

# Science Infos

## Paralysie Cérébrale

N°41 OCTOBRE 2017



### *Focus*

#### **Journée Mondiale De la Paralysie Cérébrale 6 octobre 2017 Cité Internationale de Paris**

A l'occasion de la Journée Mondiale de la Paralysie Cérébrale du vendredi 6 octobre 2017, la Fondation Paralysie Cérébrale se réjouit du recul du nombre d'enfants atteints de paralysie cérébrale au cours des 30 dernières années et salue le travail des chercheurs et des thérapeutes qui sont à l'origine de cette tendance.

Elle attire l'attention sur les enjeux à venir et sur l'importance de la recherche médicale, un enfant toutes les six heures naissant toujours avec ce handicap qui demeure la 1ère cause d'handicap moteur chez l'enfant.

Lors de cette Journée nous avons été heureux de remettre les bourses de recherche aux chercheurs lauréats 2017 .



# Manifestations et congrès

## Janvier 2018

### Les Etats Généraux de La Déficience Intellectuelle

11-12 janvier 2018

Paris, France

<http://www.defiscience.fr/actualites/etats-generaux-de-la-deficience-intellectuelle/>

## Mai 2018

### 21st European Congress of Physical and Rehabilitation Medicine

01-06 mai 2018

Vilnius, Lituanie

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

### 30th EACD Annual Meeting

28-31 mai 2018

Tbilissi, Georgia

<http://www.eacd2018.net>

## Juillet 2018

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

08-12 juillet 2018

Paris, France

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

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## 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

##### **Cerebral palsy after assisted reproductive technology: a cohort study.**

Goldsmith S , Mcintyre S , Badawi N , Hansen M .

*Dev Med Child Neurol.* 2017 Oct 4. doi: 10.1111/dmcn.13577. [Epub ahead of print]

**AIM:** To calculate the birth prevalence of cerebral palsy (CP) after assisted reproductive technology (ART) and compare the clinical outcomes of children with CP after ART or natural conception.

**METHOD:** This cohort study used linked CP and ART register data from live births in Western Australia (1994-2002). Birth prevalence was calculated and data analysed using descriptive statistics and logistic regression. It was adjusted for confounding variables and stratified by plurality and gestational age.

**RESULTS:** In total, 211 660 live births were included; prevalence of CP was increased in children born after ART (7.2/1000 live births compared with naturally conceived births, 2.5/1000). Odds of CP were doubled for singletons; when stratified by gestational age odds were only increased in the under 32-week group. Prevalence of CP was increased in ART (9.9/1000 live births) and naturally conceived twins (8.4/1000 live births). Clinical outcomes were similar between ART and naturally conceived children.

**INTERPRETATION:** The birth prevalence of CP is increased two-fold after ART. After stratification for gestational age and plurality, residual risk remains in singletons born very preterm. Birth prevalence of CP will be tracked over time to identify any impact of changes to clinical practice.

**WHAT THIS PAPER ADDS:** In Western Australia, assisted reproductive technology (ART) increases birth prevalence of cerebral palsy (CP), mediated mostly by preterm and multiple births. Preterm birth alone does not account for the doubled odds of CP for ART singletons born very preterm. Clinical outcomes are similar between ART and naturally conceived children with CP.

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DOI: 10.1111/dmcn.13577

PMID: 28980316

##### **Congenital anomalies and the severity of impairments for cerebral palsy**

Jystad KP , Strand KM , Bjellmo S , Lydersen S , Klungsöyr K , Stoknes M , Skranes J , Andersen GL , Vik T .

*Dev Med Child Neurol.* 2017 Nov;59(11):1174-1180. doi: 10.1111/dmcn.13552. Epub 2017 Oct 2.

**AIM:** To study the prevalence of congenital anomalies among children with cerebral palsy (CP) born at term or late preterm, and if CP subtypes and clinical manifestations differ between children with and without congenital anomalies.

**METHOD:** This was a cross-sectional study using data from the Cerebral Palsy Register of Norway and the Medical Birth Registry of Norway. All children with congenital CP born at and later than 34 weeks' gestation in Norway from 1999 to 2009 were included. Anomalies were classified according to the European Surveillance of Congenital Anomalies classification guidelines. Groups were compared using Fisher's exact test, Kruskal-Wallis test, and the Mann-Whitney U test.

**RESULTS:** Among 685 children with CP, 169 (25%) had a congenital anomaly; 125 within the central nervous system. Spastic bilateral CP was more prevalent in children with anomalies (42%) than in children without (34%; p=0.011).

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Children with anomalies less frequently had low Apgar scores ( $p < 0.001$ ), but more often had severe limitations in gross- and fine-motor function, speech impairments, epilepsy, severe vision, and hearing impairments than children without anomalies ( $p < 0.03$ ).

INTERPRETATION: Although children with CP and anomalies had low Apgar scores less frequently, they had more severe limitations in motor function and more associated problems than children with CP without anomalies.

WHAT THIS PAPER ADDS: One in four children with cerebral palsy (CP) born at term or late preterm has a congenital anomaly. The added value of neuroimaging to detect central nervous system anomalies in children with CP. Children with anomalies have more severe motor impairments. More severe clinical manifestations are not explained by perinatal complications as indicated by low Apgar scores.

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DOI: 10.1111/dmnc.13552

PMID: 28967231 [Indexed for MEDLINE]

### **Neurodevelopmental outcomes at 3 years old for infants with birth weights under 500 g.**

Nagara S , Kouwaki M , Togawa T , Sugiura T , Okada M , Koyama N .

*Pediatr Neonatol.* 2017 Sep 21. pii: S1875-9572(17)30094-3. doi: 10.1016/j.pedneo.2017.09.005. [Epub ahead of print]

BACKGROUND: Marked improvements have been achieved in the survival of extremely low birth weight infants, but survival rates and prognoses of extremely small infants with birth weights  $\leq 500$  g remain poor. The aim of this study was to clarify long-term outcomes for surviving infants with birth weights  $\leq 500$  g. METHODS: The study population comprised fetuses of gestational age  $\geq 22$  weeks, expected live- or stillbirth weight  $\leq 500$  g, and birth date between 2003 and 2012. Developmental assessments were performed prospectively at 3 years old.

RESULTS: Data were obtained for 21 fetuses, including 10 live births and 11 stillbirths. Of the 10 live births, median gestational age was 25.2 weeks (range, 22.4-27.1 weeks), median birth weight was 426 g (range, 370-483 g), and two neonates died before discharge. One infant with severe asphyxia died within 12 h and another infant with Down syndrome died at 34 days. The survival rate was thus 80%. All surviving infants were small for gestational age. Seven of the 8 surviving infants (88%) weighed less than 2500 g at a corrected age of 40 weeks. Seven infants were available for developmental assessments at 3 years old. One infant could not be followed. Two of those seven infants (29%) showed normal development, three infants (42%) showed mild neurodevelopmental disability, and two infants (29%) showed severe neurodevelopmental disability. One infant had periventricular leukomalacia and cerebral palsy. Two of the seven infants (29%) had short stature ( $< 3$  SD) at 3 years old.

CONCLUSION: Although the survival rate among live births was good (80%) in this study, neurodevelopmental outcomes remained poor in infants with birth weights  $\leq 500$  g. Further large studies are needed to assess long-term outcomes for extremely small infants.

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DOI: 10.1016/j.pedneo.2017.09.005

PMID: 29030024

### **Neurological complications after therapy for fetal-fetal transfusion syndrome: a systematic review of the outcomes at 24 months.**

Miralles-Gutiérrez A , Narbona-Arias I , González-Mesa E .

*J Perinat Med.* 2017 Sep 29. pii:/j/jpme.ahead-of-print/jpm-2017-0217/jpm-2017-0217.xml. doi: 10.1515/jpm-2017-0217. [Epub ahead of print]

OBJECTIVE: The main objective of this study was to review the available scientific evidence about mid-term neurological outcomes in twins after laser therapy for twin-to-twin transfusion syndrome (TTTS).

METHODS: A systematic review of studies on neurodevelopmental outcomes (cognition, motor development, communication skills and cerebral palsy) of twins after laser therapy for TTTS was conducted. Outcomes at 24 months of age and the use of validated scales for assessment were the selected criteria. Electronic and manual research identified 25 studies, and nine of them were eligible for the review. RESULTS: The global mean rate of neurological injury in twins treated with laser was 14.07%. The mean rate of cognitive impairment was 8.41%, 11.14% for motor delay, 16.5% for communication delay and 5.73% for cerebral palsy. These rates were higher than

the results found in dichorionic twins, but lower than the results found in twins treated with amnio-reductions or conservative management.

**CONCLUSION:** Laser therapy is associated with a lower rate of neurological injury at 24 months of age compared to other therapeutic techniques. This tendency was also observed with specific incidences regarding cognition, motor skills and cerebral palsy.

DOI: 10.1515/jpm-2017-0217

PMID: 28961141

### **Pathophysiology of Birth Asphyxia.**

Rainaldi MA, Perlman JM.

*Clin Perinatol.* 2016 Sep;43(3):409-22. doi: 10.1016/j.clp.2016.04.002. Epub 2016 Jun 17.

The pathophysiology of asphyxia generally results from interruption of placental blood flow with resultant fetal hypoxia, hypercarbia, and acidosis. Circulatory and noncirculatory adaptive mechanisms exist that allow the fetus to cope with asphyxia and preserve vital organ function. With severe and/or prolonged insults, these compensatory mechanisms fail, resulting in hypoxic ischemic injury, leading to cell death via necrosis and apoptosis. Permanent brain injury is the most severe long-term consequence of perinatal asphyxia. The severity and location of injury is influenced by the mechanisms of injury, including degree and duration, as well as the developmental maturity of the brain.

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DOI: 10.1016/j.clp.2016.04.002

PMID: 27524444 [Indexed for MEDLINE]

## **Génétique**

### **MLEC gene polymorphisms promote cerebral palsy via M2-like macrophage polarization.**

Shi W , Zhu Y , Zhou M , Ruan Y , Chen X , Chen X .

*Clin Genet.* 2017 Oct 3. doi: 10.1111/cge.13149. [Epub ahead of print]

The relationship between gene polymorphisms and the pathogenesis of cerebral palsy (CP) is uncovering recently. Here, we suggested that single nucleotide polymorphisms (SNPs) of MLEC gene might take part in the pathogenesis of CP. We genotyped and analyzed six SNP positions of MLEC gene in 916 CP patients and 957 healthy people, which are from the Chinese Han population. The results indicated significant associations between the risk of CP and rs10431386 (allele: p-value = 0.006, odds ratio (OR) = 1.587, 95% confidence interval (CI) = 1.198-1.967) and rs7964786 (allele: p-value = 0.005, OR = 1.956, 95% CI = 1.238-2.519) SNP positions of MLEC gene. Further investigations revealed that C alleles of rs10431386 and rs7964786 inhibit the expression of MLEC in blood of CP patients and macrophage cell line. In vitro experiments revealed that MLEC promotes M1 to M2 macrophage polarization. The results of in vitro studies suggest that C alleles of rs10431386 and rs7964786 on MLEC promotes CP by inhibiting M1 to M2 macrophage polarization. Generally, this work suggested the contribution of MLEC gene polymorphisms to the pathogenesis of CP. This article is protected by copyright. All rights reserved.

DOI: 10.1111/cge.13149

PMID: 28972276

### **Study of global DNA methylation in monozygotic twins with cerebral palsy.**

Yuan Y.

*Pak J Pharm Sci.* 2017 Jul;30(4(Suppl.)):1467-1473.

The objective of this paper is to study the global DNA Methylation in monozygotic (MZ) twins with cerebral palsy. Two pairs of twins (a cerebral palsy children, a normal child) admitted to the First Affiliated Hospital of Zhengzhou University were selected as subjects. The phenol-chloroform method was used to extract DNA from venous blood and micro satellite DNA genotyping technique was used to identify the eggs of the twins. DNA methylation fragments were enriched by MBD affinity column chromatography, followed by Solexa sequencing and bioinformatics analysis. In this study, we found that there were different DNA hypermethylation regions between each pair of twins and normal children through global DNA methylation analysis technique by analyzing the blood

cells of two pairs of monozygotic twins with cerebral palsy and normal infants. The results revealed the region of DNA methylation and the protein coding genes of promoter region of common methylation of cerebral palsy were both higher than normal children. These common promoter hypermethylation genes in cerebral palsy are involved in a variety of biological processes such as membrane protein transport, neuronal development, apoptosis, and metabolism. Moreover, DNA methylation plays an important role in gene expression. We hypothesized that the onset of cerebral palsy in twins is associated with hypermethylation of the promoter which inhibiting the expression of hypermethylation genes in children with cerebral palsy. The current research provided a basis for further study of the large sample of twins and sporadic cerebral palsy.

PMID: 29043999

### **Whole-genome scale identification of methylation markers specific for cerebral palsy in monozygotic discordant twins.**

Jiao Z , Jiang Z , Wang J , Xu H , Zhang Q , Liu S , Du N , Zhang Y , Qiu H .

