuromuscular control. This facilitation of

muscle and joint control is probably due to a reduction of spasticity-associated spinal excitability in favor of giving access for greater supraspinal input during voluntary motor control.

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DOI: 10.3389/fneur.2017.00416

PMCID: PMC5561012

PMID: 28861038

### **Comparing Unimanual and Bimanual Training in Upper Extremity Function in Children With Unilateral Cerebral Palsy.**

Klepper SE , Clayton Krasinski D, Gilb MC, Khalil N.

*Pediatr Phys Ther. 2017 Oct;29(4):288-306. doi: 10.1097/PEP.0000000000000438.*

**PURPOSE:** This systematic review compared intensive bimanual therapy (IBT) and modified constraint-induced movement therapy (mCIMT) in upper limb function in children with unilateral cerebral palsy (CP).

**METHODS:** Four electronic databases were searched from 2009 through October 2015 for randomized control trials comparing IBT with mCIMT.

**RESULTS:** Eight articles met the inclusion criteria; 5 randomized clinical trials with 221 participants with unilateral CP, ages 1.5 to 16 years, who received the intervention in a day camp, clinical, or preschool setting were included. The IBT group performed bimanual motor activities; the mCIMT group performed unilateral motor activities.

**CONCLUSION:** There was a strong, nonspecific recommendation for either approach to improve quality of unimanual movement, bimanual capacity, and movement efficiency. There was a weak, specific recommendation for IBT in improving movement quality and a specific but weak recommendation favoring IBT to improve the child's performance on parent-reported outcomes.

DOI: 10.1097/PEP.0000000000000438

PMID: 28953170

### **Creative Dance Practice Improves Postural Control in a Child With Cerebral Palsy.**

Stribling K , Christy J.

*Pediatr Phys Ther. 2017 Oct;29(4):365-369. doi: 10.1097/PEP.0000000000000450.*

**PURPOSE:** To investigate the effect of creative dance instruction on postural control and balance in an 11-year-old with spastic triplegic cerebral palsy, Gross Motor Function Classification Scale level II.

**DESCRIPTIONS:** We conducted 1-hour dance interventions twice weekly for 8 weeks, with a focus on somatosensory awareness and movement in all planes of motion. Computerized dynamic posturography using the SMART Balance Master/EquiTest (NeuroCom) was used to assess postural control and balance reactions before the first class and following the final class.

**OUTCOMES:** Gains in standing stability, balance recovery, directional control, and endpoint excursion of movement were found. Participation in creative dance lessons appears to improve somatosensory effectiveness and postural control in a child with cerebral palsy.

**WHAT THIS CASE ADDS:** Dance is a fun way to improve balance and coordination. These interventions could be easily implemented into programs for children with cerebral palsy.

DOI: 10.1097/PEP.0000000000000450

PMID: 28953185

### **Deliberately Light Interpersonal Contact Affects the Control of Head Stability During Walking in Children and Adolescents With Cerebral Palsy.**

Schuller KH , Burfeind F , Höß-Zenker B , Feketené Szabó É , Herzig N , Ledebt A , Johannsen L .

*Arch Phys Med Rehabil. 2017 Sep;98(9):1828-1835. doi: 10.1016/j.apmr.2017.01.026. Epub 2017 Feb 27.*

**OBJECTIVE:** To evaluate the potential of deliberately light interpersonal touch (IPT) for reducing excessive head and trunk sway during self-paced walking in children and adolescents with cerebral palsy (CP).

**DESIGN:** Quasi-experimental, proof-of-concept study with between-groups comparison.

**SETTING:** Ambulant care facility, community center.

**PARTICIPANTS:** Children and adolescents (N=65), consisting of those with CP (spastic and ataxic, n=26; Gross Motor Function Classification System I-III; mean age, 9.8y; 11 girls, 15 boys) and those who were typically developed (TD, n=39; mean age, 10.0y; 23 girls, 16 boys).

**INTERVENTIONS:** IPT applied by a therapist to locations at the back and the head. **MAIN OUTCOME MEASURES:** As primary outcomes, head and trunk sway during self-paced walking were assessed by inertial measurement units. Secondary outcomes were average step length and gait speed.

**RESULTS:** CP group: apex and occiput IPT reduced head velocity sway compared with thoracic IPT (both  $P=0.04$ ) irrespective of individuals' specific clinical symptoms. TD group: all testing conditions reduced head velocity sway compared with walking alone (all  $P\leq 0.03$ ), as well as in apex and occiput IPT compared with paired walking (both  $P\leq 0.02$ ).

**CONCLUSIONS:** Deliberately light IPT at the apex of the head alters control of head sway in children and adolescents with CP. The effect of IPT varies as a function of contact location and acts differently in TD individuals.

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DOI: 10.1016/j.apmr.2017.01.026

PMID: 28254638 [Indexed for MEDLINE]

### **Factors Influencing the Gross Motor Outcome of Intensive Therapy in Children with Cerebral Palsy and Developmental Delay.**

Hong BY , Jo L , Kim JS , Lim SH , Bae JM .

*J Korean Med Sci.* 2017 May;32(5):873-879. doi: 10.3346/jkms.2017.32.5.873.

The study was designed to identify factors influencing the short term effect of intensive therapy on gross motor function in children with cerebral palsy or developmental delay. Retrospectively, total Gross Motor Function Measure-88 (GMFM-88) scores measured during the first and last weeks of intensive therapy were analyzed (n = 103). Good and poor responder groups were defined as those in the top and bottom 25% in terms of score difference, respectively. The GMFM-88 score increased to  $4.67 \pm 3.93$  after 8 weeks of intensive therapy ( $P < 0.001$ ). Gross Motor Function Classification System (GMFCS) level (I-II vs. IV-V; odds ratio [OR] = 7.763, 95% confidence interval [CI] = 2.177-27.682,  $P = 0.002$ ) was a significant factor in a good response to therapy. Age ( $\geq 36$  months; OR = 2.737, 95% CI = 1.003-7.471,  $P = 0.049$ ) and GMFCS level (I-II vs. IV-V; OR = 0.189, 95% CI = 0.057-0.630,  $P = 0.007$ ; and III vs. IV-V; OR = 0.095, 95% CI = 0.011-0.785,  $P = 0.029$ ) were significantly associated with a poor response. GMFCS level is the most important prognostic factor for the effect of intensive therapy on gross motor function. In addition, age  $\geq 36$  months, is associated with a poor outcome.

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DOI: 10.3346/jkms.2017.32.5.873

PMCID: PMC5383623

PMID: 28378564 [Indexed for MEDLINE]

### **Contribution of sensory feedback to plantar flexor muscle activation during push-off in adults with cerebral palsy.**

Frisk RF , Jensen P , Kirk H, Bouyer LJ , Lorentzen J , Nielsen JB .

*J Neurophysiol.* 2017 Sep 13;jn.00508.2017. doi: 10.1152/jn.00508.2017. [Epub ahead of print]

**INTRODUCTION:** Exaggerated sensory activity has been assumed to contribute to functional impairment following lesion of the central motor pathway. However, recent studies have suggested that sensory contribution to muscle activity during gait is reduced in stroke patients and children with cerebral palsy (CP). We investigated whether this also occurs in CP adults and whether daily treadmill training is accompanied by alterations in sensory contribution to muscle activity.

**MATERIALS AND METHODS:** 17 CP adults and 12 uninjured individuals participated. The participants walked on a treadmill while a robotized ankle-foot orthosis applied unload perturbations at the ankle hereby removing sensory feedback naturally activated during push-off. Reduction of electromyographic (EMG) activity in the soleus muscle caused by unloads was compared and related to kinematics and ankle joint stiffness measurements. Similar measures were obtained after 6 weeks of gait training.

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**RESULTS:** Sensory contribution to soleus EMG activation was reduced in CP adults compared with uninjured adults. The lowest contribution of sensory feedback was found in participants with lowest maximal gait speed. This was related to increased ankle plantar flexor stiffness. 6 weeks of gait training did not alter the contribution of sensory feedback.

**CONCLUSION:** Exaggerated sensory activity is unlikely to contribute to impaired gait in CP adults, since sensory contribution to muscle activity during gait was reduced compared with uninjured individuals. Increased passive stiffness around the ankle joint is likely to diminish sensory feedback during gait so that a larger part of plantar flexor muscle activity must be generated by descending motor commands.

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DOI: 10.1152/jn.00508.2017

PMID: 28904105

### **Effects of neuromuscular electrical stimulation and kinesio taping applications in children with cerebral palsy on postural control and sitting balance.**

Elbasan B , Akkaya KU , Akyüz M , Oskay D .

*J Back Musculoskelet Rehabil.* 2017 Aug 21. doi: 10.3233/BMR-169656. [Epub ahead of print]

**BACKGROUND:** Neurodevelopmental treatment (NDT), neuromuscular electrical stimulation (NMES), and Kinesio Taping (KT) applications are separately used to improve postural control and sitting balance in children with cerebral palsy (CP).

**OBJECTIVE:** The aim of this study is to examine the combined effect of NDT, NMES and KT applications on postural control and sitting balance in children with CP.

**METHODS:** Forty five children, in 3 groups, between the ages 5-12 years were included in the study. Group 1 received NDT; group 2 received NDT + NMES; and the group 3 received NDT + NMES + KT for 6 weeks. Sitting function evaluated by the sitting section of the gross motor function measure (GMFM), and postural control assessed with the seated postural control measurement (SPCM).

**RESULTS:** Seating section of GMFM was improved significantly in all the groups; however, increases in the group 3 were higher than groups 1 and 2 ( $p= 0.001$ ). While significant differences were observed in all groups in the SPCM posture ( $p< 0.001$ ), function ( $p< 0.001$ ), and the total scores ( $p< 0.001$ ); the change in the third group was higher according to the comparison of the three groups within each other.

**CONCLUSIONS:** Implementation of the NMES, and KT additionally to NDT improve the sitting posture, postural control, seating function, and gross motor function in children with CP.

DOI: 10.3233/BMR-169656

PMID: 28869434

### **Effects of whole body vibration on muscle spasticity for people with central nervous system disorders: a systematic review.**

Huang M , Liao LR , Pang MY .

*Clin Rehabil.* 2017 Jan;31 :23-33. doi: 10.1177/0269215515621117. Epub 2016 Jul 11.

**OBJECTIVES:** To examine the effects of whole-body vibration on spasticity among people with central nervous system disorders.

**METHODS:** Electronic searches were conducted using CINAHL, Cochrane Library, MEDLINE, Physiotherapy Evidence Database, PubMed, PsycINFO, SPORTDiscus and Scopus to identify randomized controlled trials that investigated the effect of whole-body vibration on spasticity among people with central nervous system disorders (last search in August 2015). The methodological quality and level of evidence were rated using the PEDro scale and guidelines set by the Oxford Centre for Evidence-Based Medicine.

**RESULTS:** Nine trials with totally 266 subjects (three in cerebral palsy, one in multiple sclerosis, one in spinocerebellar ataxia, and four in stroke) fulfilled all selection criteria. One study was level 1b (PEDro $\geq$ 6 and sample size $>$ 50) and eight were level 2b (PEDro $<$ 6 or sample size  $\leq$ 50). All three cerebral palsy trials (level 2b) reported some beneficial effects of whole-body vibration on reducing leg muscle spasticity. Otherwise, the results revealed no consistent benefits on spasticity in other neurological conditions studied. There is little evidence that change in spasticity was related to change in functional performance. The optimal protocol could not be identified.

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Many reviewed studies were limited by weak methodological and reporting quality. Adverse events were minor and rare.

CONCLUSION: Whole-body vibration may be useful in reducing leg muscle spasticity in cerebral palsy but this needs to be verified by future high quality trials. There is insufficient evidence to support or refute the notion that whole-body vibration can reduce spasticity in stroke, spinocerebellar ataxia or multiple sclerosis.

DOI: 10.1177/0269215515621117

PMID: 26658333 [Indexed for MEDLINE]

### **Garment Therapy does not Improve Function in Children with Cerebral Palsy: A Systematic Review.**

Wells H , Marquez J , Wakely L .

*Phys Occup Ther Pediatr.* 2017 Sep 18:1-22. doi: 10.1080/01942638.2017.1365323. [Epub ahead of print]

AIMS: To conduct a systematic review asking, does garment therapy improve motor function in children with cerebral palsy?

METHODS: A systematic review with meta-analysis was conducted to review the literature. Inclusion criteria involved the wearing of therapy suits/garments in children with cerebral palsy. The primary outcome of interest was movement related function and secondary outcomes included impairment, participation, parental satisfaction and adverse outcomes of garment wear.

RESULTS: 14 studies with 234 participants were included, of which 5 studies were included for meta-analysis. Garment therapy showed a nonsignificant effect on post-intervention function as measured by the Gross Motor Function Measure when compared to controls (MD = -1.9; 95% CI = -6.84, 3.05). Nonsignificant improvements in function were seen long-term (MD = -3.13; 95% CI = -7.57, 1.31). Garment therapy showed a significant improvement in proximal kinematics (MD = -5.02; 95% CI = -7.28, -2.76), however significant improvements were not demonstrated in distal kinematics (MD = -0.79; 95% CI = -3.08, 1.49).

CONCLUSIONS: This review suggests garment therapy does not improve function in children with cerebral palsy. While garment therapy was shown to improve proximal stability, this benefit must be considered functionally and consider difficulties associated with garment use.

DOI: 10.1080/01942638.2017.1365323

PMID: 28922041

### **Impaired Voluntary Movement Control and Its Rehabilitation in Cerebral Palsy.**

Gordon AM .

*Adv Exp Med Biol.* 2016;957:291-311. doi: 10.1007/978-3-319-47313-0\_16.