*Mol Med Rep.* 2017 Oct 17. doi: 10.3892/mmr.2017.7800. [Epub ahead of print]

Cerebral palsy (CP) is a severe type of brain disease affecting movement and posture. Although CP has strong genetic and environmental components, considerable differences in the methylome between monozygotic (MZ) twins discordant for CP implicates epigenetic contributors as well. In order to determine the differences in methylation in patients with CP without interference of the interindividual genomic variation, four pairs of MZ twins discordant for CP were profiled for DNA methylation changes using reduced representation bisulfite sequencing on the genomic-scale. Similar DNA methylation patterns were observed in all samples. However, MZ twins demonstrated higher correlations and closer evolutionary associations compared with the other samples, indicating a stable methylome of MZ twins. A total of 190 differentially methylated genes (DMGs) were identified using Student's t-test, of which 37 genes were hypermethylated in the CP group while the remainders were hypomethylated compared with control group. The identified DMGs were enriched in several cerebral abnormalities, including cerebral cortical atrophy and cerebral atrophy, suggesting that the occurrence of CP may be associated with the methylation alterations. The neighboring genes of DMGs in the protein-protein interaction network were enriched in numerous important functions in essential processes. The results of the present study identified important genes that may epigenetically contribute to the occurrence and development of CP in MZ twins, suggesting that the different prevalence of CP in identical twins may be associated with DNA methylation alterations.

DOI: 10.3892/mmr.2017.7800

PMID: 29039597

## **Lésions - Prévention des lésions- relation structure fonction**

### **+ Données fondamentales**

#### **Activated Microglia Targeting Dendrimer-Minocycline Conjugate as Therapeutics for Neuroinflammation.**

Sharma R, Kim SY, Sharma A, Zhang Z, Kambhampati SP, Kannan S, Kannan RM

*Bioconjug Chem.* 2017 Oct 27. doi: 10.1021/acs.bioconjugchem.7b00569. [Epub ahead of print]

Brain-related disorders have outmatched cancer and cardiovascular diseases worldwide as the leading cause of morbidity and mortality. The lack of effective therapies and the relatively dry central nervous system (CNS) drug pipeline pose formidable challenge. Superior, targeted delivery of current clinically approved drugs may offer significant potential. Minocycline has shown promise for the treatment of neurological diseases owing to its ability to penetrate the blood-brain barrier (BBB) and potency. Despite its potential in the clinic and in preclinical models, the high doses needed to affect a positive therapeutic response have led to side effects. Targeted delivery of minocycline to the injured site and injured cells in the brain can be highly beneficial. Systemically administered hydroxyl poly(amidoamine) (PAMAM) generation-6 (G6) dendrimers have a longer blood circulation time and have been shown to cross the impaired BBB. We have successfully prepared and characterized the in vitro efficacy and in vivo targeting ability of hydroxyl-G6 PAMAM dendrimer-9-amino-minocycline conjugate (D-mino). Minocycline is a challenging drug to carry out chemical transformations due to its inherent instability. We used a combination of a highly efficient and mild copper catalyzed azide-alkyne click reaction (CuAAC) along with microwave energy to conjugate 9-amino-minocycline (mino) to the dendrimer surface via enzyme responsive linkages. D-mino was further

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evaluated for anti-inflammatory and antioxidant activity in lipopolysaccharides-activated murine microglial cells. D-mino conjugates enhanced the intracellular availability of the drug due to their rapid uptake, suppressed inflammatory cytokine tumor necrosis factor  $\alpha$  (TNF- $\alpha$ ) production, and reduced oxidative stress by suppressing nitric oxide production, all significantly better than the free drug. Fluorescently labeled dendrimer conjugate (Cy5-D-mino) was systematically administered (intravenous, 55 mg/kg) on postnatal day 1 to rabbit kits with a clinically relevant phenotype of cerebral palsy. The in vivo imaging study indicates that Cy5-D-mino crossed the impaired blood-brain barrier and co-localized with activated microglia at the periventricular white matter areas, including the corpus callosum and the angle of the lateral ventricle, with significant implications for positive therapeutic outcomes. The enhanced efficacy of D-mino, when combined with the inherent neuroinflammation-targeting capability of the PAMAM dendrimers, may provide new opportunities for targeted drug delivery to treat neurological disorders.

DOI: 10.1021/acs.bioconjchem.7b00569

PMID: 29028353

### **Maternal Glucose Supplementation in a Murine Model of Chorioamnionitis Alleviates Dysregulation of Autophagy in Fetal Brain.**

Lei J , Zhong W , Almalki A , Zhao H , Arif H , Rozzah R , Al Yousif G , Alhejaily N , Wu D , McLane M , Burd I .  
*Reprod Sci.* 2017 Jan 1:1933719117734321. doi: 10.1177/1933719117734321. [Epub ahead of print]

Fetal brain injury induced by intrauterine inflammation is a major risk factor for adverse neurological outcomes, including cerebral palsy, cognitive dysfunction, and behavioral disabilities. There are no adequate therapies for neuronal protection to reduce fetal brain injury, especially new strategies that may apply promptly and conveniently. In this study, we explored the effect of maternal glucose administration in a mouse model of intrauterine inflammation at term. Our results demonstrated that maternal glucose supplementation significantly increased survival birth rate and improved the neurobehavioral performance of pups exposed to intrauterine inflammation. Furthermore, we demonstrated that maternal glucose administration improved myelination and oligodendrocyte development in offspring exposed to intrauterine inflammation. Though the maternal blood glucose concentration was temporally prevented from decrease induced by intrauterine inflammation, the glucose concentration in fetal brain was not recovered by maternal glucose supplementation. The adenosine triphosphate (ATP) level and autophagy in fetal brain were regulated by maternal glucose supplementation, which may prevent dysregulation of cellular metabolism. Our study is the first to provide evidence for the role of maternal glucose supplementation in the cell survival of fetal brain during intrauterine inflammation and further support the possible medication with maternal glucose treatment.

DOI: 10.1177/1933719117734321

PMID: 29017418

### **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

*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.

### [Free PMC Article](#)

DOI: 10.1371/journal.pone.0184653

PMCID: PMC5608203

PMID: 28934247 [Indexed for MEDLINE]



## Données cliniques

### **Assessing the neuroprotective benefits for babies of antenatal magnesium sulphate: An individual participant data meta-analysis.**

Crowther CA, Middleton PF, Voysey M, Askie L, Duley L, Pryde PG, Marret S, Doyle LW; AMICABLE Group.

*PLoS Med.* 2017 Oct 4;14(10):e1002398. doi: 10.1371/journal.pmed.1002398. eCollection 2017 Oct.

**BACKGROUND:** Babies born preterm are at an increased risk of dying in the first weeks of life, and those who survive have a higher rate of cerebral palsy (CP) compared with babies born at term. The aim of this individual participant data (IPD) meta-analysis (MA) was to assess the effects of antenatal magnesium sulphate, compared with no magnesium treatment, given to women at risk of preterm birth on important maternal and fetal outcomes, including survival free of CP, and whether effects differed by participant or treatment characteristics such as the reason the woman was at risk of preterm birth, why treatment was given, the gestational age at which magnesium sulphate treatment was received, or the dose and timing of the administration of magnesium sulphate.

**METHODS AND FINDINGS:** Trials in which women considered at risk of preterm birth (<37 weeks' gestation) were randomised to magnesium sulphate or control treatment and where neurologic outcomes for the baby were reported were eligible for inclusion. The primary outcomes were infant death or CP and severe maternal outcome potentially related to treatment. Studies were identified based on the Cochrane Pregnancy and Childbirth search strategy using the terms [antenatal or prenatal] and [magnesium] and [preterm or premature or neuroprotection or 'cerebral palsy']. The date of the last search was 28 February 2017. IPD were sought from investigators with eligible trials. Risk of bias was assessed using criteria from the Cochrane Collaboration. For each prespecified outcome, IPD were analysed using a 1-stage approach. All 5 trials identified were included, with 5,493 women and 6,131 babies. Overall, there was no clear effect of magnesium sulphate treatment compared with no treatment on the primary infant composite outcome of death or CP (relative risk [RR] 0.94, 95% confidence interval (CI) 0.85 to 1.05, 6,131 babies, 5 trials,  $p = 0.07$  for heterogeneity of treatment effect across trials). In the prespecified sensitivity analysis restricted to data from the 4 trials in which the intent of treatment was fetal neuroprotection, there was a significant reduction in the risk of death or CP with magnesium sulphate treatment compared with no treatment (RR 0.86, 95% CI 0.75 to 0.99, 4,448 babies, 4 trials), with no significant heterogeneity ( $p = 0.28$ ). The number needed to treat (NNT) to benefit was 41 women/babies to prevent 1 baby from either dying or having CP. For the primary outcome of severe maternal outcome potentially related to magnesium sulphate treatment, no events were recorded from the 2 trials providing data. When the individual components of the composite infant outcome were assessed, no effect was seen for death overall (RR 1.03, 95% CI 0.91 to 1.17, 6,131 babies, 5 trials) or in the analysis of death using only data from trials with the intent of fetal neuroprotection (RR 0.95, 95% CI 0.80 to 1.13, 4,448 babies, 4 trials). For cerebral palsy in survivors, magnesium sulphate treatment had a strong protective effect in both the overall analysis (RR 0.68, 95% CI 0.54 to 0.87, 4,601 babies, 5 trials, NNT to benefit 46) and the neuroprotective intent analysis (RR 0.68, 95% CI 0.53 to 0.87, 3,988 babies, 4 trials, NNT to benefit 42). No statistically significant

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differences were seen for any of the other secondary outcomes. The treatment effect varied little by the reason the woman was at risk of preterm birth, the gestational age at which magnesium sulphate treatment was given, the total dose received, or whether maintenance therapy was used. A limitation of the study was that not all trials could provide the data required for the planned analyses so that combined with low event rates for some important clinical events, the power to find a difference was limited.

**CONCLUSIONS:** Antenatal magnesium sulphate given prior to preterm birth for fetal neuroprotection prevents CP and reduces the combined risk of fetal/infant death or CP. Benefit is seen regardless of the reason for preterm birth, with similar effects across a range of preterm gestational ages and different treatment regimens. Widespread adoption worldwide of this relatively inexpensive, easy-to-administer treatment would lead to important global health benefits for infants born preterm.

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DOI: 10.1371/journal.pmed.1002398

PMCID: PMC5627896

PMID: 28976987 [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 .

*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]

**Nutritional intervention and neurodevelopmental outcome in infants with suspected cerebral palsy: the Dolphin infant double-blind randomized controlled trial.**

Andrew MJ , Parr JR , Montague-Johnson C , Laler K , Qi C , Baker B , Sullivan PB .

*Dev Med Child Neurol.* 2017 Oct 12. doi: 10.1111/dmcn.13586. [Epub ahead of print]

**AIM:** To investigate whether docosahexaenoic acid (DHA), choline, and uridine-5-monophosphate (UMP) supplementation improves neurodevelopmental outcome in infants with suspected cerebral palsy (CP) versus a comparison group of children.

**METHOD:** Infants aged 1 to 18 months with suspected CP were recruited from UK child development centres. Participants received daily treatment or control supplementation for 2 years (double-blind randomized control design). Stratification was by age, sex, predominant pattern of motor involvement (four limbs or other), and visual impairment (or not). The primary outcome was the cognitive composite score of the Bayley Scales of Infant and Toddler Development, Third Edition (CCS-Bayley-III). Secondary outcomes included language composite and motor composite scores of the Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III).

**RESULTS:** Forty infants were recruited; 35 began supplementation, 29 completed 1 to 2 years' supplementation. The treatment group CCS-Bayley-III was non-significantly higher than the comparison group (mean 77.7 [SD 19.2] and

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72.2 [SD 19.8] respectively, mean modelled difference 4.4 [-2.8, 11.6]). The treatment group language scores, but not motor scores, were non-significantly higher than for the comparison group.

INTERPRETATION: Most families found supplementation feasible. No statistically significant differences in neurodevelopmental outcome between the treatment and comparison groups were identified. Further investigation of neurodevelopmental outcome after supplementation with DHA, choline, and UMP of infants with suspected CP is warranted.

WHAT THIS PAPER ADDS: This was the first trial of phosphatidylcholine precursor supplementation in infants with suspected cerebral palsy (CP). Families of infants with suspected CP found 2-year nutritional supplementation feasible. There was no statistically significant neurodevelopmental advantage for the treatment group versus the comparison group. However, treatment group cognitive and language advantage were of clinically meaningful magnitude.

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### **Perinatal Asphyxia from the Obstetric Standpoint: Diagnosis and Interventions.**

Herrera CA, Silver RM.

*Clin Perinatol.* 2016 Sep;43(3):423-38. doi: 10.1016/j.clp.2016.04.003. Epub 2016 Jun 17.

Perinatal asphyxia is a general term referring to neonatal encephalopathy related to events during birth. Asphyxia refers to a deprivation of oxygen for a duration sufficient to cause neurologic injury. Most cases of perinatal asphyxia are not necessarily caused by intrapartum events but rather associated with underlying chronic maternal or fetal conditions. Of intrapartum causes, obstetric emergencies are the most common and are not always preventable. Screening high-risk pregnancies with ultrasound, Doppler velocimetry, and antenatal testing can aid in identifying fetuses at risk. Interventions such as intrauterine resuscitation or operative delivery may decrease the risk of severe hypoxia from intrauterine insults and improve long-term neurologic outcomes.

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PMID: 27524445 [Indexed for MEDLINE]

### **Timing of administration of antenatal magnesium sulfate and umbilical cord blood magnesium levels in preterm babies.**

Reynolds A , Slattery S , Byrne S , Neary E , Müllers S , Kent E , Malone FD , El-Khuffash A , McGarvey C , Hayes BC .

*J Matern Fetal Neonatal Med.* 2017 Oct 29;1-141. doi:10.1080/14767058.2017.1398724. [Epub ahead of print]

BACKGROUND: The optimum timing of administration of magnesium sulfate (MgSO<sub>4</sub>) in relation to delivery is not known. The general consensus is to achieve administration to the mother at least 4 hours prior to preterm delivery.

OBJECTIVE: To investigate potential predictors of umbilical cord blood magnesium (Mg) concentrations, in particular timing of antenatal MgSO<sub>4</sub> administration in relation to delivery.

STUDY DESIGN: A prospective observational study of infants delivered at less than 32 weeks' gestational age. Cord bloods samples were collected at delivery and Mg levels analyzed.

RESULTS: Of the 81 included cases, 5 received no antenatal MgSO<sub>4</sub>, 65 received a 4 g bolus only, and 11 received a 4 g bolus and 1 g/hour infusion. The median time of bolus administration before delivery was 104 minutes (IQR: 57-215). The mean magnesium level was 0.934 mmol/L in the No Antenatal MgSO<sub>4</sub> Group, 1.018 mmol/L in the Bolus Only Group, and 1.225 mmol/L in the Bolus and Infusion Group (p < 0.05). In the Bolus Only Group, the highest mean magnesium concentration (1.091 mmol/L) was achieved with administration 1-2 hours before delivery, but the difference was small and not statistically significant. On multiple regression analysis, lower birthweight Z scores and gestational age were independently associated with higher cord blood Mg levels.

CONCLUSION: In the Bolus Only Group, the highest mean Mg levels were observed with administration 1-2 hours before delivery, but the findings was not statistically significant. Compared to rest of the cohort, higher Mg levels were found when a bolus was followed by an infusion. Following a MgSO<sub>4</sub> bolus, some growth restricted extremely preterm babies may have higher Mg levels than would be otherwise expected.

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## **Use of progesterone supplement therapy for prevention of preterm birth: review of literatures.**

Choi SJ .

*Obstet Gynecol Sci.* 2017 Sep;60(5):405-420. doi: 10.5468/ogs.2017.60.5.405. Epub 2017 Sep 18.

Preterm birth (PTB) is one of the most common complications during pregnancy and it primarily accounts for neonatal mortality and numerous morbidities including long-term sequelae including cerebral palsy and developmental disability. The most effective treatment of PTB is prediction and prevention of its risks. Risk factors of PTB include history of PTB, short cervical length (CL), multiple pregnancies, ethnicity, smoking, uterine anomaly and history of curettage or cervical conization. Among these risk factors, history of PTB, and short CL are the most important predictive factors. Progesterone supplement therapy is one of the few proven effective methods to prevent PTB in women with history of spontaneous PTB and in women with short CL. There are 2 types of progesterone therapy currently used for prevention of PTB: weekly intramuscular injection of 17-alpha hydroxyprogesterone caproate and daily administration of natural micronized progesterone vaginal gel, vaginal suppository, or oral capsule. However, the efficacy of progesterone therapy to prevent PTB may vary depending on the administration route, form, dose of progesterone and indications for the treatment. This review aims to summarize the efficacy and safety of progesterone supplement therapy on prevention of PTB according to different indication, type, route, and dose of progesterone, based on the results of recent randomized trials and meta-analysis.

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PMCID: PMC5621069

PMID: 28989916

## **Détection – Diagnostic**

### **+Données cliniques**

#### **A video/IMU hybrid system for movement estimation in infants.**

Machireddy A, van Santen J, Wilson JL, Myers J, Hadders-Algra M, Xubo Song.

*Conf Proc IEEE Eng Med Biol Soc.* 2017 Jul;2017:730-733. doi:10.1109/EMBC.2017.8036928.

Cerebral palsy is a non-progressive neurological disorder occurring in early childhood affecting body movement and muscle control. Early identification can help improve outcome through therapy-based interventions. Absence of so-called "fidgety movements" is a strong predictor of cerebral palsy. Currently, infant limb movements captured through either video cameras or accelerometers are analyzed to identify fidgety movements. However both modalities have their limitations. Video cameras do not have the high temporal resolution needed to capture subtle movements. Accelerometers have low spatial resolution and capture only relative movement. In order to overcome these limitations, we have developed a system to combine measurements from both camera and sensors to estimate the true underlying motion using extended Kalman filter. The estimated motion achieved 84% classification accuracy in identifying fidgety movements using Support Vector Machine.

DOI: 10.1109/EMBC.2017.8036928

PMID: 29059976

#### **Characteristics of general movements in preterm infants assessed by computer-based video analysis.**

Adde L , Yang H , Sæther R , Jensenius AR , Ihlen E , Cao JY , Støen R .

*Physiother Theory Pract.* 2017 Oct 24:1-7. doi: 10.1080/09593985.2017.1391908.[Epub ahead of print]

**BACKGROUND:** Previous evidence suggests that the variability of the spatial center of infant movements, calculated by computer-based video analysis software, can identify fidgety general movements (GMs) and predict cerebral palsy.

**AIM:** To evaluate whether computer-based video analysis quantifies specific characteristics of normal fidgety movements as opposed to writhing general movements.

**METHODS:** A longitudinal study design was applied. Twenty-seven low-to moderate-risk preterm infants (20 boys, 7 girls; mean gestational age 32 [SD 2.7, range 27-36] weeks, mean birth weight 1790 grams [SD 430g, range 1185-

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2700g]) were videotaped at the ages of 3-5 weeks (period of writhing GMs) and 10-15 weeks (period of fidgety GMs) post term. GMs were classified according to Prechtl's general movement assessment method (GMA) and by computer-based video analysis. The variability of the centroid of motion (CSD), derived from differences between subsequent video frames, was calculated by means of computer-based video analysis software; group mean differences between GM periods were reported.

RESULTS: The mean variability of the centroid of motion (CSD) determined by computer-based video analysis was 7.5% lower during the period of fidgety GMs than during the period of writhing GMs ( $p = 0.004$ ).

CONCLUSION: Our findings support that the variability of the centroid of motion reflects small and variable movements evenly distributed across the body, and hence shows that computer-based video analysis qualifies for assessment of direction and amplitude of FMs in young infants.

DOI: 10.1080/09593985.2017.1391908

PMID: 29064734

### **Clinical hypoxic-ischemic encephalopathy score of the Iberoamerican Society of Neonatology (Siben): A new proposal for diagnosis and management.**

Perez JM , Golombek SG , Sola A .

*Rev Assoc Med Bras (1992)*. 2017 Jan 1;63(1):64-69. doi: 10.1590/1806-9282.63.01.64.

Hypoxic ischemic encephalopathy is a major complication of perinatal asphyxia, with high morbidity, mortality and neurologic sequelae as cerebral palsy, mostly in poor or developing countries. The difficulty in the diagnosis and management of newborns in these countries is astonishing, thus resulting in unreliable data on this pathology and bad outcomes regarding mortality and incidence of neurologic sequelae. The objective of this article is to present a new clinical diagnostic score to be started in the delivery room and to guide the therapeutic approach, in order to improve these results.

#### [Free Article](#)

DOI: 10.1590/1806-9282.63.01.64

PMID: 28225884 [Indexed for MEDLINE]

### **Development, and construct validity and internal consistency of the Grasp and Reach Assessment of Brisbane (GRAB) for infants with asymmetric brain injury.**

Perez M , Ziviani J , Guzzetta A , Ware RS , Tealdi G , Burzi V , Boyd RN .

*Infant Behav Dev*. 2016 Nov;45(Pt A):110-123. doi: 10.1016/j.infbeh.2016.10.004. Epub 2016 Oct 27.

INTRODUCTION: Infants with asymmetric brain injury (asymBI) are at high risk of Unilateral Cerebral Palsy (UCP). The Grasp and Reach Assessment of Brisbane (GRAB) was developed to detect asymmetries in unimanual/bimanual upper limb (UL) reach and grasp behaviours in infants with asymBI. This study reports the development of the GRAB and evaluates its construct validity and internal consistency.

MATERIAL AND METHODS: Prospective study of twenty four infants with asymBI and twenty typically developing (TD) infants at 18 weeks corrected age (C.A.) in a structured play session. Three different coloured toys were presented at the midline in a block design of six 30-s trials of toy presentation, separated by five 30-s trials of no toy presentation. The number and duration of: (i) unimanual contacts; (ii) unimanual grasps; (iii) bimanual midline grasps; and (iv) duration of other unimanual behaviours (e.g. prehensile movements and transport phase) were measured. An Asymmetry Index (AI) was calculated to determine asymmetries between ULs. Possible AI values ranged from 0 to 100%, indicating proportion of toy presentation time that unimanual behaviours were asymmetric between ULs. Internal consistency of both the Time Phase (TP) and Toy Colour Phase (TCP) test items were determined by calculating Cronbach's alpha coefficients. Each assessment occasion was split into six TPs and two TCPs; whereby one TP comprised one 30-s trial of one toy presentation and one TCP comprised two 30-s trials of the same toy presentation.

RESULTS: For TP, seven out of nine unimanual behaviours and two out of three bimanual behaviours demonstrated strong internal consistency (Cronbach's alpha coefficients 0.72-0.89). No unimanual activity demonstrated the strongest IC (0.89). For TCP, six out of nine unimanual behaviours demonstrated strong IC (0.73-0.82). Number of unimanual contacts and duration of unimanual prehensile movements demonstrated the strongest IC (0.82). Duration of unimanual contribution to hands at midline and duration of bimanual midline behaviour demonstrated the weakest IC for both TP and TCP (0.46-0.50). For unimanual contacts, the asymBI group were more asymmetric

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between ULs (mean AI=50%) compared to the TD group (mean AI=30%). For unimanual grasps, both groups were similarly asymmetric (both mean AI=40%). The TD group were almost twice as likely to demonstrate bimanual grasps as the asymBI group (incidence rate ratio IRR 1.9, 95% CI 1.4 to 2.5,  $p<0.001$ ). Infants with asymBI were less likely to use the impaired UL compared to the unimpaired UL for grasping (IRR 0.6, 95% CI 0.5 to 0.8,  $p<0.001$ ); and used the impaired UL for a shorter proportion of time compared to the unimpaired UL for grasping (mean difference -9.1%, 95% CI -16.6 to -1.7,  $p=0.02$ ).

**CONCLUSIONS:** The GRAB is a criterion-referenced research measure that detects and quantifies the presence or absence of unimanual and bimanual reach and grasp behaviours at 18 weeks C.A. in infants at risk of UCP. The GRAB demonstrated moderate to strong construct validity and strong IC within an assessment occasion. There was no toy preference or warm-up effect for TP or TCP for either group; confirming that the GRAB is a consistent measure across toy presentations within an assessment occasion. In this study, the GRAB identified that infants with asymBI demonstrated a paucity of bimanual grasping compared to TD infants; and demonstrated asymmetric unimanual grasping between ULs at 18 weeks C.A.

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### **Health Disparities and Child Development After Prematurity.**

Carter FA, Msall ME.

*Pediatr Ann. 2017 Oct 1;46(10):e360-e364. doi: 10.3928/19382359-20170919-02.*

There is increased recognition that preterm neonates require sequential surveillance to capture the spectrum of coordination, communication, learning, and behavior regulation disorders that may occur in the first 5 years of life and beyond. In particular, the framework of follow-up needs to go beyond the detection of cerebral palsy, blindness, and deafness in the first 2 years of life for only those at highest preterm risk (ie, <28 weeks gestation, with combinations of severe cranial sonographic abnormalities, bronchopulmonary dysplasia, and retinopathy of prematurity). In addition, there are numerous barriers for diverse families in accessing quality, comprehensive early intervention and early child education supports. This article highlights recent research on the long-term impact of preterm birth with a focus on disparities in resource access and in outcomes at entry to kindergarten and early educational trajectories. Across all degrees of prematurity, children from disadvantaged backgrounds face significant disparities both in access to comprehensive and continuous supports and in long-term academic outcomes. Ten key recommendations are provided for ensuring proactive management strategies for the long-term academic, behavioral, and social success of these at-risk children. [Pediatr Ann.

2017;46(10):e360-e364.].

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DOI: 10.3928/19382359-20170919-02

PMID: 29019629

### **Identifying relevant biomarkers of brain injury from structural MRI: Validation using automated approaches in children with unilateral cerebral palsy.**

Pagnozzi AM , Dowson N , Doecke J , Fiori S , Bradley AP , Boyd RN , Rose S .