Cerebral palsy is caused by early damage to the developing brain, as the most common pediatric neurological disorder. Hemiplegia (unilateral spastic cerebral palsy) is the most common subtype, and the resulting impairments, lateralized to one body side, especially affect the upper extremity, limiting daily function. This chapter first describes the pathophysiology and mechanisms underlying impaired upper extremity control of cerebral palsy. It will be shown that the severity of impaired hand function closely relates to the integrity of the corticospinal tract innervating the affected hand. It will also be shown that the developing corticospinal tract can reorganize its connectivity depending on the timing and location of CNS injury, which also has implications for the severity of hand impairments and rehabilitation. The mechanisms underlying impaired motor function will be highlighted, including deficits in movement execution and planning and sensorimotor integration. It will be shown that despite having unimanual hand impairments, bimanual movement control deficits and mirror movements also impact function. Evidence for motor learning-based therapies including Constraint-Induced Movement Therapy and Bimanual Training, and the possible pathophysiological predictors of treatment outcome and plasticity will be described. Finally, future directions for rehabilitations will be presented.

DOI: 10.1007/978-3-319-47313-0\_16

PMID: 28035572 [Indexed for MEDLINE]

### **Motor imagery training promotes motor learning in adolescents with cerebral palsy: comparison between left and right hemiparesis.**

Cabral-Sequeira AS , Coelho DB , Teixeira LA .

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This experiment was designed to evaluate the effects of pure motor imagery training (MIT) and its combination with physical practice on learning an aiming task with the more affected arm in adolescents suffering from cerebral palsy. Effect of MIT was evaluated as a function of side of hemiparesis. The experiment was accomplished by 11- to 16-year-old participants (M = 13.58 years), who suffered left (n = 16) or right (n = 15) mild hemiparesis. They were exposed to pure MIT (day 1) followed by physical practice (day 2) on an aiming task demanding movement accuracy and speed. Posttraining movement kinematics of the group receiving MIT were compared with movement kinematics of the control group after receiving recreational activities (day 1) and physical practice (day 2). Kinematic analysis showed that MIT led to decreased movement time and straighter hand displacements to the target. Performance achievements from MIT were increased with further physical practice, leading to enhanced effects on motor learning. Retention evaluation indicated that performance improvement from pure MIT and its combination with physical practice were stable over time. Performance achievements were equivalent between adolescents with either right or left hemiparesis, suggesting similar capacity between these groups to achieve performance improvement from pure imagery training and from its association with physical practice. Our results suggest that motor imagery training is a procedure potentially useful to increase motor learning achievements in individuals suffering from cerebral palsy.

DOI: 10.1007/s00221-016-4554-3

PMID: 26821314 [Indexed for MEDLINE]

### **Neurophysiological mechanisms and functional impact of mirror movements in children with unilateral spastic cerebral palsy.**

Kuo HC , Friel KM , Gordon AM .

*Dev Med Child Neurol.* 2017 Sep 8. doi: 10.1111/dmcn.13524. [Epub ahead of print]

Children with unilateral spastic cerebral palsy (CP) often have mirror movements, i.e. involuntary imitations of unilateral voluntary movements of the contralateral upper extremity. The pathophysiology of mirror movements has been investigated in small and heterogeneous cohorts in the literature. Specific pathophysiology of mirror movements and their impact on upper extremity function require systematic investigation in larger and homogeneous cohorts of children with unilateral spastic CP. Here we review two possible neurophysiological mechanisms underlying mirror movements in children with CP and those with typical development: (1) an ipsilateral corticospinal tract projecting from the contralesional motor cortex (M1) to both upper extremities; (2) insufficient interhemispheric inhibition between the two M1s. We also discuss clinical implications of mirror movements in children with unilateral CP and suggest that a thorough examination of the relationship between the pathophysiology and clinical manifestations of mirror movements is warranted. We suggest two premises: (1) the presence of mirror movements is indicative of an ipsilateral corticospinal tract reorganization; and (2) the corticospinal tract organization may affect patients' responses to certain treatment. If these premises are supported through future research, mirror movements should be clinically evaluated for patient selection to maximize benefits of therapy, hence promoting individualized medicine in this population.

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PMID: 28884806

### **Psychometric and Clinimetric Properties of the Melbourne Assessment 2 in Children With Cerebral Palsy.**

Wang TN , Liang KJ , Liu YC , Shieh JY , Chen HL .

*Arch Phys Med Rehabil.* 2017 Sep;98(9):1836-1841. doi: 10.1016/j.apmr.2017.01.024.

**OBJECTIVE:** To examine the psychometric and clinimetric properties of the Melbourne Assessment 2 (MA2), an outcome measurement that is increasingly used in clinical studies.

**DESIGN:** Psychometric and clinimetric study.

**SETTING:** Community.

**PARTICIPANTS:** Seventeen children with cerebral palsy (CP) from 5 to 12 years were recruited for the estimation of the test-retest reliability and minimal detectable change (MDC). Thirty-five children with CP were recruited to

receive an 8-week intensive neurorehabilitation intervention to estimate the validity, responsiveness, and minimal clinically important difference (MCID).

INTERVENTIONS: Thirty-five children with CP received upper limb neurorehabilitation programs for 8 weeks.

MAIN OUTCOME MEASURES: The MA2 and the criterion measures, including the Bruininks-Oseretsky Test of Motor Proficiency, 2nd edition (BOT-2), the Box and Blocks Test (BBT), and the Pediatric Motor Activity Log-Revised (PMAL-R), were evaluated at pretreatment and posttreatment.

RESULTS: The MA2 has 4 subscales: range of motion, fluency, accuracy, and dexterity. The test-retest reliability of the MA2 is high (intraclass correlation coefficient, .92-.98). The significant relationships between the MA2 and BBT, BOT-2, and PMAL-R support its validity. The significance of paired t test results ( $P < .001$ ) and large magnitudes of the standardized response mean (1.70-2.00) confirm the responsiveness of the MA2. The MDC values of the 4 subscales of the MA2 are 2.85, 1.63, 1.97, and 1.84, respectively, and the suggested MCID values of these 4 subscales are 2.35, 3.20, 2.09, and 2.22, respectively, indicating the minimum scores of improvement to be interpreted as both statistically significant and clinically important.

CONCLUSIONS: The study findings indicate that the MA2 has sound psychometric and clinimetric properties and is thus an adequate measurement for research and clinical applications.

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DOI: 10.1016/j.apmr.2017.01.024

PMID: 28254639 [Indexed for MEDLINE]

### **REACH: study protocol of a randomised trial of rehabilitation very early in congenital hemiplegia.**

Boyd RN , Ziviani J , Sakzewski L , Novak I , Badawi N , Pannek K , Elliott C , Greaves S , Guzzetta A , Whittingham K , Valentine J , Morgan C , Wallen M , Eliasson AC , Findlay L , Ware R , Fiori S , Rose S .

*BMJ Open*. 2017 Sep 18;7(9):e017204. doi: 10.1136/bmjopen-2017-017204.

OBJECTIVES: Congenital hemiplegia is the most common form of cerebral palsy (CP). Children with unilateral CP show signs of upper limb asymmetry by 8 months corrected age (ca) but are frequently not referred to therapy until after 12 months ca. This study compares the efficacy of infant-friendly modified constraint-induced movement therapy (Baby mCIMT) to infant friendly bimanual therapy (Baby BIM) on upper limb, cognitive and neuroplasticity outcomes in a multisite randomised comparison trial.

METHODS AND ANALYSIS: 150 infants (75 in each group), aged between 3 and 6 months ca, with asymmetric brain injury and clinical signs of upper extremity asymmetry will be recruited. Children will be randomised centrally to receive equal doses of either Baby mCIMT or Baby BIM. Baby mCIMT comprises restraint of the unimpaired hand using a simple restraint (eg, glove, sock), combined with intensive parent implemented practice focusing on active use of the impaired hand in a play-based context. In contrast, Baby BIM promotes active play requiring both hands in a play-based context. Both interventions will be delivered by parents at home with monthly home visits and interim telecommunication support by study therapists. Assessments will be conducted at study entry; at 6, 12 months ca immediately postintervention (primary outcome) and 24 months ca (retention). The primary outcome will be the Mini-Assisting Hand Assessment. Secondary outcomes include the Bayley Scale for Infant and Toddler Development (cognitive and motor domains) and the Hand Assessment of Infants. A subset of children will undertake MRI scans at 24 months ca to evaluate brain lesion severity and brain (re)organisation after intervention.

ETHICS AND DISSEMINATION: Full ethical approvals for this study have been obtained from the relevant sites. The findings will be disseminated in peer-reviewed publications.

TRIAL REGISTRATION NUMBER: Australian and New Zealand Clinical Trials Registry:

ACTRN12615000180516, Pre results.

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DOI: 10.1136/bmjopen-2017-017204

PMID: 28928195

### **Reliability of the Assisting Hand Assessment in adolescents.**

Louwers A , Krumlinde-Sundholm L , Boeschoten K , Beelen A .

*Dev Med Child Neurol.* 2017 Sep;59(9):926-932. doi: 10.1111/dmcn.13465. Epub 2017 May 29.

**AIM:** To investigate the interrater and test-retest reliability of the Assisting Hand Assessment in adolescents (Ad-AHA) with cerebral palsy (CP) and to evaluate the alternate-form reliability of different test activities.

**METHOD:** Participants were 112 adolescents with unilateral CP (60 males, 52 females; mean age 14y 5mo [standard deviation {SD} 2y 8mo], Manual Ability Classification System levels I-III). Reliability was evaluated using intraclass correlation coefficients (ICC), smallest detectable change (SDC), and Bland-Altman plots.

**RESULTS:** ICCs for interrater (n=38) and test-retest reliability (n=31) were excellent: 0.97 (95% CI 0.94-0.98) and 0.99 (95% CI 0.98-0.99) respectively. The alternate-form reliability of different test activities was excellent for children (age 10-12y, n=30) performing the School-Kids AHA and Ad-AHA Board Game 0.99 (95% CI 0.98-0.99) and for adolescents (age 13-18y) performing the Ad-AHA Board Game compared to the Ad-AHA Present (n=28) 0.99 (95% CI 0.95-0.98), or the Ad-AHA Sandwich (n=29) 0.99 (95% CI 0.98-0.99) tasks. SDC for test-retest was 4.5 AHA-units.

**INTERPRETATION:** Ad-AHA scores are consistent across different raters and occasions. The good alternate-form reliability indicates that the different test activities can be used interchangeably in adolescents with unilateral CP. Differences greater than or equal to 5 AHA-units can be considered a change beyond measurement error. The use of logit based AHA-units makes change comparable for persons at different ability levels.

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PMID: 28555755 [Indexed for MEDLINE]

### **Requirements for and current provision of rehabilitation services for children after severe acquired brain injury in the UK: a population-based study.**

Hayes L , Shaw S , Pearce MS , Forsyth RJ .

*Arch Dis Child.* 2017 Sep;102(9):813-820. doi: 10.1136/archdischild-2016-312166. Epub 2017 Apr 17.

**OBJECTIVES:** Survival with brain injury is an outcome of severe illness that may be becoming more common. Provision for children in this situation has received little attention. We sought to estimate rates of severe paediatric acquired brain injury (ABI) requiring rehabilitation and to describe current provision of services for these children in the UK.

**METHODS:** This study conducted an analysis of Hospital Episode Statistics data between April 2003 and March 2012, supplemented by a UK provider survey completed in 2015. A probable severe ABI requiring rehabilitation (PSABIR) event was inferred from the co-occurrence of a medical condition likely to cause ABI (such as meningitis) and a prolonged inpatient stay ( $\geq 28$  days).

**RESULTS:** During the period studied, 4508 children aged 1-18 years in England had PSABIRs. Trauma was the most common cause (30%) followed by brain tumours (19%) and anoxia (18.3%). An excess in older males was attributable to trauma. We estimate the incidence of PSABIR to be at least 2.93 (95%CI 2.62 to 3.26) per 100 000 young people (1-18 years) pa. The provider survey confirmed marked geographic variability in the organisation of services in the UK.

**CONCLUSIONS:** There are at least 350 PSABIR events in children in the UK annually, a health problem of similar magnitude to that of cerebral palsy. Service provision for this population varies widely around the UK, in contrast with the nationally coordinated approach to paediatric intensive care and major trauma provision.

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DOI: 10.1136/archdischild-2016-312166

PMID: 28416561 [Indexed for MEDLINE]

### **The Feasibility and Validity of Body-Worn Sensors to Supplement Timed Walking Tests for Children with Neurological Conditions.**

Sivarajah L , Kane KJ , Lanovaz J , Bisaro D , Oates A , Ye M , Musselman KE .

*Phys Occup Ther Pediatr.* 2017 Sep 7:1-11. doi: 10.1080/01942638.2017.1357066. [Epub ahead of print]

**AIMS:** The 10-meter walk test (10 mWT) and Timed Up and Go (TUG) are assessments of speed/time with a ceiling effect in pediatric populations. This study aimed to (1) determine whether collecting spatiotemporal data with

inertial sensors (Mobility Lab, APDM Inc.) during these tests improves their discriminative validity, and (2) evaluate the clinical feasibility of Mobility Lab.

**METHODS:** Fifteen children with spina bifida (SB) or cerebral palsy (CP) ( $7.9 \pm 3.1$  years old) and fifteen age- and sex-matched typically-developing (TD) children completed the 10 mWT and TUG wearing Mobility Lab. Spatiotemporal data were compared between groups. Mobility Lab's potential to distinguish children with SB/CP from TD children was examined using conditional logistic regression. Feasibility was evaluated through participant adherence and a clinical utility scale.

**RESULTS:** For the 10 mWT, group differences ( $p < 0.01$ ) were found in horizontal and frontal trunk range of motion, horizontal trunk velocity, and swing asymmetry. Children with SB/CP took significantly longer to turn during the TUG. These five variables together distinguished the two groups ( $p = 0.006$ ). 78% of participants with SB/CP completed the testing protocol. Mobility Lab scored 4/10 on the clinical utility scale.

**CONCLUSIONS:** Instrumenting the 10 mWT and TUG improves the tests' ability to discriminate between children with SB/CP and TD children.