*PLoS One. 2017 Aug 1;12(8):e0181605. doi: 10.1371/journal.pone.0181605. eCollection 2017.*

Previous studies have proposed that the early elucidation of brain injury from structural Magnetic Resonance Images (sMRI) is critical for the clinical assessment of children with cerebral palsy (CP). Although distinct aetiologies, including cortical maldevelopments, white and grey matter lesions and ventricular enlargement, have been categorised, these injuries are commonly only assessed in a qualitative fashion. As a result, sMRI remains relatively underexploited for clinical assessments, despite its widespread use. In this study, several automated and validated techniques to automatically quantify these three classes of injury were generated in a large cohort of children ( $n = 139$ ) aged 5-17, including 95 children diagnosed with unilateral CP. Using a feature selection approach on a training data set ( $n = 97$ ) to find severity of injury biomarkers predictive of clinical function (motor, cognitive, communicative and visual function), cortical shape and regional lesion burden were most often chosen associated with clinical function. Validating the best models on the unseen test data ( $n = 42$ ), correlation values ranged between 0.545 and 0.795 ( $p<0.008$ ), indicating significant associations with clinical function. The measured prevalence of injury, [Science Infos Paralysie Cérébrale, Octobre 2017, FONDATION PARALYSIE CEREBRALE 67 rue Vergniaud 18 75013 Paris - tel +33 1 45 54 03 03 contact: Christine Doumergue \[cdoumergue@lafondationmotrice.org\]\(mailto:cdoumergue@lafondationmotrice.org\)](#)

including ventricular enlargement (70%), white and grey matter lesions (55%) and cortical malformations (30%), were similar to the prevalence observed in other cohorts of children with unilateral CP. These findings support the early characterisation of injury from sMRI into previously defined aetiologies as part of standard clinical assessment. Furthermore, the strong and significant association between quantifications of injury observed on structural MRI and multiple clinical scores accord with empirically established structure-function relationships.

### [Free PMC Article](#)

DOI: 10.1371/journal.pone.0181605

PMCID: PMC5538741

PMID: 28763455 [Indexed for MEDLINE]

## **Implementation of Early Diagnosis and Intervention Guidelines for Cerebral Palsy in a High-Risk Infant Follow-Up Clinic.**

Byrne R , Noritz G , Maitre NL ; NCH Early Developmental Group .

*Pediatr Neurol.* 2017 Aug 30. pii: S0887-8994(17)30782-8. doi:10.1016/j.pediatrneurol.2017.08.002. [Epub ahead of print]

**BACKGROUND:** Cerebral palsy is the most common physical disability in childhood, and is mostly diagnosed after age 2 years. Delays in diagnosis can have negative long-term consequences for children and parents. New guidelines for early cerebral palsy diagnosis and intervention were recently published, after systematic review of the evidence by international multidisciplinary experts aiming to decrease age at diagnosis. The current study tested the feasibility of implementing these guidelines in an American clinical setting.

**METHODS:** We designed a stepwise implementation process in a neonatal intensive care follow-up clinic. Efficacy was tested by comparing 10-month pre- and post-implementation periods. Clinic visit types, cerebral palsy diagnosis, provider competencies and perspectives, and balancing measures were analyzed.

**RESULTS:** Changes to infrastructure, assessments, scheduling algorithms, documentation and supports in diagnosis or counseling were successfully implemented. Number of three- to four-month screening visits increased (255 to 499,  $P < 0.001$ ); mean age at diagnosis decreased (18 to 13 months,  $P < 0.001$ ). Clinic team awareness of early diagnosis and interventions increased ( $P < 0.001$ ). There was no decrease in family satisfaction with overall clinic function. Opportunities for improvements included documentation for transitioning patients, generalizability across hospital clinics, systematic identification of high-risk status during hospitalization, and need for cerebral palsy care guidelines for infants under age 2 years.

**CONCLUSIONS:** We demonstrated for the first time in a US clinical setting the feasibility of implementation of international early diagnosis and treatment guidelines for cerebral palsy. This process is adaptable to other settings and underscores the necessity of future research on cerebral palsy treatments in infancy.

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DOI: 10.1016/j.pediatrneurol.2017.08.002

PMID: 28982529

## **Predictive value of General Movement Assessment for preterm infants' development at 2 years - implementation in clinical routine in a non-academic setting.**

De Bock F , Will H , Behrenbeck U , Jarczok MN , Hadders-Algra M , Philippi H .

*Res Dev Disabil.* 2017 Mar;62:69-80. doi: 10.1016/j.ridd.2017.01.012. Epub 2017 Jan 20.

**BACKGROUND:** General movements (GM) are used in academic settings to predict developmental outcome in infants born preterm. However, little is known about the implementation and predictive value of GM in non-academic settings.

**AIMS:** The aim of this study is twofold: To document the implementation of GM assessment (GMA) in a non-academic setting and to assess its predictive value in infants born preterm.

**METHODS AND PROCEDURES:** We documented the process of implementing GMA in a non-academic outpatient clinic. In addition, we assessed the predictive value of GMA at 1 and 3 months' corrected age for motor and cognitive development at 2 years in 122 children born <33 weeks' gestation. Outcome at two years was based upon the Bayley Scales of Infant Development-II (mental/psychomotor developmental index (MDI, PDI)) and a neurological examination. The infants' odds of atypical outcome (MDI or PDI  $\leq 70$  or diagnosis CP) and the predictive accuracy of abnormal GMA were calculated in a clinical routine scenario, which used all available GM information (primarily at 3

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months or at 1 month, when 3 months were not available). In addition, separate analysis was undertaken for the samples of GMA at 1 and 3 months.

**OUTCOMES AND RESULTS:** Tips to facilitate GMA implementation are described. In our clinical routine scenario, children with definitely abnormal GM were more likely to have an atypical two-year outcome than children with normal GM (OR 13.2 (95% CI 1.56; 112.5); sensitivity 55.6%, specificity 82.1%). Definitely abnormal GM were associated with reduced MDI (-12.0, 95% CI -23.2; -0.87) and identified all children with cerebral palsy (CP) in the sample of GMA at 3 months only.

**CONCLUSIONS AND IMPLICATIONS:** GMA can be successfully implemented in a non-academic outpatient setting. In our clinical routine scenario, GMA allowed for adequate prediction of neurodevelopment in infants born preterm, thereby allaying concerns about diagnostic accuracy in non-academic settings.

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PMID: 28113095 [Indexed for MEDLINE]

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

### **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.

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PMCID: PMC5577618

PMID: 28954007 [Indexed for MEDLINE]

### **Ability-Based Balancing Using the Gross Motor Function Measure in Exergaming for Youth with Cerebral Palsy.**

MacIntosh A , Switzer L , Hwang S , Schneider ALJ , Clarke D , Graham TCN , Fehlings DL .

*Games Health J*. 2017 Oct 10. doi: 10.1089/g4h.2017.0053. [Epub ahead of print]

**OBJECTIVE:** To test if the gross motor function measure (GMFM) could be used to improve game balancing allowing youth with cerebral palsy (CP) with different physical abilities to play a cycling-based exercise videogame together. Our secondary objective determined if exergaming with the GMFM Ability-Based algorithm was enjoyable.

**MATERIALS AND METHODS:** Eight youth with CP, 8-14 years of age, GMFM scores between 25.2% and 87.4% (evenly distributed between Gross Motor Function Classification System levels II and III), competed against each other in head-to-head races, totaling 28 unique race dyads. Dyads raced three times, each with a different method of

minimizing the distance between participants (three balancing algorithms). This was a prospective repeated measures intervention trial with randomized and blinded algorithm assignment. The GMFM Ability-Based algorithm was developed using a least squares linear regression between the players' GMFM score and cycling cadence. Our primary outcome was dyad spread or average distance between players. The GMFM Ability-based algorithm was compared with a control algorithm (No-Balancing), and an idealized algorithm (one-speed-for-all [OSFA]). After each race, participants were asked "Was that game fun?" and "Was that game fair?" using a five-point Likert scale.

**RESULTS:** Participants pedaled quickly enough to elevate their heart rate to an average of  $120 \pm 8$  beats per minute while playing. Dyad spread was lower when using GMFM Ability-Based balancing ( $4.6 \pm 4.2$ ) compared with No-Balancing ( $11.9 \pm 6.8$ ) ( $P < 0.001$ ). When using OSFA balancing, dyad spread was ( $1.6 \pm 0.9$ ), lower than both GMFM Ability-Based ( $P = 0.006$ ) and No-Balancing ( $P < 0.001$ ). Cycling cadence positively correlated to GMFM, equal to  $0.58$  (GMFM)  $+33.29$  ( $R(2)_{adj} = 0.662$ ,  $P = 0.004$ ). Participants rated the games a median score 4/5 for both questions: "was that game fun?" and "was that game fair?."

**CONCLUSION:** The GMFM Ability-Based balancing decreased dyad spread while requiring participants to pedal quickly, facilitating interaction and physical activity.

DOI: 10.1089/g4h.2017.0053

PMID: 29016199

### **ACTIVLIM-CP a new Rasch-built measure of global activity performance for children with cerebral palsy.**

Bleyenheuft Y , Paradis J , Renders A , Thonnard JL , Arnould C .

*Res Dev Disabil.* 2017 Jan;60:285-294. doi: 10.1016/j.ridd.2016.10.005. Epub 2016 Oct 27.

**OBJECTIVE:** Children with cerebral palsy (CP) often have upper extremity (UE) and lower extremity (LE) impairments. While tools measuring separately UE and LE abilities are currently used, activities in which UE and LE are used in combination - numerous in everyday life - cannot be assessed because no instrument allows capturing global activity performance in children with CP. This study aimed to develop a clinical tool for measuring their global activity performance using the Rasch model.

**STUDY DESIGN:** The caregivers of 226 children with CP (2-18 years old) answered a 154-item experimental questionnaire. Within 4-6 weeks, 129 of them filled in the questionnaire a second time. Responses were analyzed using the Rasch RUMM2020 software.

**RESULTS:** The final 43 item scale presented a high reliability ( $R=0.98$ ) and reproducibility ( $R=0.97$ ). The item difficulty hierarchy was consistent over time and did not vary according to age, gender, or clinical form, allowing the follow-up of children from 2 to 18 years old.

**CONCLUSIONS:** ACTIVLIM-CP is a unidimensional scale specifically developed to measure global activity performance in children with CP providing a reliable tool to follow children's evolution and document changes related to neurorehabilitation, especially where a combination of UE and LE is targeted. Its responsiveness is still to be tested.

#### [Free Article](#)

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### **An independent assessment of reliability of the Melbourne Cerebral Palsy Hip Classification System.**

Shrader MW , Koenig AL , Falk M , Belthur M , Boan C .

*J Child Orthop.* 2017 Oct 1;11(5):334-338. doi: 10.1302/1863-2548.11.170077.

**PURPOSE:** Neuromuscular (NM) hip dysplasia is common in patients with cerebral palsy (CP). Traditionally, migration percentage (MP) has been used to measure the severity of NM hip dysplasia; however, the MP has some limitations. The purpose of this study is to determine the intra- and inter-reliability of the Melbourne Cerebral Palsy Hip Classification System in the typical paediatric population of patients with CP.

**METHODS:** A total of 65 anteroposterior pelvis radiographs in patients (age range 12 years to 21 years) with CP spanning all grades (I to VI) of the classification system were identified and collected for analysis in this institutional review board approved study. Four paediatric orthopaedic surgeons and one orthopaedic surgical resident classified each radiograph according to the Melbourne system. Then, at least four weeks later, the raters repeated the process with a re-randomised order of radiographs. Statistical analysis was performed using the intraclass correlation coefficient (ICC) where  $< 0$  denotes poor agreement and  $> 0.8$  indicates almost perfect agreement.

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RESULTS: The interobserver reliability was found to be excellent with the ICC of 0.853 (0.813 to 0.887) and 0.839 (0.795 to 0.877). The intraobserver reliability was also found to be excellent with the ICC in the range of 0.838 to 0.933 among the raters. Subgroup analysis indicated no differences in the reliability of observers based on clinical experience.

CONCLUSION: This study independently demonstrates that the Melbourne Cerebral Palsy Hip Classification System for NM hip dysplasia in patients with CP can be reliably used for communication among various healthcare providers and research and epidemiological purposes.

DOI: 10.1302/1863-2548.11.170077

PMCID: PMC5643926

PMID: 29081847

### **Antagonist thigh-muscle activity in 6-to-8-year-old children assessed by surface EMG during walking.**

Di Nardo F, Strazza A, Mengarelli A, Ercolani S, Burattini L, Fioretti S.

*Conf Proc IEEE Eng Med Biol Soc.* 2017 Jul;2017:3469-3472. doi:10.1109/EMBC.2017.8037603.

Analysis of muscle co-contractions seems to be relevant in the characterization of children pathologies such as spastic cerebral palsy. The aim of the study was the quantification of thigh-muscle co-contractions during walking in healthy children. To this aim, the Statistical Gait Analysis, a recent methodology providing a statistical characterization of gait, was performed on surface EMG signals from Vastus Medialis (VM) and Lateral Hamstrings (LH) in 30 healthy 6-to-8-year-old children. Muscular co-contraction was assessed as the overlapping period between activation intervals of agonist and antagonist muscles. As in adults, VM activity occurring from terminal swing to the following loading response superimposed LH activity in the same percentage of the gait cycle. This co-contraction occurred in order to control knee joint stability during weight acceptance. It was acknowledged in the totality (100 %) of the considered strides. Concomitant activity of VM and LH was detected also in the second half of stance phase in  $17.1 \pm 4.8$  % of the considered strides. Working VM and LH on different joints, this concomitant activity of antagonist muscles should not be considered as an actual co-contraction. Present findings provide new information on the variability of the reciprocal role of VM and LH during child walking, useful for comparison between normal and pathological walking in the clinical context and for designing future studies on maturation of gait.

DOI: 10.1109/EMBC.2017.8037603

PMID: 29060644

### **Anterior or posterior walkers for children with cerebral palsy? A systematic review.**

Poole M, Simkiss D, Rose A, Li FX.

*Disabil Rehabil Assist Technol.* 2017 Oct 6:1-12. doi:10.1080/17483107.2017.1385101. [Epub ahead of print]

OBJECTIVE: To review the literature comparing use of anterior and posterior walkers (PW's) by children with cerebral palsy (CP) to determine which walker type is preferable.