DOI: 10.1080/01942638.2017.1357066

PMID: 28880702

### **Treadmill interventions in children under six years of age at risk of neuromotor delay.**

Valentín-Gudiol M , Mattern-Baxter K, Girabent-Farrés M, Bagur-Calafat C, Hadders-Algra M, Angulo-Barroso RM.

Update of *Cochrane Database Syst Rev.* 2011 Dec 07;(12):CD009242.

*Cochrane Database Syst Rev.* 2017 Jul 29;7:CD009242. doi: 10.1002/14651858.CD009242.pub3.

**BACKGROUND:** Delayed motor development may occur in children with Down syndrome, cerebral palsy, general developmental delay or children born preterm. It limits the child's exploration of the environment and can hinder cognitive and social-emotional development. Literature suggests that task-specific training, such as locomotor treadmill training, facilitates motor development.

**OBJECTIVES:** To assess the effectiveness of treadmill interventions on locomotor development in children with delayed ambulation or in pre-ambulatory children (or both), who are under six years of age and who are at risk for neuromotor delay.

**SEARCH METHODS:** In May 2017, we searched CENTRAL, MEDLINE, Embase, six other databases and a number of trials registers. We also searched the reference lists of relevant studies and systematic reviews.

**SELECTION CRITERIA:** We included randomised controlled trials (RCTs) and quasi-RCTs that evaluated the effect of treadmill intervention in the target population.

**DATA COLLECTION AND ANALYSIS:** Four authors independently extracted the data. Outcome parameters were structured according to the International Classification of Functioning, Disability and Health model.

**MAIN RESULTS:** This is an update of a Cochrane review from 2011, which included five trials. This update includes seven studies on treadmill intervention in 175 children: 104 were allocated to treadmill groups, and 71 were controls. The studies varied in population (children with Down syndrome, cerebral palsy, developmental delay or at moderate risk for neuromotor delay); comparison type (treadmill versus no treadmill; treadmill with versus without orthoses; high- versus low-intensity training); study duration, and assessed outcomes. Due to the diversity of the studies, only data from five studies were used in meta-analyses for five outcomes: age of independent walking onset, overall gross motor function, gross motor function related to standing and walking, and gait velocity. GRADE assessments of quality of the evidence ranged from high to very low. The effects of treadmill intervention on independent walking onset compared to no treadmill intervention was population dependent, but showed no overall effect (mean difference (MD) -2.08, 95% confidence intervals (CI) -5.38 to 1.22, 2 studies, 58 children; moderate-quality evidence): 30 children with Down syndrome benefited from treadmill training (MD -4.00, 95% CI -6.96 to -1.04), but 28 children at moderate risk of developmental delay did not (MD -0.60, 95% CI -2.34 to 1.14). We found no evidence regarding walking onset in two studies that compared treadmill intervention with and without orthotics in 17 children (MD 0.10, 95% CI -5.96 to 6.16), and high- versus low-intensity treadmill interventions in 30 children with Down syndrome (MD -2.13, 95% -4.96 to 0.70). Treadmill intervention did not improve overall gross motor function (MD 0.88, 95% CI -4.54 to 6.30, 2 studies, 36 children; moderate-quality evidence) or gross motor skills related to standing (MD 5.41, 95% CI -1.64 to 12.43, 2 studies, 32 children; low-quality evidence), and had a negligible improvement in gross motor skills related to walking (MD 4.51, 95% CI 0.29 to 8.73, 2 studies, 32 children;

low-quality evidence). It led to improved walking skills in 20 ambulatory children with developmental delay (MD 7.60, 95% CI 0.88 to 14.32, 1 study) and favourable gross motor skills in 12 children with cerebral palsy (MD 8.00, 95% CI 3.18 to 12.82). A study which compared treadmill intervention with and without orthotics in 17 children with Down syndrome suggested that adding orthotics might hinder overall gross motor progress (MD -8.40, 95% CI -14.55 to -2.25). Overall, treadmill intervention showed a very small increase in walking speed compared to no treadmill intervention (MD 0.23, 95% CI 0.08 to 0.37, 2 studies, 32 children; high-quality evidence). Treadmill intervention increased walking speed in 20 ambulatory children with developmental delay (MD 0.25, 95% CI 0.08 to 0.42), but not in 12 children with cerebral palsy (MD 0.18, 95% CI -0.09 to 0.45).

**AUTHORS' CONCLUSIONS:** This update of the review from 2011 provides additional evidence of the efficacy of treadmill intervention for certain groups of children up to six years of age, but power to find significant results still remains limited. The current findings indicate that treadmill intervention may accelerate the development of independent walking in children with Down syndrome and may accelerate motor skill attainment in children with cerebral palsy and general developmental delay. Future research should first confirm these findings with larger and better designed studies, especially for infants with cerebral palsy and developmental delay. Once efficacy is established, research should examine the optimal dosage of treadmill intervention in these populations.

DOI: 10.1002/14651858.CD009242.pub3

PMID: 28755534 [Indexed for MEDLINE]

### **What areas of functioning are influenced by aquatic physiotherapy? Experiences of parents of children with cerebral palsy.**

Güeita-Rodríguez J , García-Muro F , Rodríguez-Fernández ÁL , Lambeck J , Fernández-de-Las-Peñas C , Palacios-Ceña D .

*Dev Neurorehabil.* 2017 Sep 21:1-9. doi: 10.1080/17518423.2017.1368728. [Epub ahead of print]

**OBJECTIVES:** To explore the experiences regarding aquatic physiotherapy among parents of children with cerebral palsy and to identify a list of relevant intervention categories for aquatic physiotherapy treatments.

**METHODS:** We conducted semi-structured interviews and focus groups using the components of the International Classification of Functioning, Disability and Health (ICF) as a frame of reference to explore and code experiences regarding aquatic physiotherapy. A non-probabilistic purposive sampling strategy was used. Content analysis methods and ICF linking processes were used to analyze data.

**RESULTS:** From the parents' perspective (n = 34), both the Body Functions and Activities and Participation components were mainly influenced by aquatic physiotherapy. Also, parents described Environmental Factors acting as barriers affecting progress during therapy.

**CONCLUSIONS:** Parents identified a wide range of categories influenced by aquatic physiotherapy. Social and contextual aspects were highlighted, as well as a series of changes related to the illness as a result of treatment.

DOI: 10.1080/17518423.2017.1368728

PMID: 28933572

### **Orthèses**

### **Do research papers provide enough information on design and material used in ankle foot orthoses for children with cerebral palsy? A systematic review.**

Eddison N , Mulholland M , Chockalingam N .

*J Child Orthop.* 2017 Aug 1;11 :263-271. doi: 10.1302/1863-2548.11.160256.

**OBJECTIVES:** The purpose of this article is to determine how many of the current peer-reviewed studies of ankle foot orthoses (AFOs) on children with cerebral palsy (CP) have included adequate details of the design and material of the AFO, to enable the study to be reproduced and outcomes clearly understood.

**METHODS:** A thorough search of studies published in English was conducted in March 2015, with no restriction on dates, within all major databases using relevant phrases. These searches were then supplemented by tracking all key references from the appropriate articles identified.

**STUDY SELECTION:** The inclusion criteria were as follows: (1) population - children with CP; (2) intervention - AFOs; and (3) outcome measure. One reviewer extracted data regarding the characteristics of the included studies, with

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the extracted data checked for accuracy and completeness by a second reviewer. None of the studies reviewed gave adequate details of the AFOs. Only 3.6% (n = 2) of papers tested the stiffness. Many studies (54.5%) did not describe the material used nor the material thickness (72.7 %). None of them gave any clinical justification for the chosen design of AFO.

**CONCLUSIONS:** There is a clear paucity of detail regarding the design and material used in AFOs on studies involving children with CP. Such a lack of detail has the potential to affect the validity of the reported outcomes, the ability to reproduce the studies and may misinform clinical practice.

[Free PMC Article](#)

DOI: 10.1302/1863-2548.11.160256

PMCID: PMC5584494

PMID: 28904631

### **Long-Term Effects of Orthoses Use on the Changes of Foot and Ankle Joint Motions of Children With Spastic Cerebral Palsy.**

Liu XC , Embrey D , Tassone C , Zvara K , Brandsma B , Lyon R , Goodfriend K , Tarima S , Thometz J .

*PM R. 2017 Sep 1. pii: S1934-1482(17)30004-7. doi: 10.1016/j.pmrj.2017.08.438. [Epub ahead of print]*

**BACKGROUND:** Orthoses commonly are prescribed to children with cerebral palsy (CP) to provide foot correction and to improve ambulatory function. Immediate effects of ankle foot orthosis (AFOs) have been investigated, but long-term kinematic effects are lacking clinical evidence.

**OBJECTIVE:** To determine changes in 3-dimensional ankle and foot segment motion in pediatric patients with CP between initial and follow-up visits (18-month average time differences) in both barefoot gait and gait with their AFO. We also investigated intravisit changes between barefoot and AFO gait.

**DESIGN:** A prospective cohort study.

**SETTING:** Children's Hospital of Wisconsin, Department of Orthopaedic Surgery, Medical College of Wisconsin.

**PATIENTS:** A total of 23 children with CP, mean age 10.5 years (6.2-18.1 years) were clinically prescribed either a solid ankle foot orthotic (SAFO), hinged ankle foot orthotic (HAFO), or supramalleolar orthotic.

**METHODS:** Holes were cut in the study orthoses so that electromagnetic markers could be directly placed on the skin. A 6-foot segment model was used.

**OUTCOME MEASUREMENTS:** Kinematic and kinetic data was recorded for each patient's initial and follow-up visit (18-month follow-up average, 15-20 months range). **RESULTS:** For the SAFO group (gait with AFO), a significant decrease in dorsiflexion was found between the initial and third visit (P = .008). Furthermore, the SAFO group (barefoot gait) had an increased eversion at the midfoot for most of the gait cycle (P < .008). Sagittal forefoot range of motion was reduced for all 3 groups between the barefoot and AFO groups.

**CONCLUSION:** The use of AFOs long term either maintained or improved foot deformities or dysfunction.

**LEVEL OF EVIDENCE:** To be determined.

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DOI: 10.1016/j.pmrj.2017.08.438

PMID: 28867667

### **Simulated impacts of ankle foot orthoses on muscle demand and recruitment in typically-developing children and children with cerebral palsy and crouch gait.**

Rosenberg M , Steele KM .

*PLoS One. 2017 Jul 13;12(7):e0180219. doi: 10.1371/journal.pone.0180219. eCollection 2017.*

Passive ankle foot orthoses (AFOs) are often prescribed for children with cerebral palsy (CP) to assist locomotion, but predicting how specific device designs will impact energetic demand during gait remains challenging. Powered AFOs have been shown to reduce energy costs of walking in unimpaired adults more than passive AFOs, but have not been tested in children with CP. The goal of this study was to investigate the potential impact of powered and passive AFOs on muscle demand and recruitment in children with CP and crouch gait. We simulated gait for nine children with crouch gait and three typically-developing children with powered and passive AFOs. For each AFO design, we computed reductions in muscle demand compared to unassisted gait. Powered AFOs reduced muscle

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demand 15-44% compared to unassisted walking, 1-14% more than passive AFOs. A slower walking speed was associated with smaller reductions in absolute muscle demand for all AFOs ( $r^2 = 0.60-0.70$ ). However, reductions in muscle demand were only moderately correlated with crouch severity ( $r^2 = 0.40-0.43$ ). The ankle plantarflexor muscles were most heavily impacted by the AFOs, with gastrocnemius recruitment decreasing 13-73% and correlating with increasing knee flexor moments ( $r^2 = 0.29-0.91$ ). These findings support the potential use of powered AFOs for children with crouch gait, and highlight how subject-specific kinematics and kinetics may influence muscle demand and recruitment to inform AFO design.

[Free PMC Article](#)

DOI: 10.1371/journal.pone.0180219

PMCID: PMC5509139

PMID: 28704464 [Indexed for MEDLINE]

**Testing Gait with Ankle-Foot Orthoses in Children with Cerebral Palsy by Using Functional Mixed-Effects Analysis of Variance.**

Zhang B , Twycross-Lewis R , Großmann H , Morrissey D .

*Sci Rep. 2017 Sep 11;7(1):11081. doi: 10.1038/s41598-017-11282-1.*

Existing statistical methods extract insufficient information from 3-dimensional gait data, rendering clinical interpretation of impaired movement patterns sub-optimal. We propose an alternative approach based on functional data analysis that may be worthy of exploration. We apply this to gait data analysis using repeated-measurements data from children with cerebral palsy who had been prescribed fixed ankle-foot orthoses as an example. We analyze entire gait curves by means of a new functional F test with comparison to multiple pointwise F tests and also to the traditional method - univariate repeated-measurements analysis of variance of joint angle minima and maxima. The new test maintains the nominal significance level and can be adapted to test hypotheses for specific phases of the gait cycle. The main findings indicate that ankle-foot orthoses exert significant effects on coronal and sagittal plane ankle rotation; and both sagittal and horizontal plane foot rotation. The functional F test provided further information for the stance and swing phases. Differences between the results of the different statistical approaches are discussed, concluding that the novel method has potential utility and is worthy of validation through larger scale patient and clinician engagement to determine whether it is preferable to the traditional approach.

[Free PMC Article](#)

DOI: 10.1038/s41598-017-11282-1

PMCID: PMC5594035

PMID: 28894132

**Robots -Exosquelettes**

**Development of a Robotic System for Enhancing Children's Motivation in Constraint Induced Movement Therapy (CIMT).**

Psychouli P , Cheng P , Dimopoulos C .

*Stud Health Technol Inform. 2017;242:479-483.*

This paper presents a novel robotic system, which aims to enhance children's motivation through the gamification of the CIMT process. The system offers adjustability of the required movement skills, ensuring children will put increasingly more effort to achieve the rehabilitation goal, while keeping the task fun and engaging.

PMID: 28873842

**Stimulation transcrânienne**

**Changes in spectroscopic biomarkers after transcranial direct current stimulation in children with perinatal stroke.**

Carlson HL , Ciechanski P , Harris AD , MacMaster FP , Kirton A .

*Brain Stimul. 2017 Sep 13. pii: S1935-861X(17)30899-9. doi: 10.1016/j.brs.2017.09.007. [Epub ahead of print]*

**BACKGROUND:** Perinatal stroke causes lifelong motor disability, affecting independence and quality of life. Non-invasive neuromodulation interventions such as transcranial direct current stimulation (tDCS) combined with intensive therapy may improve motor function in adult stroke hemiparesis but is under-explored in children. Measuring cortical metabolites with proton magnetic resonance spectroscopy (MRS) can inform cortical neurobiology in perinatal stroke but how these change with neuromodulation is yet to be explored.

**METHODS:** A double-blind, sham-controlled, randomized clinical trial tested whether tDCS could enhance intensive motor learning therapy in hemiparetic children. Ten days of customized, goal-directed therapy was paired with cathodal tDCS over contralesional primary motor cortex (M1, 20 min, 1.0 mA, 0.04 mA/cm<sup>2</sup>) or sham. Motor outcomes were assessed using validated measures. Neuronal metabolites in both M1s were measured before and after intervention using fMRI-guided short-echo 3T MRS.

**RESULTS:** Fifteen children [age(range) = 12.1(6.6-18.3) years] were studied. Motor performance improved in both groups and tDCS was associated with greater goal achievement. After cathodal tDCS, the non-lesioned M1 showed decreases in glutamate/glutamine and creatine while no metabolite changes occurred with sham tDCS. Lesioned M1 metabolite concentrations did not change post-intervention. Baseline function was highly correlated with lesioned M1 metabolite concentrations (N-acetyl-aspartate, choline, creatine, glutamate/glutamine). These correlations consistently increased in strength following intervention. Metabolite changes were not correlated with motor function change. Baseline lesioned M1 creatine and choline levels were associated with clinical response.

**CONCLUSIONS:** MRS metabolite levels and changes may reflect mechanisms of tDCS-related M1 plasticity and response biomarkers in hemiparetic children with perinatal stroke undergoing intensive neurorehabilitation.

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DOI: 10.1016/j.brs.2017.09.007

PMID: 28958737

### **Jeux video – Réalité virtuelle**

#### **Use of active video gaming in children with neuromotor dysfunction: a systematic review.**

Hickman R , Popescu L , Manzanares R , Morris B , Lee SP , Dufek JS .

*Dev Med Child Neurol.* 2017 Sep;59(9):903-911. doi: 10.1111/dmcn.13464. Epub 2017 May 19.

**AIM:** To examine current evidence on use of active video gaming (AVG) to improve motor function in children with movement disorders including cerebral palsy, developmental coordination disorder, and Down syndrome.

**METHOD:** Scopus, MEDLINE, Cochrane Library, EMBASE, and CINAHL were searched. Included papers studied the use of AVG for improving movement-related outcomes in these populations. Parameters studied included health condition, strength of evidence, AVG delivery methods, capacity for individualizing play, outcomes addressed, effectiveness for achieving outcomes, and challenges/limitations.

**RESULTS:** The 20 extracted articles varied in quality. Studies involved children with six different conditions using AVG in clinical, home, or school settings for

49 different motor outcomes. Dosage varied in frequency and duration. Choice of games played and difficulty level were therapist determined (n=6) or child controlled (n=14). The most common study limitations were small sample sizes and difficulty individualizing treatment. All articles showed improvement in outcomes with AVG, although differences were not consistently significant compared with conventional therapy.

**INTERPRETATION:** Heterogeneity of measurement tools and target outcomes prevented meta-analysis or development of formal recommendations. However, AVG is feasible and shows potential for improving outcomes in this population. Additional investigations of dosing variables, utility as a home supplement to clinical care, and outcomes with larger sample sizes are merited.

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DOI: 10.1111/dmcn.13464

PMID: 28542867 [Indexed for MEDLINE]

#### **Use of virtual reality intervention to improve reaction time in children with cerebral palsy: A randomized controlled trial.**

Pourazar M , Mirakhori F , Hemayattalab R , Bagherzadeh F .

**PURPOSE:** The purpose of this study was to investigate the training effects of Virtual Reality (VR) intervention program on reaction time in children with cerebral palsy.

**METHODS:** Thirty boys ranging from 7 to 12 years (mean = 11.20; SD = .76) were selected by available sampling method and randomly divided into the experimental and control groups. Simple Reaction Time (SRT) and Discriminative Reaction Time (DRT) were measured at baseline and 1 day after completion of VR intervention. Multivariate analysis of variance (MANOVA) and paired sample t-test were performed to analyze the results.

**RESULTS:** MANOVA test revealed significant effects for group in posttest phase, with lower reaction time in both measures for the experimental group. Based on paired sample t-test results, both RT measures significantly improved in experimental group following the VR intervention program.

**CONCLUSIONS:** This paper proposes VR as a promising tool into the rehabilitation process for improving reaction time in children with cerebral palsy.

DOI: 10.1080/17518423.2017.1368730

PMID: 28933977

### **Weight-supported training of the upper extremity in children with cerebral palsy: a motor learning study.**

Keller JW , van Hedel HJA .

*J Neuroeng Rehabil.* 2017 Aug 30;14(1):87. doi: 10.1186/s12984-017-0293-3.

**BACKGROUND:** Novel neurorehabilitation technologies build upon treatment principles derived from motor learning studies. However, few studies have investigated motor learning with assistive devices in children and adolescents with Cerebral Palsy (CP). The aim of this study was to investigate whether children with CP who trained with weight support in a playful, virtual environment would improve upper extremity task performance (i.e. skill acquisition), transfer, and retention, three aspects that indicate whether motor learning might have occurred or not.

**METHODS:** Eleven children with CP (mean age 13.3 years, standard deviation 3.4 years), who were mildly to moderately impaired, participated. They played in the Armeo® Spring the exergame Moorhuhn with their more affected arm during 3 days (70 min pure play time). For this within-subject design, kinematic assessments, the Box and Block Test, and five items of the Melbourne Assessment were administered twice during a baseline week (one week before the intervention), directly before and after the intervention, and one day after the training phase (retention).

**RESULTS:** The average exergame score improved from 209.55 to 339.73 ( $p < 0.001$ , Cohen's  $d = 1.80$ ), indicating skill acquisition. The change in the Box and Block test improved from 0.45 (baseline week) to 3.95 (intervention week;  $p = 0.008$ ,  $d = 1.59$ ) indicating skill transfer. The kinematic assessments and the Melbourne items did not change. Improvement in game score and Box and Block Test persisted one day later (retention).

**CONCLUSIONS:** We found evidence indicating the successful acquisition, transfer, and retention of upper extremity skills in children with CP. We therefore infer that motor learning occurred when children with CP trained their more affected arm with weight-support in a playful, virtual environment.

[Free PMC Article](#)

DOI: 10.1186/s12984-017-0293-3

PMCID: PMC5577664

PMID: 28854939

## **Thérapies cellulaires**

### **Expression of Concern to: Therapeutic potential of human embryonic stem cell transplantation in patients with cerebral palsy.**

Shroff G , Gupta A , Barthakur JK . Expression of concern for *J Transl Med.* 2014 Dec 12;12:318.

*J Transl Med.* 2017 Sep 18;15(1):193. doi: 10.1186/s12967-017-1292-7.

The Editor-in-Chief of the Journal of Translational Medicine is issuing an editorial expression of concern to alert readers that concerns have been raised regarding the ethics of this study [1] and the potential association of the risk

of teratoma formation with the transplantation of embryonic stem cells. Appropriate editorial action will be taken once this has been fully investigated. The authors disagree with this notice.

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DOI: 10.1186/s12967-017-1292-7

PMCID: PMC5604399

PMID: 28923074

**Stem cells and cell-based therapies for cerebral palsy: A call for rigor.**

*Pediatr Res.* 2017 Sep 18. doi: 10.1038/pr.2017.233. [Epub ahead of print]

Jantzie LL , Scafidi J , Robinson S .

Cell-based therapies hold significant promise for infants at risk for cerebral palsy (CP) from perinatal brain injury (PBI). PBI leading to CP results from multi-faceted damage to neural cells. Complex developing neural networks are injured by neural cell damage plus unique perturbations in cell signaling. Given that cell-based therapies can simultaneously repair multiple injured neural components during critical neurodevelopmental windows, these interventions potentially offer efficacy for patients with CP. Currently, use of cell-based interventions in infants at risk for CP is limited by critical gaps in knowledge. In this review, we will highlight key questions facing the field, including: Who are optimal candidates for treatment? What are goals of therapeutic interventions? What are best strategies for agent delivery, including timing, dosage, location and type? And, how are short- and long-term efficacy reliably tracked? Challenges unique to treating PBI with cell-based therapies, and lessons learned from cell-based therapies in closely related neurological disorders in the mature central nervous system (CNS), will be reviewed. Our goal is to update pediatric specialists who may be counseling families about the current state of the field. Finally, we will evaluate how rigor can be increased in the field to ensure the safety and best interests of this vulnerable patient population. *Pediatric Research* accepted article preview online, 18 September 2017.

doi:10.1038/pr.2017.233.

DOI: 10.1038/pr.2017.233

PMID: 28922350

**Umbilical cord blood cells for treatment of cerebral palsy; timing and treatment options.**

McDonald CA , Fahey MC , Jenkin G , Miller SL .

*Pediatr Res.* 2017 Sep 22. doi: 10.1038/pr.2017.236. [Epub ahead of print]

Cerebral palsy is the most common cause of physical disability in children, and there is no cure. Umbilical cord blood (UCB) cell therapy for the treatment of children with cerebral palsy is currently being assessed in clinical trials. While there is much interest in the use of UCB stem cells for neuroprotection and neuroregeneration, the mechanisms of action are not fully understood. Further, UCB contains many stem and progenitor cells of interest, and we will point out that individual cell types within UCB may elicit specific effects. UCB is a clinically proven source of hematopoietic stem cells (HSCs). It also contains mesenchymal stromal cells (MSCs), endothelial progenitor cells (EPCs) and immunosuppressive cells such as regulatory T cells (Tregs) and monocyte-derived suppressor cells. Each of these cell types may be individual candidates for the prevention of brain injury following hypoxic and inflammatory events in the perinatal period. We will discuss specific properties of cell types in UCB, with respect to their therapeutic potential and the importance of optimal timing of administration. We propose that tailored cell therapy and targeted timing of administration will optimise results for future clinical trials in the neuroprotective treatment of perinatal brain injury. *Pediatric Research* accepted

article preview online, 22 September 2017. doi:10.1038/pr.2017.236.

DOI: 10.1038/pr.2017.236

PMID: 28937975

## Langage - Communication

**Eye-gaze control technology for children, adolescents and adults with cerebral palsy with significant physical disability: Findings from a systematic review.**

Science Infos Paralysie Cérébrale, Septembre 2017, FONDATION PARALYSIE CEREBRALE 67 rue Vergniaud 75013 Paris - tel +33 1 45 54 03 03 contact: Christine Doumergue  
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Karlsson P , Allsop A , Dee-Price BJ , Wallen M .

*Dev Neurorehabil.* 2017 Sep 1:1-9. doi: 10.1080/17518423.2017.1362057. [Epub ahead of print]

**PURPOSE:** The primary objective of this systematic review was to examine the effectiveness of eye-gaze control technology for facilitating communication across different social contexts for people with cerebral palsy and significant physical disability.

**METHODS:** Systematic review.

**RESULTS:** The search identified 756 potentially eligible articles, of which two, low level articles were eligible. One study reported positive results for achieving communication goals for children with cerebral palsy. The second concluded that eye-gaze control technology resulted in greater quality of life and less depression for adults with late stage amyotrophic lateral sclerosis when compared to non-users.

**DISCUSSION:** Research regarding the effectiveness of eye-gaze control technology used to access a laptop, tablet or computer on communication outcomes, participation, quality of life and self-esteem in children, adolescents and adults with cerebral palsy and significant physical disability is sparse. A scoping review to fully identify issues to inform clinical practice and future research is required.

DOI: 10.1080/17518423.2017.1362057

PMID: 28862491

## **Douleur**

### **Pain Assessment and Treatment in Children With Significant Impairment of the Central Nervous System.**

Hauer J, Houtrow AJ; SECTION ON HOSPICE AND PALLIATIVE MEDICINE, COUNCIL ON CHILDREN WITH DISABILITIES.

*Pediatrics.* 2017 Jun;139(6). pii: e20171002. doi: 10.1542/peds.2017-1002.

Pain is a frequent and significant problem for children with impairment of the central nervous system, with the highest frequency and severity occurring in children with the greatest impairment. Despite the significance of the problem, this population remains vulnerable to underrecognition and undertreatment of pain. Barriers to treatment may include uncertainty in identifying pain along with limited experience and fear with the use of medications for pain treatment. Behavioral pain-assessment tools are reviewed in this clinical report, along with other strategies for monitoring pain after an intervention. Sources of pain in this population include acute-onset pain attributable to tissue injury or inflammation resulting in nociceptive pain, with pain then expected to resolve after treatment directed at the source. Other sources can result in chronic intermittent pain that, for many, occurs on a weekly to daily basis, commonly attributed to gastroesophageal reflux, spasticity, and hip subluxation. Most challenging are pain sources attributable to the impaired central nervous system, requiring empirical medication trials directed at causes that cannot be identified by diagnostic tests, such as central neuropathic pain. Interventions reviewed include integrative therapies and medications, such as gabapentinoids, tricyclic antidepressants,  $\alpha$ -agonists, and opioids. This clinical report aims to address, with evidence-based guidance, the inherent challenges with the goal to improve comfort throughout life in this vulnerable group of children.

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DOI: 10.1542/peds.2017-1002

PMID: 28562301 [Indexed for MEDLINE]

### **Parents and Physiotherapists Recognition of Non-Verbal Communication of Pain in Individuals with Cerebral Palsy.**

Riquelme I , Pades Jiménez A , Montoya P .