METHODS: Electronic databases were searched using pre-defined terms by two independent reviewers. Reference lists of included studies were hand searched. Studies published between 1985 and 2016 comparing use of anterior and PW's by children with CP were included. All study designs and outcomes were accepted. Risk of bias was assessed using the "Quality assessment standard for a cross-over study". Quality of evidence was evaluated using GRADE.

RESULTS: Six studies were analysed. All studies had small sample sizes. A total of 4/6 studies were randomized. A total of 4/6 had high risk of bias. Outcomes included velocity, pelvic tilt, hip flexion, knee flexion, step length, stride length, cadence, double stance time, oxygen cost and participant/parental preference. Velocity, trunk flexion/pelvic tilt, and stability may be improved by using a PW, however, GRADE quality was very low for all outcomes and there was heterogeneity between studies. The majority of participants and parents preferred the PW.

CONCLUSIONS: Heterogeneity and low quality of existing evidence prevented recommendation of one walker type. Well-designed studies with adequate power are needed to inform clinical recommendations. Implications for rehabilitation Clinical recommendations cannot be made for whether anterior or posterior walkers are preferable for children with cerebral palsy based on the existing evidence. Velocity, trunk flexion/pelvic tilt, and stability may be improved by using a posterior walker. The majority of walking aid users and their parents preferred posterior walkers. Adequately powered studies designed to minimize bias are needed.

DOI: 10.1080/17483107.2017.1385101

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PMID: 28984507

**Best seating condition in children with spastic cerebral palsy: One type does not fit all.**

Angsupaisal M , Dijkstra LJ , la Bastide-van Gemert S , van Hoorn JF , Burger K , Maathuis CGB , Hadders-Algra M .  
*Res Dev Disabil.* 2017 Oct 5;71:42-52. doi: 10.1016/j.ridd.2017.09.016. [Epub ahead of print]

**BACKGROUND:** The effect of forward-tilting of the seat surface and foot-support in children with spastic cerebral palsy (CP) is debated.

**AIM:** To assess the effect of forward-tilting of the seat surface and foot-support in children with CP on kinematic head stability and reaching.

**METHODS:** Nineteen children functioning at Gross Motor Function Classification System levels I-III participated [range 6-12y; ten unilateral spastic CP (US-CP) and nine bilateral spastic CP (BS-CP)]. Kinematic data were recorded of head sway and reaching with the dominant arm in four sitting conditions: a horizontal and a 15° forward (FW) tilted seat surface, each with and without foot-support.

**RESULTS:** Seating condition did not affect head stability during reaching, but did affect kinematic reaching quality. The major reaching parameters, i.e., the proportion of reaches with one movement unit (MU) and the size of the transport MU, were not affected by foot-support. Forward-tilting had a positive effect on these parameters in children with US-CP, whereas the horizontal condition had this effect in children with BS-CP.

**IMPLICATIONS:** A 15° forward-tilted seating and foot-support do not affect head stability. Reaching in children with US-CP profits from forward-tilting; in children with BS-CP forward-tilting worsens reaching - effects that are independent of foot-support.

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PMID: 28987971

**Clinical assessment and three-dimensional movement analysis: An integrated approach for upper limb evaluation in children with unilateral cerebral palsy.**

Mailleux L , Jaspers E , Ortibus E , Simon-Martinez C , Desloovere K , Molenaers G , Klingels K , Feys H .  
*PLoS One.* 2017 Jul 3;12(7):e0180196. doi: 10.1371/journal.pone.0180196. eCollection 2017.

**INTRODUCTION:** The clinical application of upper limb (UL) three-dimensional movement analysis (3DMA) in children with unilateral cerebral palsy (uCP) remains challenging, despite its benefits compared to conventional clinical scales. Moreover, knowledge on UL movement pathology and how this relates to clinical parameters remains scarce. Therefore, we investigated UL kinematics across different manual ability classification system (MACS) levels and explored the relation between clinical and kinematic parameters in children with uCP.

**PATIENTS AND METHODS:** Fifty children (MACS: I = 15, II = 26, III = 9) underwent an UL evaluation of sensorimotor impairments (grip force, muscle strength, muscle tone, two-point discrimination, stereognosis), bimanual performance (Assisting Hand Assessment, AHA), unimanual capacity (Melbourne Assessment 2, MA2) and UL-3DMA during hand-to-head, hand-to-mouth and reach-to-grasp tasks. Global parameters (Arm Profile Score (APS), duration, (timing of) maximum velocity, trajectory straightness) and joint specific parameters (angles at task endpoint, ROM and Arm Variable Scores (AVS)) were extracted. The APS and AVS refer respectively to the total amount of movement pathology and movement deviations of wrist, elbow, shoulder, scapula and trunk.

**RESULTS:** Longer movement durations and increased APS were found with higher MACS-levels ( $p < 0.001$ ). Increased APS was also associated with more severe sensorimotor impairments ( $r = -0.30$ - $(-0.73)$ ) and with lower AHA and MA2-scores ( $r = -0.50$ - $(-0.86)$ ). For the joint specific parameters, stronger movement deviations distally were significantly associated with increased muscle weakness ( $r = -0.32$ - $(-0.74)$ ) and muscle tone ( $r = 0.33$ - $(-0.61)$ ); proximal movement deviations correlated only with muscle weakness ( $r = -0.35$ - $0.59$ ). Regression analysis exposed grip force as the most important predictor for the variability in APS ( $p < 0.002$ ).

**CONCLUSION:** We found increased movement pathology with increasing MACS-levels and demonstrated the adverse impact of especially muscle weakness. The lower correlations suggest that 3DMA provides additional information regarding UL motor function, particularly for the proximal joints. Integrating both methods seems clinically meaningful to obtain a comprehensive representation of all aspects of a child's UL functioning.

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DOI: 10.1371/journal.pone.0180196

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PMCID: PMC5495347

PMID: 28671953 [Indexed for MEDLINE]

### **Development of the Hand Assessment for Infants: evidence of internal scale validity.**

Krumlinde-Sundholm L , Ek L , Sicola E , Sjöstrand L , Guzzetta A , Sgandurra G , Cioni G , Eliasson AC .

*Dev Med Child Neurol.* 2017 Oct 6. doi: 10.1111/dmcn.13585. [Epub ahead of print]

**AIM:** The aim of this study was to develop a descriptive and evaluative assessment of upper limb function for infants aged 3 to 12 months and to investigate its internal scale validity for use with infants at risk of unilateral cerebral palsy.

**METHOD:** The concepts of the test items and scoring criteria were developed. Internal scale validity and aspects of reliability were investigated on the basis of 156 assessments of infants at 3 to 12 months corrected age (mean 7.2mo, SD 2.5) with signs of asymmetric hand use. Rasch measurement model analysis and non-parametric statistics were used.

**RESULTS:** The new test, the Hand Assessment for Infants (HAI), consists of 12 unimanual and five bimanual items, each scored on a 3-point rating scale. It demonstrated a unidimensional construct and good fit to the Rasch model requirements. The excellent person reliability enabled person separation to six significant ability strata. The HAI produced an interval-level measure of bilateral hand use as well as unimanual scores of each hand, allowing a quantification of possible asymmetry expressed as an asymmetry index.

**INTERPRETATION:** The HAI can be considered a valid assessment tool for measuring bilateral hand use and quantifying side difference between hands among infants at risk of developing unilateral cerebral palsy.

**WHAT THIS PAPER ADDS:** The Hand Assessment for Infants (HAI) measures the use of both hands and quantifies a possible asymmetry of hand use. HAI is valid for infants at 3 to 12 months corrected age at risk of unilateral cerebral palsy.

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PMID: 28984352

### **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 Nov;59(11):1164-1173. doi: 10.1111/dmcn.13538. Epub 2017 Sep 6.

**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.

**WHAT THIS PAPER ADDS:** Reaching quality improves throughout infancy in all infants at high risk (VHR-infants). Infants with cerebral palsy (CP) show a worse reaching quality than VHR-infants without CP. Infants with CP achieve head stability differently from infants without CP. Infants with CP exhibit kinematic reaching problems from early age onwards.

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PMID: 28877349 [Indexed for MEDLINE]



### **Effect of sensory and motor connectivity on hand function in pediatric hemiplegia.**

Gupta D , Barachant A , Gordon AM(5), Ferre C , Kuo HC , Carmel JB , Friel KM .  
*Ann Neurol.* 2017 Oct 16. doi: 10.1002/ana.25080. [Epub ahead of print]

**OBJECTIVE:** We tested the hypothesis that somatosensory system injury would more strongly affect movement than motor system injury in children with unilateral cerebral palsy (USCP). This hypothesis was based on how somatosensory and corticospinal circuits adapt to injury during development: while the motor system can maintain connections to the impaired hand from the uninjured hemisphere, this doesn't occur in the somatosensory system. As a corollary, cortical injury strongly impairs sensory function, so we hypothesized that cortical lesions would impair hand function more than subcortical lesions.

**METHODS:** Twenty-four children with unilateral CP had physiological and anatomical measures of the motor and somatosensory systems and lesion classification. Motor physiology was performed with transcranial magnetic stimulation and somatosensory physiology with vibration-evoked EEG potentials. Tractography of the corticospinal tract and the medial lemniscus were performed with diffusion tensor imaging, and lesions were classified by MRI. Anatomical and physiological results were correlated with measures of hand function using two independent statistical methods.

**RESULTS:** Children with disruptions in the somatosensory connectivity, and cortical lesions had the most severe upper extremity impairments, particularly somatosensory function. Motor system connectivity was significantly correlated with bimanual function, but not unimanual function or somatosensory function.

**INTERPRETATION:** Both sensory and motor connectivity impact hand function in children with USCP. Somatosensory connectivity could be an important target for recovery of hand function in children with USCP.

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DOI: 10.1002/ana.25080

PMID: 29034483

### **Effects of Visual Manipulation in Sit-to-Stand Movement in Children With Cerebral Palsy.**

Pavão SL , Arnoni JLB , Rocha NACF .

*J Mot Behav.* 2017 Oct 4:1-6. doi: 10.1080/00222895.2017.1367641. [Epub ahead of print]

The authors sought to verify the effects of vision on sit-to-stand (STS) movement performance by means of postural sway in children with cerebral palsy (CP) and typical children (TC). Participants were 42 TC and 21 children with CP. STS movement was assessed with eyes open and with eyes closed. Area and velocity of center of pressure sway were analyzed in each of the 3 STS phases. We observed greater postural sway during STS movement with eyes closed. Children with CP presented greater postural sway than TC did. Both groups exhibited greater postural instability with absence of vision expressing the role of vision to keep postural stability. Moreover, the greater postural instability was observed in children with CP.

DOI: 10.1080/00222895.2017.1367641

PMID: 28976286

### **Efficacy of constraint-induced movement therapy compared with bimanual intensive training in children with unilateral cerebral palsy: a systematic review.**

Tervahauta MH , Girolami GL , Øberg GK .

*Clin Rehabil.* 2017 Nov;31(11):1445-1456. doi: 10.1177/0269215517698834. Epub 2017 Mar 20.

**OBJECTIVE:** To systematically review the evidence on the effect of constraint-induced movement therapy compared with bimanual intensive training in children with unilateral cerebral palsy.

**DATA SOURCES:** Seven electronic databases (Cinahl, Cochrane Library, EMBASE, Ovid MEDLINE, PEDro, PsycINFO, PubMed) were searched from database inception through December 2016.

**METHODS:** A systematic review was performed using the American Academy of Cerebral Palsy and Developmental Medicine and Preferred Reporting Items for Systematic Review and Meta-Analysis guidelines. Standardised mean differences (effect sizes) were calculated for each study and outcome.

**RESULTS:** Nine studies met the eligibility criteria. All studies provided level II evidence. Methodological quality was high in two studies, moderate in four studies and low in three studies. The methodology, participant and

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intervention characteristics were heterogeneous. The participants' ages ranged from 1.5 to 16 years. Their initial hand function ranged from Manual Ability Classification System Level I to Level III. The total intervention dose ranged from 24 to 210 hours and duration from one week to ten weeks. The studies measured outcomes assessing unimanual and bimanual hand and arm function, participation and attainment of individualised goals. Overall, the effect sizes did not favour one of the interventions at short- or long-term follow-up. The 95% confidence intervals were broad, indicating inaccurate precision of the effect sizes. Pooling of the data for a meta-analysis was judged to be of little clinical value owing to heterogeneity.

**CONCLUSION:** It is not possible to conclude whether constraint-induced movement therapy or bimanual intensive training is more effective than the other in children with unilateral cerebral palsy.

DOI: 10.1177/0269215517698834

PMID: 29050511

### **Joint kinematic calculation based on clinical direct kinematic versus inverse kinematic gait models.**

Kainz H , Modenese L , Lloyd DG , Maine S , Walsh HP , Carty CP .

*J Biomech.* 2016 Jun 14;49(9):1658-69. doi: 10.1016/j.jbiomech.2016.03.052. Epub 2016 Apr 1.