*Health Commun.* 2017 Aug 29:1-6. doi: 10.1080/10410236.2017.1358243. [Epub ahead of print]

Pain assessment is difficult in individuals with cerebral palsy (CP). This is of particular relevance in children with communication difficulties, when non-verbal pain behaviors could be essential for appropriate pain recognition. Parents are considered good proxies in the recognition of pain in their children; however, health professionals also need a good understanding of their patients' pain experience. This study aims at analyzing the agreement between parents' and physiotherapists' assessments of verbal and non-verbal pain behaviors in individuals with CP. A written survey about pain characteristics and non-verbal pain expression of 96 persons with CP (45 classified as communicative, and 51 as non-communicative individuals) was performed. Parents and physiotherapists displayed a

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high agreement in their estimations of the presence of chronic pain, healthcare seeking, pain intensity and pain interference, as well as in non-verbal pain behaviors. Physiotherapists and parents can recognize pain behaviors in individuals with CP regardless of communication disabilities.

DOI: 10.1080/10410236.2017.1358243

PMID: 28850264

## Autres Troubles / Troubles concomitants

### ✚ Sphère bucco-dentaire – Troubles de la déglutition

#### Parent-reported indicators for detecting feeding and swallowing difficulties and undernutrition in preschool-aged children with cerebral palsy.

Benfer KA , Weir KA , Ware RS , Davies PSW , Arvedson J , Boyd RN , Bell KL .

*Dev Med Child Neurol.* 2017 Sep 6. doi: 10.1111/dmcn.13498. [Epub ahead of print]

AIM: To determine the most accurate parent-reported indicators for detecting (1) feeding/swallowing difficulties and (2) undernutrition in preschool-aged children with cerebral palsy (CP).

METHOD: This was a longitudinal, population-based study, involving 179 children with CP, aged 18 to 60 months (mean 34.1mo [SD 11.9] at entry, 111 males, 68 females [Gross Motor Function Classification System level I, 84; II, 23; III, 28; IV, 18; V, 26], 423 data points). Feeding/swallowing difficulties were determined by the Dysphagia Disorders Survey and 16 signs suggestive of pharyngeal phase impairment. Undernutrition was indicated by height-weight and skinfold composite z-scores less than -2. Primary parent-reported indicators included mealtime duration, mealtime stress, concern about growth, and respiratory problems. Other indicators were derived from a parent feeding questionnaire, including 'significant difficulty eating and drinking'. Data were analysed using multilevel mixed-effects regression and diagnostic statistics.

RESULTS: Primary parent-reported indicators associated with feeding/swallowing were 'moderate-severe parent stress' (odds ratio [OR]=3.2 [95% confidence interval {CI} 1.3-7.8]; p<0.01), 'moderate-severe concern regarding growth' (OR=4.5 [95% CI 1.7-11.9]; p<0.01), and 'any respiratory condition' (OR=1.8 [95% CI 1.4-5.8]; p<0.01). The indicator associated with undernutrition was 'moderate-severe concern regarding growth' (height-weight OR=13.5 [95% CI 3.0-61.3]; p<0.01; skinfold OR=19.1 [95% CI 3.7-98.9]; p<0.01). 'Significant difficulty eating and drinking' was most sensitive/specific for feeding outcome (sensitivity=58.6%, specificity=100.0%), and 'parent concern regarding growth' for undernutrition (sensitivity=77.8%, specificity=77.0%).

INTERPRETATION: Parent-reported indicators are feasible for detecting feeding and swallowing difficulties and undernutrition in children with CP, but need formal validation.

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DOI: 10.1111/dmcn.13498

PMID: 28877337

#### Prognosis after treatment with multiple dental implants under general anesthesia and sedation in a cerebral palsy patient with mental retardation: A case report.

Hong YJ , Dan JB , Kim MJ , Kim HJ , Seo KS .

*J Dent Anesth Pain Med.* 2017 Jun;17(2):149-155. doi: 10.17245/jdapm.2017.17.2.149. Epub 2017 Jun 29.

Cerebral palsy is a non-progressive disorder resulting from central nervous system damage caused by multiple factors. Almost all cerebral palsy patients have a movement disorder that makes dental treatment difficult. Oral hygiene management is difficult and the risks for periodontitis, dental caries and loss of multiple teeth are high. Placement of dental implants for multiple missing teeth in cerebral palsy patients needs multiple rounds of general anesthesia, and the prognosis is poor despite the expense. Therefore, making the decision to perform multiple dental implant treatments on cerebral palsy patients is difficult. A 33-year-old female patient with cerebral palsy and mental retardation was scheduled for multiple implant treatments. She underwent computed tomography (CT) under sedation and the operation of nine dental implants under general anesthesia. Implant-supported fixed prosthesis treatment was completed. During follow-up, she had the anterior incisors extracted and underwent the

surgery of 3 additional dental implants, completing the prosthetic treatment. Although oral parafunctions existed due to cerebral palsy, no implant failure was observed 9 years after the first implant surgery.

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DOI: 10.17245/jdapm.2017.17.2.149

PMCID: PMC5564150

PMID: 28879344

## Nutrition

### **Comparative study on gastrostomy and orally nutrition of children and adolescents with tetraparesis cerebral palsy.**

Caselli TB , Lomazi EA , Montenegro MAS , Bellomo-Brandão MA .

*Arq Gastroenterol.* 2017 Sep 21:0. doi: 10.1590/S0004-2803.201700000-48. [Epub ahead of print]

**BACKGROUND::** Gastrostomy tube feeding (GTF) is indicated for children with feeding difficulties due to tetraspastic cerebral palsy, although there are no definitive conclusions about the benefits of GTF.

**OBJECTIVE::** To compare nutritional status and diet of pediatric patients with tetraparesis cerebral palsy who are fed by GTF with those fed orally (PO).

**METHODS::** A transversal and descriptive study on 54 patients with spastic tetraparesis was held. The referred parameters were: weight, knee height and estimated height, cutaneous folds and circumferences. The Frisancho reference was used to compare the skin folds and body circumferences. The Brooks et al. curve was adopted as a reference for weight, height, and BMI. Food inquiry was performed using the Habitual Dietary Recall method. The total energetic value (TEV) of macronutrients and fibers was performed by Avanutri® version 4.0, a nutrition software program. The differences of nutritional parameters between the GTF and the PO groups were calculated by chi-squared and Fisher's exact tests, and the comparison between the groups for variable numbers was performed using the Mann-Whitney test. The significance level adopted was 5%.

**RESULTS::** The PO group presented more individuals in the malnourished range (24.14%) and high levels of adipose and thin mass depletion. The ingestion of lipids was larger in the GTF group, even though the proteins and fibers were higher in the PO group. The comparison between the diets in the GTF group indicated that the mixed diet (industrialized and artisanal) supplied a greater contribution of proteins and fibers.

**CONCLUSION::** Comparing the groups, the tetraparesis cerebral palsy patients fed orally have a greater impairment of their nutritional status, even though they have higher intakes of protein and fiber than those patients fed by gastrostomy, demonstrating a consistent argument for the use of gastrostomy.

[Free Article](#)

DOI: 10.1590/S0004-2803.201700000-48

PMID: 28954047

### **Comparing behavioral treatment of feeding difficulties and tube dependence in children with cerebral palsy and autism spectrum disorder.**

Taylor T , Kozlowski AM , Girolami PA .

*NeuroRehabilitation.* 2017 Sep 16. doi: 10.3233/NRE-162071. [Epub ahead of print]

**BACKGROUND:** Feeding disorders are multifaceted with behavioral components often contributing to the development and continuation of food refusal. In these cases, behavioral interventions are effective in treating feeding problems, even when medical or oral motor components are also involved. Although behavioral interventions for feeding problems are frequently employed with children with autism, they are less commonly discussed for children with cerebral palsy.

**OBJECTIVE:** The purpose of this study was to compare the effectiveness of using applied behavior analytic interventions to address feeding difficulties and tube dependence in children with autism and children with cerebral palsy.

**METHOD:** Children ages 1 to 12 years who were enrolled in an intensive feeding program between 2003 and 2013, where they received individualized behavioral treatment, participated. **RESULTS:** Behavioral treatment components were similar across groups, predominately consisting of escape extinction (e.g., nonremoval of the spoon) and

differential reinforcement. For both groups, behavioral treatment was similarly effective in increasing gram consumption and in decreasing refusal and negative vocalizations. A high percentage of individualized goals were met by both groups as well as high caregiver satisfaction reported.

**CONCLUSIONS:** Behavioral interventions for food refusal are effective for children with cerebral palsy with behavioral refusal, just as they are for children with autism.

DOI: 10.3233/NRE-162071

PMID: 28946574

### **Detection of gastroesophageal reflux in children with cerebral palsy using combined multichannel intraluminal impedance-ph procedure.**

Çaltepe G , Yüce Ö , Comba A , Özyürek H , Kalaycı AG , Taşdemir HA .

*Turk J Pediatr.* 2016;58(5):524-531. doi: 10.24953/turkped.2016.05.010.

Gastroesophageal reflux (GER) is a very common condition in children with neurological impairment and this can influence nutritional and respiratory outcomes. The aim of this study was to investigate the presence of GER in children with cerebral palsy (CP) using multiple intraluminal impedance (MII)-pH monitoring. The use of combined MII-pH allows for the detection of both acid and non-acid reflux episodes. A total of 29 CP patients with symptoms suggesting GER, aged 2 to 10 years old, underwent 24-hour combined MII-pH monitoring. There were a total of 3899 reflux episodes, of which 29% were acid, 60% were weakly acid and 11% were alkaline. The number of non-acid reflux episodes was statistically significantly greater ( $p < 0.01$ ). These findings confirm that GER disease is seen frequently in children with cerebral palsy and most of the reflux episodes are not acidic. Non-acid reflux can also influence the morbidity in patients with cerebral palsy. It can be concluded that 70% of the reflux episodes would not have been recognized by pH measurement alone.

#### [Free Article](#)

DOI: 10.24953/turkped.2016.05.010

PMID: 28621094 [Indexed for MEDLINE]

### **[Morbimortality associated to nutritional status and feeding path in children with cerebral palsy].[Article in Spanish]**

Fiuroa MJ , Rojas C , Barja S .

*Rev Chil Pediatr.* 2017;88(4):478-486. doi: 10.4067/S0370-41062017000400006.

**INTRODUCTION:** Children and adolescents with cerebral palsy (CP) have a high prevalence of malnutrition associated to poor prognosis. For an adequate nutritional assessment, new growth curves (Brooks, 2011) are available, in which precise cut-off points in Weight/Age index correlate to increased morbidity and mortality rate.

**OBJECTIVE:** To evaluate risk of hospitalization and death in patients with CP, according to nutritional risk (NR).

**PATIENTS AND METHOD:** Observational and prospective cohort study of patients with CP in an outpatient referral center. We registered demographic, socioeconomic data and nutritional assessment. During a one-year follow-up, hospitalizations and mortality were recorded. The correspondent committee extended an ethical approval.

**RESULTS:** 81 CP patients were recruited, age  $131.6 \pm 60.4$  months (25-313), 60 % male, 77.5 % without independent mobility. The 23 NR patients (28.4%) had lower muscle and fat mass ( $p = 0.000$ ). During the follow-up, 29/81 patients required hospitalization (35.8%) and 4/81 died (4.9%). There was not an increased risk of hospitalization and/or mortality in NR group, but both were significantly higher in gastrostomy-fed children (RR: 2,98 CI 95%: 1.32-6.75 combining both variables).

**CONCLUSIONS:** In this study, children and adolescents with severe CP and nutritional risk had similar morbidity and mortality during a one-year follow-up, compared to those with acceptable nutritional status. Both risks were higher in gastrostomy-fed than the orally fed children.

DOI: 10.4067/S0370-41062017000400006

PMID: 28898315

## **Troubles urinaires**

### **Urodynamic Findings in Adults With Moderate to Severe Cerebral Palsy.**

Science Infos Paralysie Cérébrale, Septembre 2017, FONDATION PARALYSIE CEREBRALE 67 rue Vergniaud 75013 Paris - tel +33 1 45 54 03 03 contact: Christine Doumergue  
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Cotter KJ , Levy ME , Goldfarb RA , Liberman D , Katorski J , Myers JB , Elliott SP .  
*Urology*. 2016 Sep;95:216-21. doi: 10.1016/j.urology.2016.05.024. Epub 2016 May 19.

**OBJECTIVE:** To determine urodynamic studies (UDS) findings in adult cerebral palsy (CP) patients. CP patients may suffer from voiding dysfunction. UDS in children with CP has consistently shown an upper motor neuron bladder with detrusor-sphincter dyssynergia.

**METHODS:** We included adult CP patients seen at Gillette Transitional Urology Clinic who underwent UDS for voiding dysfunction between 2011 and 2014. Descriptive statistics were used to characterize findings.

**RESULTS:** There were 49/211 CP patients who underwent UDS. Average age was 30 years; 55% were men. Ninety-eight percent had moderate to severe CP. UDS was initiated for irritative symptoms in 55%, obstructive voiding symptoms in 25%, hydronephrosis in 18%, and other reasons in 2%. Incontinence was reported in 57%. Detrusor-sphincter dyssynergia was seen in 12%, detrusor overactivity in 30%, and detrusor leak point pressure (DLPP) >40 cmH<sub>2</sub>O in 51%. Median compliance was 18 mL/cmH<sub>2</sub>O (0.78-365). Maximum cystometric capacity (MCC) was 80-1400 mL and was <300 mL in 27%. Sixteen percent had an MCC <300 mL and a compliance <20 mL/cmH<sub>2</sub>O. Twelve percent had an MCC <300 mL and a DLPP >40 cmH<sub>2</sub>O.

**CONCLUSION:** UDS findings in symptomatic adult CP patients are varied. Fifty-one percent had upper motor neuron bladder findings, similar to that seen in the pediatric literature, but 6% had large flaccid bladders. Half of the patients had concerning findings, such as compliance <20 or DLPP >40 cmH<sub>2</sub>O. Our results emphasize the need to thoroughly investigate voiding dysfunction in those with CP. Further characterization of this population is needed to correlate these UDS findings with clinical outcomes.

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DOI: 10.1016/j.urology.2016.05.024

PMID: 27210572 [Indexed for MEDLINE]

## Troubles visuels

### **Vision Assessments and Interventions for Infants 0-2 Years at High Risk for Cerebral Palsy: A Systematic Review.**

Chorna OD , Guzzetta A , Maitre NL .

*Pediatr Neurol*. 2017 Jul 20. pii: S0887-8994(17)30544-1. doi: 10.1016/j.pediatrneurol.2017.07.011. [Epub ahead of print]

We performed a systematic review and evaluated the level of evidence of vision interventions and assessments for infants at high risk for or with a diagnosis of cerebral palsy from 0 to 2 years of age. Articles were evaluated based on the level of methodologic quality, evidence, and clinical utilization. Thirty publications of vision assessments and five of vision interventions met criteria for inclusion. Assessments included standard care neuroimaging, electrophysiology, and neuro-ophthalmologic examination techniques that are utilized clinically with any preverbal or nonverbal pediatric patient. The overall level of evidence of interventions was strong for neuroprotective interventions such as caffeine and hypothermia but weak for surgery, visual training, or developmental programs. There are few evidence-based interventions and assessments that address cerebral/cortical visual impairment-related needs of infants and toddlers at high risk for or with cerebral palsy. Recommendation guidelines include the use of three types of standard care methodologies and two types of protective interventions.

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DOI: 10.1016/j.pediatrneurol.2017.07.011

PMID: 28918222

## Croissance

### **Validation of US cerebral palsy growth charts using a UK cohort.**

Wright CM , Reynolds L , Ingram E , Cole TJ , Brooks J .

*Dev Med Child Neurol*. 2017 Sep;59(9):933-938. doi: 10.1111/dmcn.13495. Epub 2017 Jun 28.

**AIM:** Growth charts for cerebral palsy (CP) have been constructed using data for 24 920 Californian patients, covering ages 2 to 20 years, with separate charts for the five severity levels of the Gross Motor Function

Classification System (GMFCS). Our aim was to test how the data for British children with CP fit these charts, compared with conventional local charts.

METHOD: US CP growth reference was reanalysed using the lambda-mu-sigma (LMS) method to allow calculation of standard deviation z-scores. Growth data for 195 children with CP in Glasgow, UK, were retrieved and converted to z-scores using the CP reference as well as the combined World Health Organization and UK 1990 growth reference (UK-WHO).

RESULTS: Compared to the UK-WHO reference, measurements diverged progressively with increasing severity, with mean height for GMFCS level V being close to the second UK-WHO centile. Compared with the CP reference, mean height and weight z-scores were between the 50th and 75th centiles for all severity levels, while body mass index was just below the 50th centile.

INTERPRETATION: British children with severe CP seem relatively very small when their growth data are plotted on non-CP charts, but their data for weight and body mass index fit well to US CP charts and reasonably well for height. The LMS look-up tables will make it possible to calculate z-scores and produce charts in local formats.

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DOI: 10.1111/dmnc.13495

PMID: 28656704 [Indexed for MEDLINE]

## Santé mentale

### **The prevalence of mental health disorders and symptoms in children and adolescents with cerebral palsy: a systematic review and meta-analysis.**

Downs J , Blackmore AM , Epstein A , Skoss R , Langdon K , Jacoby P , Whitehouse AJO , Leonard H , Rowe PW , Glasson EJ ; Cerebral Palsy Mental Health Group.  
*Dev Med Child Neurol.* 2017 Sep 15. doi: 10.1111/dmnc.13555. [Epub ahead of print]

AIM: Mental health conditions and problems are often reported in children and adolescents with cerebral palsy (CP). A systematic review was undertaken to describe their prevalence.

METHOD: MEDLINE and PsycINFO databases from 1996 to 2016 were searched and reference lists of selected studies were reviewed. Studies were included if they reported point prevalence of mental health diagnoses or symptoms in a general population of children and/or adolescents with CP. Pooled prevalence for mental health symptoms was determined using a random effects meta-analysis.

RESULTS: Of the 3158 studies identified, eight met the inclusion criteria. Mental health disorders were diagnosed by psychiatric interview in one study, giving a prevalence of 57% (32 out of 56 children). The remaining seven studies (n=1715 children) used parent-report mental health screening tools. The pooled prevalence for mental health symptoms using the Strengths and Difficulties Questionnaire (n=5 studies) was 35% (95% confidence interval [CI] 20-61) and using the Child Behavior Checklist (n=2 studies) was 28% (95% CI 22-36). Evidence was characterized by a moderate level of bias.

INTERPRETATION: More studies are needed to ascertain the prevalence of mental health disorders. Mental health symptoms are common and mental health evaluations should be incorporated into multidisciplinary assessments for these children.

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PMID: 28914445

## **Qualité de vie et rapport au monde**

### Qualité de vie – Retentissement dans la vie quotidienne

#### **Enteral feeding and its impact on family mealtime routines for caregivers of children with cerebral palsy: A mixed method study.**

Russell M , Jewell V , Poskey GA , Russell A .

*Aust Occup Ther J.* 2017 Aug 29. doi: 10.1111/1440-1630.12418. [Epub ahead of print]

**BACKGROUND/AIM:** Enteral feedings are part of the daily mealtime experience for many caregivers of children with cerebral palsy. The scope of occupational therapy practice incorporates multiple aspects of the enteral feeding process. Yet, the research in this area is very limited. The purpose of this study was to provide practitioners with better understanding of the impact enteral feedings of children with cerebral palsy have on family mealtime routines.

**METHODS:** Using a complimentary mixed method approach, data were obtained through an online survey containing the Satisfaction Questionnaire with Gastrostomy Feeding (SAGA-8) and supplementary questions, and qualitative semi-structured phone interviews. Participants were caregivers of children with cerebral palsy who receive their primary nutrition through a gastrostomy tube.

**RESULTS:** This study's cohort consisted of n = 36, SAGA-8, and n = 6 in-depth interviews. The mean age of children of was 9.4 (6.94 SD) with a mean age of 3.4 (5.35 SD) when enteral feeding was introduced. While families' overall situations positively changed after the gastrostomy tube placement, environmental barriers and length of feeding time continued to present a challenge to mealtime routines. The mixed methods data analysis revealed that successful adjustment to having a child with a gastrostomy tube and problem solving are closely linked and a consistent part of mealtime experience. **CONCLUSION:** Findings highlighted the necessity of comprehensive support from health professionals in achieving positive mealtime experience. Themes in this study indicated that caregivers would benefit from a professional with knowledge in the development and integration of rituals and routines to support positive outcomes.

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DOI: 10.1111/1440-1630.12418

PMID: 28850693

### **Influences on students' assistive technology use at school: the views of classroom teachers, allied health professionals, students with cerebral palsy and their parents.**

Karlsson P , Johnston C , Barker K .

*Disabil Rehabil Assist Technol.* 2017 Sep 7:1-9. doi: 10.1080/17483107.2017.1373307. [Epub ahead of print]

**PURPOSE:** This study explored how classroom teachers, allied health professionals, students with cerebral palsy, and their parents view high-tech assistive technology service delivery in the classroom.

**METHODS:** Semi-structured interviews with six classroom teachers and six parents and their children were conducted. Additionally, two focus groups comprising 10 occupational therapists and six speech pathologists were carried out. Ethical and confidentiality considerations meant that the groups were not matched.

**RESULTS:** Results revealed that it is often untrained staff member who determine students' educational needs. The participants' experiences suggested that, particularly in mainstream settings, there is a need for support and guidance from a professional with knowledge of assistive technology who can also take a lead and guide classroom teachers in how to meet students' needs. Students' motivation to use the technology was also found to be critical for its successful uptake.

**CONCLUSIONS:** The study points to the need for classroom teachers to be given sufficient time and skill development opportunities to enable them to work effectively with assistive technology in the classroom. The participants' experiences suggest that such opportunities are not generally forthcoming. Only in this way can it be ensured that students with disabilities receive the education that is their right. Implications for Rehabilitation Classroom teachers, allied health professionals, students, parents need ongoing support and opportunities to practise operational, strategic and linguistic skills with the assistive technology equipment. System barriers to the uptake of assistive technology need to be addressed. To address the lack of time available for training, programming and other support activities around assistive technology, dedicated administrative support is crucial. Professional development around the use of the quality low cost ICF-CY checklist is recommended for both school and allied health staff.

DOI: 10.1080/17483107.2017.1373307

PMID: 28880695

### **Protocol for a systematic review of instruments for the assessment of quality of life and well-being in children and adolescents with cerebral palsy.**

Mpundu-Kaambwa C , Chen G , Huynh E , Russo R , Ratcliffe J .

**INTRODUCTION:** Cerebral palsy is the most common cause of physical disability in children and adolescents and is associated with impairments that may reduce the quality of life (QOL) of this population. Patient-reported outcome measures (PROMs) can facilitate the assessment of the effect of disease and treatment on QOL, from a patient viewpoint. The purpose of this systematic review is to identify PROMs that are used to measure QOL and subjective well-being (SWB) outcomes in young people with cerebral palsy and to evaluate the suitability of these PROMs for application in economic evaluations within this population.

**METHODS AND ANALYSIS:** MEDLINE, Scopus, the Cochrane Library, Web of Science Core Collection, EconLit, PsycINFO, CINAHL, EMBASE and Informit will be systematically searched from inception to date of search. Published peer-reviewed, English-language articles reporting PROMs measuring QOL or SWB outcomes in children and adolescents with cerebral palsy will be included. One reviewer will conduct the initial search and screen titles and abstracts for potentially eligible studies. The search will be performed in November 2017. To reduce the likelihood of reviewer selection bias, two other reviewers will independently screen a randomly selected subsample (10%) of the citations. Two reviewers will then retrieve full texts of potentially eligible studies and assess them against predefined inclusion criteria. The suitability of selected PROMs for use in economic evaluations of young people with cerebral palsy will be assessed using the International Society of Quality of Life Research recommended Minimum Standards and the Patient-Centered Outcomes and Comparative Effectiveness Research checklist. A narrative synthesis of extracted data will be presented including study descriptive data, PROMs measurement properties, settings in which they were applied and the valuation methods. Recommendations for practice on the selection of PROMs for use in economic evaluations of children and adolescents with cerebral palsy will be presented.

**ETHICS AND DISSEMINATION:** Ethical approval is not required as the proposed systematic review will not use primary data. The results of this study will be widely disseminated through publication in a peer-reviewed journal and conference presentation(s).

**SYSTEMATIC REVIEW REGISTRATION NUMBER:** International Prospective Register of Systematic Reviews number: CRD42016049746.

#### [Free Article](#)

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DOI: 10.1136/bmjopen-2017-015924

PMID: 28899888

### **Relationship between activity limitation and health-related quality of life in school-aged children with cerebral palsy: a cross-sectional study.**

Park EY .

*Health Qual Life Outcomes.* 2017 Apr 28;15(1):87. doi: 10.1186/s12955-017-0650-8.

**BACKGROUND:** Information on health-related quality of life is becoming increasingly important in children with cerebral palsy. This study investigated the relationship between activity limitation and health-related quality of life in school-aged children with cerebral palsy.

**METHODS:** Data were collected from 71 children aged 6-15 years with cerebral palsy. Activity limitations were assessed using functional classification systems, including the Korean-Gross Motor Function Classification System (K-GMFCS) and the Korean-Manual Ability Classification System (K-MACS). Health-related quality of life was assessed using the Korean version of the Childhood Health Assessment Questionnaire. Physical therapists collected the data by interviewing the parents of the subjects.

**RESULTS:** Both the K-GMFCS and the K-MACS were significantly positively correlated with the Childhood Health Assessment Questionnaire. The Childhood Health Assessment Questionnaire score differed significantly with respect to the functional classification systems. The differences in the ratings according to the K-GMFCS levels were significant, except those between levels I and II, levels II and III, levels III and IV, and levels IV and V. In the K-MACS, there were no significant differences between levels I and II, levels III and IV, and levels IV and V. The K-GMFCS and the K-MACS were significant predictors of health-related quality of life, demonstrating 75.5% of the variance ( $p < 0.05$ ).

CONCLUSION: Comprehensive information on children with cerebral palsy should be gathered to provide professionals with a better understanding of health-related quality of life.

[Free PMC Article](#)

DOI: 10.1186/s12955-017-0650-8

PMCID: PMC5408405

PMID: 28454541 [Indexed for MEDLINE]

### **Self-rating of daily time management in children: psychometric properties of the Time-S.**

Sköld A , Janeslätt GK .

*Scand J Occup Ther.* 2017 May;24(3):178-186. doi: 10.1080/11038128.2016.1185465. Epub 2016 Jul 8.

BACKGROUND: Impaired ability to manage time has been shown in several diagnoses common in childhood. Impaired ability involves activities and participation domain (daily time management, DTM) and body function and structure domain (time-processing ability, TPA). DTM needs to be evaluated from an individual's own perspective. To date, there has been a lack of self-rating instruments for children that focus on DTM.

AIM: The aim of this study is to describe psychometric properties of Time-S when used in children aged 10-17 years with a diagnosis of ADHD, Autism, CP or mild ID. Further, to test whether TPA correlates with self-rated DTM.

MATERIAL AND METHODS: Eighty-three children aged 10-17 years participated in the study. Rasch analysis was used to assess psychometric properties. Correlation analysis was performed between Time-S and a measure of TPA.

RESULTS: The 21 items of the Time-S questionnaire fit into a unitary construct measuring self-perceived daily management of an individual's time. A non-significant, small correlation was found between TPA and DTM.

CONCLUSION AND SIGNIFICANCE: The results indicate good psychometric properties for the questionnaire. The questionnaire is potentially useful in intervention planning and evaluation.