Most clinical gait laboratories use the conventional gait analysis model. This model uses a computational method called Direct Kinematics (DK) to calculate joint kinematics. In contrast, musculoskeletal modelling approaches use Inverse Kinematics (IK) to obtain joint angles. IK allows additional analysis (e.g. muscle-tendon length estimates), which may provide valuable information for clinical decision-making in people with movement disorders. The twofold aims of the current study were: (1) to compare joint kinematics obtained by a clinical DK model (Vicon Plug-in-Gait) with those produced by a widely used IK model (available with the OpenSim distribution), and (2) to evaluate the difference in joint kinematics that can be solely attributed to the different computational methods (DK versus IK), anatomical models and marker sets by using MRI based models. Eight children with cerebral palsy were recruited and presented for gait and MRI data collection sessions. Differences in joint kinematics up to 13° were found between the Plug-in-Gait and the gait 2392 OpenSim model. The majority of these differences (94.4%) were attributed to differences in the anatomical models, which included different anatomical segment frames and joint constraints. Different computational methods (DK versus IK) were responsible for only 2.7% of the differences. We recommend using the same anatomical model for kinematic and musculoskeletal analysis to ensure consistency between the obtained joint angles and musculoskeletal estimates.

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DOI: 10.1016/j.jbiomech.2016.03.052

PMID: 27139005 [Indexed for MEDLINE]

### **Low gait efficiency is the primary reason for the increased metabolic demand during gait in children with cerebral palsy.**

Ries AJ , Schwartz MH .

*Hum Mov Sci.* 2017 Oct 21. pii: S0167-9457(17)30280-4. doi:10.1016/j.humov.2017.10.004. [Epub ahead of print]

Children diagnosed with cerebral palsy (CP) use two to three times more metabolic energy to walk than their typically developing (TD) peers. The primary cause of the metabolic increase remains unknown. In this study, we analyzed metabolic energy, center of mass (COM) work, and gait efficiency for a large group of children diagnosed with diplegic CP in order to better understand the source of the excessive metabolic demand. Our primary hypothesis is that metabolic demand is increased in CP due to low efficiency conversion of metabolic energy into useful COM work. Results show that, on average, individuals with CP produce 27% more COM work, but have 99% higher metabolic demand than their TD peers. This causes individuals with CP to have a gait efficiency that is 31% lower than the gait efficiency of TD individuals. Therefore, low efficiency is responsible for nearly three quarters of the increase in metabolic demand. These results show that the high metabolic demands in CP are largely a result of low gait efficiency, not excessive COM work. Further work is needed to identify the specific neurological and biomechanical mechanisms underlying low gait efficiency in CP.

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DOI: 10.1016/j.humov.2017.10.004

PMID: 29066191

### **Maintaining gait stability during dual walking task: effects of age and neurological disorders.**

Tramontano M , Morone G , Curcio A , Temperoni G , Medici A , Morelli D , Caltagirone C , Paolucci S , Iosa M .  
*Eur J Phys Rehabil Med.* 2017 Feb;53(1):7-13. doi: 10.23736/S1973-9087.16.04203-9. Epub 2016 Aug 30.

**BACKGROUND:** Dual task paradigm is a common mechanism of daily life, and it is often used for investigating the effect on cognitive processing of motor behavior.

**AIM:** In the present study we investigate the dual task interference during walking on upright gait stability.

**DESIGN:** Cross-sectional study.

**SETTING:** Inpatient neurorehabilitation unit and children neurorehabilitation unit.

**POPULATION:** Eighty-five subjects were enrolled, divided into five groups: healthy young, healthy elderly, children with typical development, children with cerebral palsy and adults with stroke in subacute phase.

**METHODS:** All subjects had to walk through a pathway during which they had to hear a sound, turn the head to watch a number and verbalize it. Subjects wore an accelerometer on their lumbar spine to measure upright gait stability have been assessed by means of the Root Mean Square (RMS) of the trunk acceleration. **RESULTS:** All subjects showed a reduced speed when performing a dual task with respect to single task. This reduction was significantly different among groups ( $F(4,81)=12.253, P<0.001$ , effect size 0.377). The RMS appeared to be increased along the latero-lateral axis, and reduced along the antero-posterior and the cranio-caudal axes during the dual task walking.

**CONCLUSIONS:** These accelerations were significantly related to the changes in speed that were managed in a different way in subjects affected by cerebral palsy and stroke.

**CLINICAL REHABILITATION IMPACT:** The information obtained in this study may be used to support specific rehabilitation techniques in subjects with poor balance ability.

#### [Free Article](#)

DOI: 10.23736/S1973-9087.16.04203-9

PMID: 27575014 [Indexed for MEDLINE]

### **Negative Influence of Motor Impairments on Upper Limb Movement Patterns in Children with Unilateral Cerebral Palsy. A Statistical Parametric Mapping Study.**

Simon-Martinez C, Jaspers E, Maillieux L, Desloovere K, Vanrenterghem J, Ortibus E, Molenaers G, Feys H, Klingels K.  
*Front Hum Neurosci.* 2017 Oct 5;11:482. doi: 10.3389/fnhum.2017.00482. eCollection2017.

Upper limb three-dimensional movement analysis (UL-3DMA) offers a reliable and valid tool to evaluate movement patterns in children with unilateral cerebral palsy (uCP). However, it remains unknown to what extent the underlying motor impairments explain deviant movement patterns. Such understanding is key to develop efficient rehabilitation programs. Although UL-3DMA has been shown to be a useful tool to assess movement patterns, it results in a multitude of data, challenging the clinical interpretation and consequently its implementation. UL-3DMA reports are often reduced to summary metrics, such as average or peak values per joint. However, these metrics do not take into account the continuous nature of the data or the interdependency between UL joints, and do not provide phase-specific information of the movement pattern. Moreover, summary metrics may not be sensitive enough to estimate the impact of motor impairments. Recently, Statistical Parametric Mapping (SPM) was proposed to overcome these problems. We collected UL-3DMA of 60 children with uCP and 60 typically developing children during eight functional tasks and evaluated the impact of spasticity and muscle weakness on UL movement patterns. SPM vector field analysis was used to analyze movement patterns at the level of five joints (wrist, elbow, shoulder, scapula, and trunk). Children with uCP showed deviant movement patterns in all joints during a large percentage of the movement cycle. Spasticity and muscle weakness negatively impacted on UL movement patterns during all tasks, which resulted in increased wrist flexion, elbow pronation and flexion, increased shoulder external rotation, decreased shoulder elevation with a preference for movement in the frontal plane and increased trunk internal rotation. Scapular position was altered during movement initiation, although scapular movements were not affected by muscle weakness or spasticity. In conclusion, we identified pathological movement patterns in children with uCP and additionally mapped the negative impact of spasticity and muscle weakness on these movement patterns, providing useful insights that will contribute to treatment planning. Last, we also identified a subset of the most relevant tasks for studying UL movements in children with uCP, which will facilitate the interpretation of UL-3DMA data and undoubtedly contribute to its clinical implementation.

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DOI: 10.3389/fnhum.2017.00482

PMCID: PMC5633911

PMID: 29051729

### **On the Adaptation of Pelvic Motion by Applying 3-dimensional Guidance Forces Using TPAD.**

Kang J, Vashista V, Agrawal SK.

*IEEE Trans Neural Syst Rehabil Eng.* 2017 Sep;25(9):1558-1567. doi: 10.1109/TNSRE.2017.2679607. Epub 2017 Mar 8.

Pelvic movement is important to human locomotion as the center of mass is located near the center of pelvis. Lateral pelvic motion plays a crucial role to shift the center of mass on the stance leg, while swinging the other leg and keeping the body balanced. In addition, vertical pelvic movement helps to reduce metabolic energy expenditure by exchanging potential and kinetic energy during the gait cycle. However, patient groups with cerebral palsy or stroke have excessive pelvic motion that leads to high energy expenditure. In addition, they have higher chances of falls as the center of mass could deviate outside the base of support. In this paper, a novel control method is suggested using tethered pelvic assist device (TPAD) to teach subjects to walk with a specified target pelvic trajectory while walking on a treadmill. In this method, a force field is applied to the pelvis to guide it to move on a target trajectory and correctional forces are applied, if the pelvis motion has excessive deviations from the target trajectory. Three different experiments with healthy subjects were conducted to teach them to walk on a new target pelvic trajectory with the presented control method. For all three experiments, the baseline trajectory of the pelvis was experimentally determined for each participating subject. To design a target pelvic trajectory which is different from the baseline, Experiment I scaled up the lateral component of the baseline pelvic trajectory, while Experiment II scaled down the lateral component of the baseline trajectory. For both Experiments I and II, the controller generated a 2-D force field in the transverse plane to provide the guidance force. In this paper, seven subjects were recruited for each experiment who walked on the treadmill with suggested control methods and visual feedback of their pelvic trajectory. The results show that the subjects were able to learn the target pelvic trajectory in each experiment and also retained the training effects after the completion of the experiment. In Experiment III, both lateral and vertical components of the pelvic trajectory were scaled down from the baseline trajectory. The force field was extended to three dimensions in order to correct the vertical pelvic movement as well. Three subgroups (force feedback alone, visual feedback alone, and both force and visual feedback) were recruited to understand the effects of force feedback and visual feedback alone to distinguish the results from Experiments I and II. The results show that a training method that combines visual and force feedback is superior to the training methods with visual or force feedback alone. We believe that the present control strategy holds potential in training and correcting abnormal pelvic movements in different patient populations.

DOI: 10.1109/TNSRE.2017.2679607

PMID: 28287978 [Indexed for MEDLINE]

### **Postural insoles on gait in children with cerebral palsy: Randomized controlled double-blind clinical trial.**

Pasin Neto H, Grecco LAC, Ferreira LAB, Duarte NAC, Galli M, Oliveira CS.

*J Bodyw Mov Ther.* 2017 Oct;21(4):890-895. doi: 10.1016/j.jbmt.2017.03.005. Epub 2017 Mar 4.

The aim of the present study was to assess the effect of postural insoles on gait performance in children with Cerebral Palsy (CP). Twenty four children between four and 12 years of age were randomly allocated either the control group (n = 12) or experimental group (n = 12). The control group used placebo insoles and the experimental group used postural insoles. Three-dimensional gait analysis was performed under three conditions: barefoot, in shoes and in shoes with insoles. Three evaluations were carried out: 1) immediately following placement of the insoles; 2) after three months of insole use; and 3) one month after suspending insole use. Regarding the immediate effects and after three months use of insole, significant improvements in gait velocity and cadence were found in the experimental group, along with an increase in foot dorsiflexion, a reduction in knee flexion and a reduction in internal rotation. Conversely, these changes were not maintained in the third assessment, one month after withdrawal of the insoles. The use of postural insoles led to improvements in gait performance in children with CP.

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DOI: 10.1016/j.jbmt.2017.03.005

PMID: 29037645

### **Quantitative 3-D Ultrasound of the Medial Gastrocnemius Muscle in Children with Unilateral Spastic Cerebral Palsy.**

Obst SJ , Boyd R , Read F , Barber L .

*Ultrasound Med Biol.* 2017 Sep 26. pii: S0301-5629(17)31290-5. doi: 10.1016/j.ultrasmedbio.2017.08.929. [Epub ahead of print]

Three-dimensional ultrasound (3-DUS) was used to examine the size and appearance of the medial gastrocnemius (MG) muscle in children with unilateral cerebral palsy (CP). Twenty-six children with CP and 10 typically developing (TD) children participated. Three-dimensional US images of both limbs in children with CP and the right limb in TD children were analysed using quantitative methods to determine muscle volume, global echo intensity, global echo pattern and regional echo intensity. Significant differences in MG volume and all echo parameters were found between TD and CP children. The more involved limb was smaller and had higher echo intensity and a more heterogeneous echo pattern compared with the TD group. Compared with that of the more involved limb, the MG of the less involved limb was larger but had a similar echo appearance. The MG of both limbs in children with unilateral spastic CP is smaller and, based on quantitative ultrasound, structurally different from that of TD children.

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PMID: 28967503

### **Scoliosis in Patients with Severe Cerebral Palsy: Three Different Courses in Adolescents.**

Oda Y , Takigawa T, Sugimoto Y, Tanaka M, Akazawa H, Ozaki T.

*Acta Med Okayama.* 2017 Apr;71(2):119-126. doi: 10.18926/AMO/54980.

Patients with cerebral palsy (CP) frequently present with scoliosis; however, the pattern of curve progression is difficult to predict. We aimed to clarify the natural course of the progression of scoliosis and to identify scoliosis predictors. This was a retrospective, single-center, observational study. Total of 92 CP patients from Asahikawasou Ryouiku Iryou Center in Okayama, Japan were retrospectively analyzed. Cobb angle, presence of hip dislocation and pelvic obliquity, and Gross Motor Function Classification System (GMFCS) were investigated. Severe CP was defined as GMFCS level IV or V. The mean observation period was 10.7 years. Thirtyfour severe CP patients presented with scoliosis and were divided into 3 groups based on their clinical courses: severe, moderate and mild. The mean Cobb angles at the final follow-up were 129°, 53°, and 13° in the severe, moderate, and mild groups, respectively. The average progressions from 18 to 25 years were 2.7°/year, 0.7°/year, and 0.1°/year in the severe, moderate, and mild curve groups, respectively. We observed the natural course of scoliosis and identified 3 courses based on the Cobb angle at 15 and 18 years of age. This method of classification may help clinicians predict the patients' disease progression.