DOI: 10.1080/11038128.2016.1185465

PMID: 27387553 [Indexed for MEDLINE]

### **Understanding participation of children with cerebral palsy in family and recreational activities.**

Alghamdi MS , Chiarello LA , Palisano RJ , McCoy SW .

*Res Dev Disabil.* 2017 Oct;69:96-104. doi: 10.1016/j.ridd.2017.07.006. Epub 2017 Aug 30.

AIMS: The primary aim of this study was to determine the effect of age, sex, gross motor, manual ability, and communication functions on the frequency and enjoyment of children's participation in family and recreational activities. The secondary aim was to determine the relationships between motor and communication functions and participation.

METHODS: Participants were 694 children, 1.5-12 years old, with cerebral palsy (CP) and their parents across the US and Canada. Parents rated children's frequency and enjoyment of participation using the Child Engagement in Daily Life measure. Parents and therapists identified children's level of function using Gross Motor Function Classification System (GMFCS), Manual Ability Classification System (MACS), and Communication Function Classification System (CFCs).

RESULTS: Differences in frequency and enjoyment of participation were found based on children's GMFCS, MACS, and CFCs levels but not age or sex. Children with higher gross motor, manual, and communication functions had higher frequency and enjoyment of participation, compared to children with lower functions. Frequency of participation was associated with GMFCS and CFCs levels whereas enjoyment of participation was only associated with CFCs level.

IMPLICATIONS: Knowledge of child's gross motor, manual ability, and communication functions of children with CP is important when setting goals and planning interventions for participation.

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DOI: 10.1016/j.ridd.2017.07.006

PMID: 28843215

## **Activité physique**

### **Evidence for increasing physical activity in children with physical disabilities: a systematic review.**

Science Infos Paralyse Cérébrale, Septembre 2017, **FONDATION PARALYSIE CEREBRALE** 67 rue Vergniaud 75013 Paris - tel +33 1 45 54 03 03 contact: Christine Doumergue  
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Bloemen M , Van Wely L , Mollema J , Dallmeijer A , de Groot J .

*Dev Med Child Neurol.* 2017 Oct;59(10):1004-1010. doi: 10.1111/dmcn.13422. Epub 2017 Apr 4.

**AIM:** To summarize the best evidence of interventions for increasing physical activity in children with physical disabilities.

**METHOD:** A systematic review was conducted using an electronic search executed in Academic Search Elite, Academic Search Premier, CINAHL, Embase, MEDLINE, PEDro, PsychINFO, and SPORTDiscus up to February 2016. The selection of articles was performed independently by two researchers according to predetermined eligibility criteria. Data extraction, methodological quality, and levels of evidence were independently assessed by two researchers using a data-collection form from the Cochrane Collaboration and according to the guidelines of the American Academy for Cerebral Palsy and Developmental Medicine.

**RESULTS:** Seven studies were included. Five randomized controlled trials ranged from strong level I to weak level II studies, and two pre-post design studies were classified as level IV. There is level I evidence for no effect of physical training on objectively measured physical activity, conflicting level II evidence for interventions with a behavioural component on the increase of objectively measured physical activity directly after the intervention, and level II evidence for no effect during follow-up. Results are limited to children with cerebral palsy as no other diagnoses were included.

**INTERPRETATION:** Increasing physical activity in children with physical disabilities is very complex and demands further development and research.

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DOI: 10.1111/dmcn.13422

PMID: 28374442 [Indexed for MEDLINE]

### **'It's important that we learn too': Empowering parents to facilitate participation in physical activity for children and youth with disabilities.**

Willis CE , Reid S , Elliott C , Nyquist A , Jahnsen R , Rosenberg M , Girdler S .

*Scand J Occup Ther.* 2017 Sep 20:1-14. doi: 10.1080/11038128.2017.1378367. [Epub ahead of print]

**AIM:** The actions and behaviors of parents have been identified as key factors that influence a child's participation in physical activity. However, there is limited knowledge of how parents can be supported to embody facilitative roles. This study aimed to explore how an ecological intervention encourages parents of children with disabilities to develop as facilitators, to enable ongoing physical activity participation in a child's local environment.

**METHODS:** A qualitative design using grounded theory was employed. Forty four parents (26 mothers, 18 fathers) of 31 children with a range of disabilities (mean age 12y 6m (SD 2y 2m); 18 males) partaking in the Local Environment Model intervention at Beitostolen Healthsports Centre in Norway participated in the study. Data were derived from the triangulation of semi-structured interviews and participant observation. Data analysis was an iterative approach of constant comparison, where data collection, memo writing, open, axial and selective coding analysis, were undertaken simultaneously. Findings were consolidated into a model describing the central phenomenon and its relationship to other categories.

**RESULTS:** Thematic concepts uncovered in this study describe a social process of parent learning and empowerment, comprising three primary components; (i) active ingredients of the intervention that enabled learning and empowerment to transpire, (ii) parent learning and empowerment as a process, and (iii) related outcomes.

**CONCLUSION:** A family-centered approach, encompassing family-to-family support, may enhance physical activity participation outcomes for children and youth with disabilities.

DOI: 10.1080/11038128.2017.1378367

PMID: 28927322

### **The efficacy of interventions to increase physical activity participation of children with cerebral palsy: a systematic review and meta-analysis.**

Reedman S , Boyd RN , Sakzewski L .

*Dev Med Child Neurol.* 2017 Oct;59(10):1011-1018. doi: 10.1111/dmcn.13413. Epub 2017 Mar 20.

**AIM:** To determine efficacy of therapy and behaviour change interventions to increase the level of participation in leisure-time physical activities (LTPAs) and habitual physical activity in children and young people with cerebral palsy. **METHOD:** Five databases were systematically searched. Included studies were randomized or comparison designs. Methodological quality was assessed with a modified Downs and Black Scale. Quantitative analysis was performed using RevMan 5.3 (The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark). Intervention components and behaviour change constructs were mapped against (1) the International Classification of Functioning, Disability and Health (ICF) and (2) the Theoretical Domains Framework.

**RESULTS:** Searches yielded 2487 unique articles. Eight studies (nine articles) were included. Interventions included physical training, activity level training, combined physical training and behaviour change therapy, online behaviour change modules, and context-focused therapy. Study quality varied from moderate to high. There was a small, significant effect of physical activity intervention compared with passive usual care on level of habitual physical activity, of approximately 1000 additional steps per day (standardized mean difference 0.34, 95% confidence interval 0.03-0.66,  $p=0.030$ ). There was no significant effect on LTPA participation (standardized mean difference 0.40, 95% confidence interval -0.40 to 1.19,  $p=0.330$ ).

**INTERPRETATION:** Therapy and behaviour change interventions have the potential to increase LTPA participation of children and young people with cerebral palsy, although there is a need to depart from impairment-focused approaches. Inappropriate selection of outcomes and inadequate reporting of complex interventions are barriers to progress in this field.

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DOI: 10.1111/dmnc.13413

PMID: 28318009 [Indexed for MEDLINE]

### **Yes We Can! A Phenomenological Study of a Sports Camp for Young People With Cerebral Palsy.**

Aggerholm K , Moltke Martiny KM .

*Adapt Phys Activ Q. 2017 Sep 23:1-20. doi: 10.1123/apaq.2015-0135. [Epub ahead of print]*

This article contributes to the understanding of embodied practices and experiences within adapted physical activity. It presents a study of a 4-day winter sports camp for young people with cerebral palsy. The experiences of the participants were investigated through qualitative interviews. The findings are analyzed through a phenomenological framework of embodiment and the notions of body schema and body image. By paying special attention to the bodily experience of "I can," this study shows that participants learned new ways of approaching challenges, gained bodily control in challenging situations, expanded their fields of possible actions through practicing, as well as learned to understand and accept themselves. These findings reveal central values of bodily interventions for people with cerebral palsy and have the potential to inform pedagogical work within the area of adapted physical activity.

DOI: 10.1123/apaq.2015-0135

PMID: 28942669

## **Prise en charge et Accompagnant/Accompagnement**

### **A Parental Report of Youth Transition Readiness: The Parent STARx Questionnaire (STARx-P) and Re-evaluation of the STARx Child Report.**

Nazareth M , Hart L , Ferris M , Rak E , Hooper S , van Tilburg MAL .

*J Pediatr Nurs. 2017 Sep 20. pii: S0882-5963(17)30093-3. doi: 10.1016/j.pedn.2017.08.033. [Epub ahead of print]*

**PURPOSE:** The STARx Questionnaire is a self-report measure of health care transition (HCT) readiness in youth with chronic diseases. We aimed to improve reliability and generalizability of the STARx and report initial reliability data on the STARx-P Questionnaire, a self-report measure of parent perspective on their child's HCT readiness.

**METHODS:** Participants were recruited in several clinics from a large academic hospital in the southeastern USA and via the therapeutic summer camp for children with chronic disease. Children with chronic conditions responded to the 18-question STARx Questionnaire and their parents responded to the parent version, the STARx-P Questionnaire.

**RESULTS:** IRB-approved consents were obtained from 341 parents (89.4% mothers) and 455 children (Mean age  $12.28 \pm 2.53$ ; 36.9% Males; 68.6% Caucasian; 22.6% African-American). The most common diagnoses were kidney disease, inflammatory bowel disease, diabetes, cerebral palsy, sickle cell, and cystic fibrosis. Principal component

analysis of the STARx-P Questionnaire identified three major subscales in both the child and parent-report: Disease Knowledge, Self-management and Provider Communication. Internal reliability was moderate to good ( $\alpha=0.545-0.759$ ).

**CONCLUSIONS:** The STARx-P Questionnaire and STARx Version 4 Questionnaire have demonstrated initial reliability in this multi-institution study. It is the first HCT readiness questionnaire that includes a parent-proxy report which is needed in studies of non-verbal and/or developmentally delayed children. Parent-report can also give unique insights not obtained from self-reports.

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DOI: 10.1016/j.pedn.2017.08.033

PMID: 28941954

### **A User-Centered Approach: Understanding Client and Caregiver Needs and Preferences in the Development of mHealth Apps for Self-Management.**

Bendixen RM , Fairman AD , Karavolis M , Sullivan C , Parmanto B .

*JMIR Mhealth Uhealth. 2017 Sep 26;5(9):e141. doi: 10.2196/mhealth.7136.*

**BACKGROUND:** Many adolescents and young adults with chronic illness or disability often fail to develop the self-management skills necessary to independently handle medical and self-management routines. In light of these needs, we are developing iMHere 2.0 (Interactive Mobile Health and Rehabilitation), a mobile health (mHealth) system to support a self-management program.

**OBJECTIVE:** Our objective was to gather data from persons with brain and spinal cord anomalies (BSA) and their caregivers to better understand how mHealth would be most helpful in supporting them to proactively manage daily self-care routines and to access medical care as needed. The specific purpose was not only to gather feedback and to gain increased insight into the design of the new version of iMHere, but also to gather perspectives of new groups, namely adolescents as young as 12 years and their parents and/or caregivers.

**METHODS:** Our project employed focus group sessions and surveys to collect data from participants with BSA, as well as their caregivers. A total of six focus group sessions were conducted on four separate occasions until the data gathered reached saturation. The objectives of our focus group sessions were to better understand ways to develop mHealth systems to support self-management, to promote independence, to motivate long-term system use, and to prevent medical problems that lead to hospitalizations and emergency room visits for youth and young adults with BSA.

**RESULTS:** A total of 16 youth and young adults with BSA and 11 caregivers participated in the sessions. Within and among our groups, the following five overarching themes emerged from the data: (1) make it easy, (2) engage, (3) educate and prepare, (4) motivate and support, and (5) personalize. Participants shared their perspectives and detailed information about mHealth apps that would be important for independence in self-care and self-management.

**CONCLUSIONS:** Our findings suggest that most individuals keep their mobile phones with them at all times and typically use a mobile phone for social media, music, photos, and texting. Our qualitative analysis indicates that youth and young adults with BSA, as well as their caregivers, acknowledge the importance of being actively engaged in developing and using mHealth apps that monitor and manage their health care needs. Information gleaned from these focus group sessions and surveys have provided data to refine the iMHere 2.0 mHealth prototype platform that we have developed.

[Free Article](#)

DOI: 10.2196/mhealth.7136

PMID: 28951378

### **Child characteristics, caregiver characteristics, and environmental factors affecting the quality of life of caregivers of children with cerebral palsy.**

Tseng MH , Chen KL , Shieh JY , Lu L , Huang CY , Simeonsson RJ .

*Disabil Rehabil. 2016 Dec;38(24):2374-82. doi: 10.3109/09638288.2015.1129451. Epub 2016 Jan 10.*



**PURPOSE:** The study aimed to investigate comprehensively the determinants of the quality of life (QOL) of caregivers of children with cerebral palsy (CP) based on the International Classification of Functioning, Disability and Health for Children and Youth (ICF-CY).

**METHODS:** A total of 167 children with CP (mean age 9.06 years, SD 2.61 years) and their caregivers (mean age 40.24 years, SD 5.43 years) participated in this study. The QOL of caregivers was measured with the World Health Organization Quality of Life-BREF-Taiwan version (WHOQOL-BREF-TW). The potential determinants of QOL were collected, including child characteristics, caregiver characteristics, and environmental factors from all dimensions of the ICF-CY and analysed using multiple regression models.

**RESULTS:** Four multiple regression models revealed that determinants of the QOL of caregivers of children with CP was multidimensional, encompassing child characteristics (age, type of CP, fine motor impairment, other diseases, behaviour and emotions, visual impairment, hearing impairment), caregiver characteristics (general mental health, parenting stress, marital status, family coping patterns, and socio-economic status), and environmental factors (child's medication, school setting, and current rehabilitation service, caregiver's spouse's age, family life impacts, and domestic helper).

**CONCLUSIONS:** Knowledge of the determinants of QOL could serve as a guide in a holistic approach to evaluation and intervention and help plan interventions targeted at these determinants to improve the QOL of caregivers of children with CP. Implications for Rehabilitation Caregivers of children with CP had lower QOL, except the environment QOL. The QOL determinants of caregivers of children with CP are multidimensional, including child characteristics, caregiver characteristics, and environmental factors. In addition to child characteristics of severity of fine motor impairments and emotional and behavioural problems, caregiver characteristics of general mental health, parenting stress, and coping patterns, and environmental factors of family life impacts, and school setting demonstrated important relationships with caregiver QOL.

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### **Exploring perceptions of health caregivers on the causes of caregivers' occupational burnout in institutes of children with cerebral palsy: A qualitative study.**

Dehghan A , Hosseini SA , Rassfiani M , Dalvand H .

*Electron Physician. 2017 Jun 25;9(6):4516-4523. doi: 10.19082/4516. eCollection 2017 Jun.*

**BACKGROUND:** Providing care for children with cerebral palsy (CP) is hard, energy-consuming, and long-term. Consequently, occupational burnout is highly probable for caregivers.

**OBJECTIVE:** This study aimed to explore the perception of health caregivers regarding the causes of caregivers' occupational burnout in institutes of children with CP.

**METHODS:** This qualitative study was conducted using content analysis methodology during an eight-month period in 2016. Nine caregivers, two managers, and one physiotherapist participated in the study. Purposive sampling method was used to select participants. In depth, semi-structure interviews were used to gather the data. All interviews were conducted at their workplace, in Tehran, Iran. The interviews were recorded, transcribed verbatim, and overviewed. Constant comparative analyses were used to analyze the interviews.

**RESULTS:** The results were categorized into three main categories and nine sub-categories. The main categories were as follows: care-related stress, nature of caring occupation, and organizational demands and resources.

**CONCLUSION:** Results of this study showed that several factors are involved in creating burnout among caregivers. The exploration of these factors may help us in designing appropriate interventions for caregivers to correctly implement caring activities so that they less suffer from care-related pressures and also become able to allocate some time for their own activities of interest and for recreational, social, and family activities.

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PMCID: PMC5557130

### **Gap analysis of service needs for adults with neurodevelopmental disorders.**

Burke SL , Wagner E , Marolda H , Quintana JE , Maddux M .

*J Intellect Disabil. 2017 Jan 1:1744629517726209. doi: 10.1177/1744629517726209. [Epub ahead of print]*

In Florida, the Agency for Persons with Disabilities provides waivers for adults with the following types of disabilities: intellectual disability, autism spectrum disorder, cerebral palsy, spina bifida, Down syndrome, and Prader-Willi syndrome. This review examined the peer-reviewed literature to indicate and assess the common needs for individuals with intellectual and developmental disabilities. Current models of service delivery, the efficacy of these services, and remaining gaps in the need fulfillment of individuals within the six diagnostic categorizations of interest were examined. Severity level within each diagnostic category was plotted on a matrix according to whether the needs of individuals were minimal, moderate, severe, or universal. The study found that sexual health education, socialization, and adult-focused medical care are universal needs among the six conditions. The study indicates that health-care professionals must work toward addressing the many unmet needs in comprehensive life span care services for adult individuals with neurodevelopmental disorders.

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### **Medical service use in children with cerebral palsy: The role of child and family factors characteristics.**

Meehan EM, Reid SM, Williams KJ, Freed GL, Sewell JR (6), Reddihough DS.

*J Paediatr Child Health*. 2016 Jun;52(6):621-7. doi: 10.1111/jpc.13163. Epub 2016 Apr 18. Erratum in *J Paediatr Child Health*. 2016 Aug;52(8):855.

**AIM:** The aim of the study was to investigate the patterns of medical service use in children with cerebral palsy (CP), taking into account child and family characteristics.

**METHODS:** Nine hundred and one parents and carers of children registered with the Victorian CP Register were invited to complete a survey. Participants were asked about their child's appointments with general practitioners and public and private paediatric medical specialists over the preceding 12 months. Information on family characteristics and finances was also collected. Data on CP severity and complexity were extracted from the CP Register. **RESULTS:** Three hundred and fifty parents and carers (39%) participated. Of these, 83% reported that their child had  $\geq 1$  appointment with a general practitioner over the preceding 12 months, while 84% had  $\geq 1$  appointment with a public or private paediatric medical specialist. Overall, 58% of children saw 2-5 different paediatric medical specialists, while 9% had appointments with  $\geq 6$  clinicians. Children with severe and complex CP were more likely to have had  $\geq 1$  appointment with a publically funded paediatric medical specialist and had seen a greater number of different clinicians over the study period. Family characteristics were not associated with service use.

**CONCLUSIONS:** Children with CP are managed by a number of paediatric medical specialists, and they continue to see a range of specialists throughout adolescence. In Victoria, differences in service use are not based on family characteristics; instead the highest service users are those with severe and complex CP. For this group, care co-ordination and information sharing between treating clinicians are important, if gaps in care are to be avoided.

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### **Parents' Experiences and Perceptions when Classifying their Children with Cerebral Palsy: Recommendations for Service Providers.**

Scime NV, Bartlett DJ, Brunton LK, Palisano RJ.

*Phys Occup Ther Pediatr*. 2017 Aug;37:252-267. doi: 10.1080/01942638.2016.1185505. Epub 2016 Jul 1.

**AIMS:** This study investigated the experiences and perceptions of parents of children with cerebral palsy (CP) when classifying their children using the Gross Motor Function Classification System (GMFCS), the Manual Ability Classification System (MACS), and the Communication Function Classification System (CFCS). The second aim was to collate parents' recommendations for service providers on how to interact and communicate with families.

**METHODS:** A purposive sample of seven parents participating in the On Track study was recruited. Semi-structured interviews were conducted orally and were audiotaped, transcribed, and coded openly. A descriptive interpretive approach within a pragmatic perspective was used during analysis.

**RESULTS:** Seven themes encompassing parents' experiences and perspectives reflect a process of increased understanding when classifying their children, with perceptions of utility evident throughout this process. Six

recommendations for service providers emerged, including making the child a priority and being a dependable resource.

**CONCLUSIONS:** Knowledge of parents' experiences when using the GMFCS, MACS, and CFCS can provide useful insight for service providers collaborating with parents to classify function in children with CP. Using the recommendations from these parents can facilitate family-provider collaboration for goal setting and intervention planning.

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PMID: 27366828 [Indexed for MEDLINE]

### **Psychometric evaluation of the Scandinavian version of the caregiver priorities and child health index of life with disabilities.**

Pettersson K , Bjerke KM , Jahnsen R , Öhrvik J (6), Rodby-Bousquet E .

*Disabil Rehabil.* 2017 Sep 19:1-7. doi: 10.1080/09638288.2017.1378930. [Epub ahead of print]

**PURPOSE:** To examine test-retest reliability and construct validity of the Scandinavian version of the caregiver priorities and child health index of life with disabilities (CPCHILD) questionnaire for children with cerebral palsy (CP).

**METHODS:** Families were recruited in Sweden and Norway and stratified according to the gross motor function classification system levels I-V for children born 2000-2011, mean age 7.9 (SD 3.2). Construct validity based on the first questionnaire (n = 106) was evaluated for known groups, using linear regression analysis. Intraclass correlation coefficient was used to estimate test-retest reliability (n = 64), and Cronbach's alpha was calculated as an indicator of internal consistency.

**RESULTS:** The questionnaire showed construct validity and the ability to discriminate between levels of gross motor function for the total score and all domain scores (p < 0.05). Test-retest reliability was high with intraclass correlation coefficient of 0.92 for the total score and of 0.72-0.92 for the domain scores. Cronbach's alpha was 0.96 for the total score and 0.83-0.96 for the domain scores.

**CONCLUSIONS:** The Scandinavian version of the CPCHILD for children with CP seems to be a valid and reliable proxy measure for health related quality of life. Implications for rehabilitation Valid and reliable outcome measures are needed to evaluate whether follow-up programs enhance health related quality of life in different countries. The Scandinavian version of the caregiver priorities and child health index of life with disabilities (CPCHILD) was evaluated for known-groups validity and test-retest reliability. The Scandinavian version of the CPCHILD is a sound and valid measurement for evaluation and comparison of health related quality of life of children with cerebral palsy in different countries.

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PMID: 28927310

### **Understanding allied health practitioners' use of evidence-based assessments for children with cerebral palsy: a mixed methods study.**

O'Connor B , Kerr C , Shields N , Imms C .

*Disabil Rehabil.* 2017 Sep 6:1-13. doi: 10.1080/09638288.2017.1373376. [Epub ahead of print]

**PURPOSE:** Evidence-based assessments for children with cerebral palsy are not widely used by healthcare professionals in day-to-day practice. This study aimed to examine allied health practitioner experiences, perceptions, and use of assessments for children with cerebral palsy.

**METHOD:** A mixed methods study was conducted in two rehabilitation organisations. Three focus group interviews explored therapists' assessment experiences with data analysed using interpretive description. Assessment practices of therapists (n = 55) were assessed through self-report questionnaire and case-file audit of children with cerebral palsy (n = 44).

**RESULTS:** Emergent themes described therapists' motivation to use evidence-based assessments on a behavioural continuum - I don't; I can't; I try; I do; We do; influenced by assessment satisfaction, child and family collaboration, organisational expectation, research fit, and time dedication. Only two of fifteen audited assessments were documented in more than 50% of files. Use was higher where assessments positively connected therapists, children and parents, and use was organisationally endorsed. The Cultural Cone for evidence-based assessment behaviour was conceptualised.

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CONCLUSIONS: "Engagement in" assessment appears to require a conceptual shift by therapists and organisations to understanding assessment as part of, not an adjunct to, therapy. The Cultural Cone framework may assist therapists and services in designing strategies to promote evidence-based assessment behaviours. Implications for rehabilitation Therapists' can reflect on where they are positioned on the "use continuum" in the Cultural Cone framework, and consider the contextual influences contained in this framework to understand their motivation to use evidence-based assessments. Routine use of evidenced-based assessments for children with cerebral palsy by allied health practitioners remains generally low and therapists and service organisations need to consider ways to increase use. Where possible, therapists' should choose assessment tools that fully engage children and families and themselves in the assessment process. The Cultural Cone framework may be used to assist therapists and organisations identify and design site specific strategies to increase evidence-based assessment use in day-to-day practice.

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## Technologie - Domotique

### **Does power mobility training impact a child's mastery motivation and spectrum of EEG activity? An exploratory project.**

Kenyon LK , Farris JP , Aldrich NJ , Rhodes S .

*Disabil Rehabil Assist Technol.* 2017 Aug 30;1-9. doi: 10.1080/17483107.2017.1369587. [Epub ahead of print]

PURPOSE: The purposes of this exploratory project were: (1) to evaluate the impact of power mobility training with a child who has multiple, severe impairments and to determine if the child's spectrum of electroencephalography (EEG) activity changed during power mobility training.

STUDY DESIGN: A single-subject A-B-A-B research design was conducted with a four-week duration for each phase. Two target behaviours were explored: (1) mastery motivation assessed via the dimensions of mastery questionnaire (DMQ) and (2) EEG data collected under various conditions. Power mobility skills were also assessed.

METHODS: The participant was a three-year, two-month-old girl with spastic quadriplegic cerebral palsy, gross motor function classification system level V. Each target behaviour was measured weekly. During intervention phases, power mobility training was provided.

RESULTS: Improvements were noted in subscale scores of the DMQ. Short-term and long-term EEG changes were also noted. Improvements were noted in power mobility skills.

CONCLUSIONS: The participant in this exploratory project demonstrated improvements in power mobility skill and function. EEG data collection procedures and variability in an individual's EEG activity make it difficult to determine if the participant's spectrum of EEG activity actually changed in response to power mobility training. Additional studies are needed to investigate the impact of power mobility training on the spectrum of EEG activity in children who have multiple, severe impairments. Implications for Rehabilitation Power mobility training appeared to be beneficial for a child with multiple, severe impairments though the child may never become an independent, community-based power wheelchair user. Electroencephalography may be a valuable addition to the study of power mobility use in children with multiple, severe impairments. Power mobility training appeared to impact mastery motivation (the internal drive to solve complex problems and master new skills) in a child who has multiple, severe impairments.

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### **Low cost assistive technology to support educational activities for adolescents with cerebral palsy.**

da Silva AP , Bulle Oliveira AS , Pinheiro Bezerra IM , Pedrozo Campos Antunes T , Guerrero Daboin BE , Raimundo RD , Dos Santos VR , de Abreu LC .

*Disabil Rehabil Assist Technol.* 2017 Aug 30;1-7. doi: 10.1080/17483107.2017.1369590. [Epub ahead of print]

INTRODUCTION: The concept of assistive technology covers several areas of action; one of them is communication with the elaboration of accessible solutions to overcome daily difficulties. It contributes to the resumption of functional abilities, expanding and facilitating inclusion and independent living.

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**OBJECTIVE:** To analyze the usability of a low cost prototype device to support educational activities of adolescents with cerebral palsy.

**METHODS:** A descriptive observational study. The evaluation of a prototype device was made through a validated questionnaire, Quest Version 2.0, on the level of the user's satisfaction with an assistive technology, composed of 12 evaluation items. The questionnaire was filled out by the educator based on the observation of four wheelchair-bound participants diagnosed with cerebral palsy according to the international classification of diseases and health-related problems, ICD-10, who attend a coexistence and teaching institution in the state of São Paulo, Brazil.

**RESULTS:** The device developed was considered an assistive technology, which provided an experience with a positive level of satisfaction for the participants.

**CONCLUSION:** The tested prototype contributes to communication and interaction allowing adolescents with cerebral palsy to participate in educational activities. Implications for Rehabilitation The device assists the individual in the educational activities and can positively influence their development, observe the individual number 5, who has an important limitation in coordination and fine movements, placing the role of the task in the vertical position offers a new perspective to perform the task, this stimulates him to try to perform the work, so the challenge was adjusted to the demands of each individual which can contribute to its neuromotor development, the amplitude of the distal movements and the manual ability, since it must look for alternatives to complete the task requested.

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