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DOI: 10.18926/AMO/54980

PMID: 28420893 [Indexed for MEDLINE]

### **Screening and referral for children with physical disabilities.**

Geogiadis AG, Thomason P, Willoughby K , Graham HK

*J Paediatr Child Health.* 2017 Oct 17. doi: 10.1111/jpc.13735. [Epub ahead of print]

The clinical care of children with physical disabilities is a major priority for paediatricians and paediatric orthopaedic surgeons. Cerebral palsy (CP) is the prototypical condition and remains the most common cause of physical disability in developed countries. The incidence is approximately 2 per 1000 live births, translating to between 600 and 700 new children per annum in Australia, with approximately 34 000 children and adults currently living with CP. This figure is predicted to rise inexorably over the next 20 years. The care of children with physical disabilities, including those with CP, is usually coordinated by paediatricians, general practitioners and allied health teams including physiotherapists, with input from paediatric orthopaedic surgeons when appropriate. The emphasis in care for children with CP has moved from 'reactive' to 'proactive'. In the past, children are often referred when symptomatic, for example when a hip dislocation had occurred and became painful. The emphasis now is on coordinated, multidisciplinary care in which musculoskeletal manifestations of disability are identified by screening

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programmes. Systematic screening, especially when population-based and linked to a register, avoids children getting 'lost in the system'. Early and more effective interventions may be offered for the prevention of contractures, dislocation of the hip and spinal deformities. In this review, we will focus on the assessment of gait in children with physical disabilities, and monitoring for hip and spine deformity.

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DOI: 10.1111/jpc.13735

PMID: 29044835

### **Sensory processing disorders in children with cerebral palsy.**

Pavão SL, Rocha NA

*Infant Behav Dev.* 2017 Feb;46:1-6. doi: 10.1016/j.infbeh.2016.10.007. Epub 2016 Nov 17.

**OBJECTIVE:** To evaluate sensory processing in children with CP using the Sensory Profile questionnaire and to compare results with the ones of children with typical development (TD).

**METHODS:** We assessed sensory processing of 59 TD children and 43 CP children using the Sensory Profile, a standardized parent reporting measure that records children's responses to sensory events in daily life. Mann-Whitney test was used to compare the results of sensory processing evaluation among the groups. Bonferroni correction was applied.

**RESULTS:** We found differences in sensory processing between groups in 16 out of the 23 categories evaluated in the Sensory Profile.

**CONCLUSION:** Our results pointed out to the existence of disturbances in the processing of sensory information in CP. Based on the importance of the sensory integration process for motor function, the presence of such important disturbances draw the attention to the implementation of sensory therapies which improve function in these children.

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DOI: 10.1016/j.infbeh.2016.10.007

PMID: 27866043 [Indexed for MEDLINE]

### **The effect of asymmetrical limited hip flexion on seating posture, scoliosis and windswept hip distortion.**

Ágústsson A, Sveinsson Þ, Rodby-Bousquet E.

*Res Dev Disabil.* 2017 Oct 5;71:18-23. doi: 10.1016/j.ridd.2017.09.019. [Epub ahead of print]

**BACKGROUND:** Postural asymmetries with seating problems are common in adults with cerebral palsy.

**AIMS:** To analyse the prevalence of asymmetrical limited hip flexion (<90°) in adults with CP, and to evaluate the association between asymmetrical limited hip flexion and postural asymmetries in the sitting position.

**METHODS AND PROCEDURES:** Cross-sectional data of 714 adults with CP, 16-73 years, GMFCS level I-V, reported to CPUP, the Swedish cerebral palsy national surveillance program and quality registry, from 2013 to 2015. Hip range of motion was analysed in relation to pelvic obliquity, trunk asymmetry, weight distribution, scoliosis and windswept hip distortion.

**OUTCOMES AND RESULTS:** The prevalence of asymmetrical limited hip flexion increased as GMFCS level decreased. Of adults at GMFCS level V, 22% had asymmetrical limited hip flexion (<90°). The odds of having an oblique pelvis (OR 2.6, 95% CI:1.6-2.1), an asymmetrical trunk (OR 2.1, 95% CI:1.1-4.2), scoliosis (OR 3.7, 95% CI:1.3-9.7), and windswept hip distortion (OR 2.6, 95% CI:1.2-5.4) were higher for adults with asymmetrical limited hip flexion compared with those with bilateral hip flexion >90°.

**CONCLUSIONS AND IMPLICATIONS:** Asymmetrical limited hip flexion affects the seating posture and is associated with scoliosis and windswept hip distortion.

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PMID: 28987968

### **Validity and reliability of ankle dorsiflexion measures in children with cerebral palsy.**

Kim DH, An DH, Yoo WG.

*J Back Musculoskelet Rehabil.* 2017 Sep 22. doi: 10.3233/BMR-170862. [Epub ahead of print]

**PURPOSE:** We compared a goniometer method in a non-weight-bearing position with a tape measure method in a weight-bearing position to determine which was more reliable for assessing dorsiflexion range of motion (ROM) in children with cerebral palsy (CP).

**METHODS:** Ankle dorsiflexion ROM was measured using goniometer and tape measure methods in non-weight- and weight-bearing positions, respectively.

**RESULTS:** In the test-retest reliability of ankle dorsiflexion ROM using a universal goniometer, the intraclass correlation coefficient (ICC) varied from 0.75 to 0.96 and the overall ICC score was 0.91 ( $p < 0.001$ ). In the test-retest reliability of ankle dorsiflexion ROM using a tape measure, ICC varied from 0.98 to 0.99 and the overall ICC score was 0.99 ( $p < 0.001$ ). Ankle dorsiflexion ROM using a universal goniometer had a standard error of measurement (SEM) of 2.86 and a minimum detectable change (MDC) of 7.94. Ankle dorsiflexion ROM using a tape measure had an SEM of 1.01 and a MDC of 2.80.

**CONCLUSIONS:** The tape measure method in a weight-bearing position was more reliable than using a universal goniometer in a non-weight-bearing position in children with CP.

DOI: 10.3233/BMR-170862

PMID: 28968229

## Cognition

### **Asynchronous brain-computer interface for cognitive assessment in people with cerebral palsy.**

Alcaide-Aguirre RE , Warschawsky SA, Brown D, Aref A, Huggins JE.

*J Neural Eng.* 2017 Oct 5;14(6):066001. doi: 10.1088/1741-2552/aa7fc4. [Epub ahead of print]

**OBJECTIVE:** Typically, clinical measures of cognition require motor or speech responses. Thus, a significant percentage of people with disabilities are not able to complete standardized assessments. This situation could be resolved by employing a more accessible test administration method, such as a brain-computer interface (BCI). A BCI can circumvent motor and speech requirements by translating brain activity to identify a subject's response. By eliminating the need for motor or speech input, one could use a BCI to assess an individual who previously did not have access to clinical tests.

**APPROACH:** We developed an asynchronous, event-related potential BCI-facilitated administration procedure for the peabody picture vocabulary test (PPVT-IV). We then tested our system in typically developing individuals ( $N = 11$ ), as well as people with cerebral palsy ( $N = 19$ ) to compare results to the standardized PPVT-IV format and administration.

**MAIN RESULTS:** Standard scores on the BCI-facilitated PPVT-IV, and the standard PPVT-IV were highly correlated ( $r = 0.95$ ,  $p < 0.001$ ), with a mean difference of  $2.0 \pm 6.4$  points, which is within the standard error of the PPVT-IV.

**SIGNIFICANCE:** Thus, our BCI-facilitated PPVT-IV provided comparable results to the standard PPVT-IV, suggesting that populations for whom standardized cognitive tests are not accessible could benefit from our BCI-facilitated approach.

DOI: 10.1088/1741-2552/aa7fc4

PMID: 28981448

### **Effectiveness of cognitive orientation to (daily) occupational performance (CO-OP) on children with cerebral palsy: A mixed design.**

Ghorbani N , Rassafiani M , Izadi-Najafabadi S , Yazdani F , Akbarfahimi N , Havaei N , Gharebaghy S .

*Res Dev Disabil.* 2017 Oct 5;71:24-34. doi: 10.1016/j.ridd.2017.09.007. [Epub ahead of print]

**BACKGROUND:** Cerebral palsy (CP) is the most common cause of physical disabilities during childhood. Therapeutic interventions mainly focus on impairment reduction to address motor-based difficulties. In contrast, Cognitive Orientation to daily Occupational Performance (CO-OP) is a cognitive approach, providing intervention at the level of activity and participation.

**AIMS:** This study aims to determine whether the CO-OP approach improves motor skills and achievement in motor-based occupational performance goals in children with CP.

**METHODS AND PROCEDURES:** In this mixed design research (i.e., a multiple baseline single case experimental design and a one-group pretest-posttest design), five children with CP participated in 12 CO-OP intervention sessions.

Repeated measures of motor skills for the multiple baseline single case experimental design were taken using the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP); pre- and post-measures of parent/child perception of performance and satisfaction were identified using the Canadian Occupational Performance Measure (COPM); level of achievement was identified using Goal Attainment Scaling (GAS).

**OUTCOMES AND RESULTS:** According to the BOTMP results, all children were able to engage in the CO-OP intervention to improve motor performance. Significant differences after treatment were found in both performance and performance satisfaction ratings using the COPM as rated by parents and children. The GAS results showed progress in achievement levels for all children; all goals were achieved or exceeded.

**CONCLUSIONS AND IMPLICATIONS:** CO-OP intervention can be helpful in improving motor skills and achieving self-identified, motor-based goals in children with CP.

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PMID: 28987969

### **Long-Term Cognitive Outcomes of Birth Asphyxia and the Contribution of Identified Perinatal Asphyxia to Cerebral Palsy.**

Pappas A, Korzeniewski SJ

*Clin Perinatol.* 2016 Sep;43(3):559-72. doi: 10.1016/j.clp.2016.04.012.

Neonatal encephalopathy among survivors of presumed perinatal asphyxia is recognized as an important cause of cerebral palsy (CP) and neuromotor impairment. Recent studies suggest that moderate to severe neonatal encephalopathy contributes to a wide range of neurodevelopmental and cognitive impairments among survivors with and without CP. Nearly 1 of every 4 to 5 neonates treated with hypothermia has or develops CP. Neonatal encephalopathy is diagnosed in only approximately 10% of all cases. This article reviews the long-term cognitive outcomes of children with presumed birth asphyxia and describes what is known about its contribution to CP.

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PMID: 27524454 [Indexed for MEDLINE]

## **Traitement - Rééducation motrice et cognitive**

### **Prevention of hip displacement in children with cerebral palsy: a systematic review.**

Miller SD , Juricic M , Hesketh K , Mclean L , Magnuson S , Gasior S , Schaeffer E , O'donnell M , Mulpuri K .

*Dev Med Child Neurol.* 2017 Nov;59(11):1130-1138. doi: 10.1111/dmcn.13480. Epub 2017 Jun 2.

**AIM:** To conduct a systematic review and evaluate the quality of evidence for interventions to prevent hip displacement in children with cerebral palsy (CP).

**METHOD:** A systematic review was performed using American Academy of Cerebral Palsy and Developmental Medicine (AACPD) and Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology. Searches were completed in seven electronic databases. Studies were included if participants had CP and the effectiveness of the intervention was reported using a radiological measure. Results of orthopaedic surgical interventions were excluded.

**RESULTS:** Twenty-four studies fulfilled the inclusion criteria (4 botulinum neurotoxin A; 2 botulinum neurotoxin A and bracing; 1 complementary and alternative medicine; 1 intrathecal baclofen; 1 obturator nerve block; 8 positioning; 7 selective dorsal rhizotomy). There was significant variability in treatment dosages, participant characteristics, and duration of follow-up among the studies. Overall, the level of evidence was low. No intervention in this review demonstrated a large treatment effect on hip displacement.

**INTERPRETATION:** The level and quality of evidence for all interventions aimed at slowing or preventing hip displacement is low. There is currently insufficient evidence to support or refute the use of the identified interventions to prevent hip displacement or dislocation in children and young people with CP.

**WHAT THIS PAPER ADDS:** High-quality evidence on prevention of hip displacement is lacking. No recommendations can be made for preventing hip displacement in children with cerebral palsy because of poor-quality evidence. High-quality, prospective, longitudinal studies investigating the impact of interventions on hip displacement are required.



### **Pharmacologie Efficacite Tolérance**

#### **Cost-minimization analysis in the treatment of spasticity in children with cerebral palsy with botulinum toxin type A: an observational, longitudinal, retrospective study.**

Tapias G , García-Romero M , Crespo C , Cuesta M , Forné C , Pascual-Pascual SI .

*Farm Hosp. 2016 Sep 1;40(5):412-26. doi: 10.7399/fh.2016.40.5.10429.*

**OBJECTIVE:** Cost-minimization analysis of onabotulinumtoxinA and abobotulinumtoxinA, taking into account the real dose administered to children with spasticity associated with dynamic equinus foot deformity due to cerebral palsy.

**METHOD:** A single centre, observational, longitudinal, and retrospective study which included spastic paediatric patients aged 2-to-18-years and treated with onabotulinumtoxinA or abobotulinumtoxinA from December 1995 to October 2012, in the Paediatric Neurology Unit of a first-level Spanish hospital. A longitudinal analysis of spasticity severity was made to confirm the similar efficacy of both treatments. Cost minimization was analyzed using the dose administered and the direct costs (pharmacological and medical visits costs) from the perspective of the National Health System (in euros from 2016).

**RESULTS:** We analyzed 895 patients with paediatric spasticity: 543 were treated only with onabotulinumtoxinA, 292 only with abobotulinumtoxinA, and 60 with both treatments. The mean doses administered were 5.44 U/kg (SD = 2.17) for onabotulinumtoxinA, and 14.73 U/kg (5.26) for abobotulinumtoxinA. The total annual direct cost (pharmacological and medical visits) was € 839.56 for onabotulinumtoxinA and € 631.23 for abobotulinumtoxinA, which represents a difference of € 208.34 per year in favour of treatment with abobotulinumtoxinA.

**CONCLUSIONS:** It has been demonstrated that in real clinical practice, the cost per patient and year for treatment of paediatric spasticity was lower when abobotulinumtoxinA was used.

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DOI: 10.7399/fh.2016.40.5.10429

PMID: 27570991 [Indexed for MEDLINE]

#### **Does Intrathecal Baclofen Therapy Increase Prevalence and/or Progression of Neuromuscular Scoliosis?**

Walker KR , Novotny SA , Krach LE .

*Spine Deform. 2017 Nov;5(6):424-429. doi: 10.1016/j.jspd.2017.03.006.*

**STUDY DESIGN:** Retrospective, case-matched review.

**OBJECTIVES:** Compare a group of individuals with cerebral palsy (CP) who had intrathecal baclofen (ITB) pumps to a group of individuals with CP who did not have ITB pumps in order to determine if there was a difference in the prevalence of new-onset neuromuscular scoliosis, an increased rate of progression of preexisting neuromuscular scoliosis, or an increased rate of posterior spine fusion surgery in skeletally immature individuals with CP who had ITB pumps.

**SUMMARY OF BACKGROUND DATA:** Various authors report conflicting findings, with some reporting an increased incidence or prevalence of scoliosis in individuals with CP who have ITB pumps whereas others report no difference in the rate of scoliosis between groups.

**METHODS:** Retrospective chart and radiographic case-matched study in which individuals were matched by gender and Gross Motor Function Classification Scale (GMFCS) level.

**RESULTS:** We found no difference in the rates of new-onset neuromuscular scoliosis for those with CP and ITB pumps and those without ITB pumps. However, we did see a higher rate of progression as well as an increased rate of posterior spine fusion surgery in individuals with CP who had ITB pumps than for those with CP who did not have an ITB pump.

**CONCLUSIONS:** We continue to recommend ITB pump therapy for individuals with severe spasticity associated with CP (GMFCS IV and V). There is a significant risk of complications for individuals in general. The risk of neuromuscular scoliosis is relatively high in this population. Our findings suggest that individuals with CP who have ITB pumps and

who do or do not have preexisting scoliosis should be monitored closely for either developing new neuromuscular scoliosis or progression of preexisting scoliosis.

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PMID: 29050720

### **Intrathecal Baclofen Therapy for the Treatment of Spasticity in Lithuania.**

Kvascevičius R , Lapteva O , Kesienė J , Vaitkus A , Mikulenaite L , Raugalas R , Sipylaite J , Rocka S , Juocevičius A .

*J Neurol Surg A Cent Eur Neurosurg.* 2017 May;78(3):281-285. doi: 10.1055/s-0036-1593973. Epub 2016 Nov 30.

Spasticity of cerebral or spinal origin severely impairs an individual's functional ability and quality of life. Intrathecal baclofen (ITB) therapy via an implantable pump is indicated for use in patients unresponsive to oral antispasmodics. ITB therapy improves the daily caring for and relief of painful spasms. In Lithuania, ITB therapy was introduced in clinical practice just recently. We share our experience of spasticity management with the ITB pump system in five patients at Vilnius University Hospital Santariskiu Klinikos. Four patients had spastic tetraplegia associated with cerebral palsy, and one patient developed spastic paraplegia after a spinal epidural abscess.

Georg Thieme Verlag KG Stuttgart · New York.

DOI: 10.1055/s-0036-1593973

PMID: 27903018 [Indexed for MEDLINE]

### **Lumbar translaminar fenestration for insertion of intrathecal baclofen catheter: a novel technique.**

Heran MKS , Al-Shikarchy H , Chowne C .

*Pediatr Radiol.* 2017 May;47(6):761-763. doi: 10.1007/s00247-017-3816-y. Epub 2017 Mar 20.

Intrathecal baclofen has long been known to be an efficacious treatment of spasticity in children with cerebral palsy. Test bolus administration is often necessary to ensure patients will benefit from this treatment. The introduction of an intrathecal catheter for test bolus administration can prove challenging in a subset of this population, particularly those who have received surgery with postoperative spinal fusion masses. We outline a novel technique of inserting a spinal catheter for test bolus administration in a patient with a postoperative fusion mass whereby a fenestration is created through the lamina using an osteotomy needle.

DOI: 10.1007/s00247-017-3816-y

PMID: 28317070 [Indexed for MEDLINE]

## **Chirurgie**

### **Avascular necrosis in children with cerebral palsy after reconstructive hip surgery.**

Phillips L , Hesketh K , Schaeffer EK , Andrade J , Farr J , Mulpuri K .

*J Child Orthop.* 2017 Oct 1;11(5):326-333. doi: 10.1302/1863-2548.11.170078.

**PURPOSE:** Progressive hip displacement is one of the most common orthopaedic pathologies in children with cerebral palsy (CP). Reconstructive hip surgery has become the standard treatment of care. Reported avascular necrosis (AVN) rates for hip reconstructive surgery in these patients vary widely in the literature. The purpose of this study is to identify the frequency and associated risk factors of AVN for reconstructive hip procedures.

**METHODS:** A retrospective analysis was performed of 70 cases of reconstructive hip surgery in 47 children with CP, between 2009 and 2013. All 70 cases involved varus derotation osteotomy (VDRO), with 60% having combined VDRO and pelvic osteotomies (PO), and 21% requiring open reductions. Mean age at time of surgery was 8.82 years and 90% of patients were Gross Motor Function Classification System (GMFCS) 4 and 5. Radiographic dysplasia parameters were analysed at selected intervals, to a minimum of one year post-operatively. Severity of AVN was classified by Kruczynski's method. Bivariate statistical analysis was conducted using Chi-square test and Student's t-test.

**RESULTS:** There were 19 (27%) noted cases of AVN, all radiographically identifiable within the first post-operative year. The majority of AVN cases (63%) were mild to moderate in severity. Pre-operative migration percentage (MP) ( $p = 0.0009$ ) and post-operative change in MP ( $p = 0.002$ ) were the most significant predictors of AVN. Other risk factors were: GMFCS level ( $p = 0.031$ ), post-operative change in NSA ( $p = 0.02$ ) and concomitant adductor tenotomy

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(0.028).

CONCLUSION: AVN was observed in 27% of patients. Severity of displacement correlates directly with AVN risk and we suggest that hip reconstruction, specifically VDRO, be performed early in the 'hip at risk' group to avoid this complication.

DOI: 10.1302/1863-2548.11.170078

PMCID: PMC5643925

PMID: 29081846

### **Evidence of knee extensor dysfunction during sit-to-stand following distal femoral extension osteotomy and patellar tendon advancement in young adults with cerebral palsy: A pilot study.**

Boyer ER , Stout JL , Laine JC , Gutknecht SM , Oliveira LH , Munger ME , Schwartz MH , Novacheck TF .

*Gait Posture*. 2017 Oct;58:527-532. doi: 10.1016/j.gaitpost.2017.09.018. Epub 2017 Sep 19.

A distal femoral extension osteotomy with patellar tendon advancement (DFEO+PTA) is a common treatment for individuals with cerebral palsy (CP) who walk in crouch. Musculoskeletal modeling suggests that the typical patella baja position post-DFEO+PTA may limit one's abilities to perform sit-to-stand (STS) tasks; however, STS function has not been assessed. Our purpose was to compare how well individuals who received a DFEO+PTA can perform a 5-times STS test (FTSST) eight or more years after surgery compared to their peers who did not receive a DFEO+PTA (non-DFEO+PTA group). Twenty-one participants completed the task (12 DFEO+PTA, 9 non-DFEO+PTA). Three-dimensional kinematics and kinetics were captured. Kinetics were non-dimensionalized to facilitate group comparisons. Non-DFEO+PTA participants performed the FTSST moderately faster than the DFEO+PTA group (median(IQR), 14.6(9.3) seconds vs. 20.3(10.1) seconds, non-parametric effect size  $\gamma=0.97$ ,  $p=0.241$ ). Peak negative knee power was larger for the non-DFEO+PTA group (Mean $\pm$ SD,  $-0.063\pm 0.025$  vs.  $-0.048\pm 0.020$ , Cohen's  $d=0.66$ ,  $p=0.165$ ). A similar but weaker trend was observed for negative hip power (median(IQR)  $-0.120(0.066)$  vs.  $-0.105(0.044)$ ,  $\gamma=0.43$ ,  $p=0.671$ ). Both groups used their hips approximately twice as much as their knees to perform the task. The functional deficit among DFEO+PTA participants may be due to patella baja decreasing the knee extensor moment arm, which concurs with the modeling prediction. The group differences may also be due to the non-DFEO+PTA group being slightly higher functioning. Future research is warranted to determine if optimizing patella position during a DFEO+PTA may improve unaided STS function without compromising gait improvements.

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PMID: 28961550

### **Health-Related Quality of Life and Care Giver Burden Following Spinal Fusion in Children With Cerebral Palsy.**

DiFazio RL , Miller PE, Vessey JA, Snyder BD.

*Spine (Phila Pa 1976)*. 2017 Jun 15;42(12):E733-E739. doi: 10.1097/BRS.0000000000001940

STUDY DESIGN: A prospective longitudinal cohort.

OBJECTIVE: The objective of this study was to evaluate changes in caregivers' perceptions of health-related quality of life (HRQOL) and caregiver burden in children with severe cerebral palsy (CP) following spinal fusion.

SUMMARY OF BACKGROUND DATA: Progressive scoliosis is common in nonambulatory children with CP; the utility of spine fusion has been long debated and prospective evaluations of patient reported outcomes are limited.

METHODS: Children 3 to 21 years old, gross motor classification system (GMFCS) IV-V CP, scheduled for spine fusion were enrolled consecutively from September 2011 to March 2014. Caregivers completed the CPCHILD and ACEND pre-operatively and at 6 weeks, 3, 6, 12, and 24 months postoperatively. Changes in CPCHILD and ACEND scores from preoperative to 1 and 2 years after surgery were assessed using paired t tests. Correlations between preoperative Cobb angle and CPCHILD and ACEND scores were evaluated using Pearson's correlation analysis. RESULTS: Twenty-six GMFCS IV-V CP patients with severe scoliosis treated with spine fusion were included. Mean age was 14 years, 50% male, and 46% had instrumentation to the pelvis. Average preoperative Cobb angle was 68.9° (SD 25.68) with an average improvement of 76%. The CPCHILD score increased by 9.8 points above baseline [95% confidence interval (95% CI): 3.4-16.2] at 1 year postoperatively ( $P=0.005$ ). However, at 2 years, the CPCHILD score regressed to baseline ( $P=0.40$ ). ACEND scores did not change from baseline scores at 1-year ( $P=0.09$ ) and 2-year ( $P=0.72$ ) follow-up, reflecting that caregiver burden is little changed by spine fusion. There was no correlation between preoperative Cobb angle and CPCHILD score ( $P=0.52$ ) or ACEND score ( $P=0.56$ ) at 1-year or 2-year follow-

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up ( $P=0.69$ ,  $P=0.90$ ). Children with Cobb angle  $\leq 75^\circ$  experienced more improvement 1 year after surgery than children with Cobb angle  $>75^\circ$ . CONCLUSION: HRQOL improves 1 year following spine fusion but regresses to baseline after 2 years. Caregiver burden was unchanged following spine fusion.

LEVEL OF EVIDENCE: 2.

DOI: 10.1097/BRS.0000000000001940

PMID: 27792122 [Indexed for MEDLINE]

### **Intramuscular psoas lengthening during single-event multi-level surgery fails to improve hip dynamics in children with spastic diplegia. Clinical and kinematic outcomes in the short- and medium-terms.**

Mallet C , Simon AL , Ilharrebordé B , Presedo A , Mazda K , Penneçot GF .

*Orthop Traumatol Surg Res.* 2016 Jun;*102(4):501-6.* doi: 10.1016/j.otsr.2016.01.022. Epub 2016 Mar 31.

BACKGROUND: In children with spastic diplegia, hip extension in terminal stance is limited by retraction of the psoas muscle, which decreases stride propulsion and step length on the contralateral side. Whether intramuscular psoas lengthening (IMPL) is effective remains controversial. The objective of this study was to assess the impact of IMPL as a component of single-event multi-level surgery (SEMLS) on spatial and temporal gait parameters, clinical hip flexion deformity, and hip flexion kinematics. HYPOTHESIS: IMPL as part of SEMLS does not significantly improve hip flexion kinematics.

MATERIALS AND METHODS: A retrospective review was conducted of the medical charts of consecutive ambulatory children with cerebral palsy who had clinical hip flexion deformity ( $>10^\circ$ ) with more than  $10^\circ$  of excess hip flexion in terminal stance and who underwent SEMLS. The groups with and without IMPL were compared. Preoperative values of the clinical hip flexion contracture, hip flexion kinematics in terminal stance, and spatial and temporal gait parameters were compared to the values recorded after a mean postoperative follow-up of  $2.4\pm 2.0$  years (range, 1.0-8.7 years). Follow-up was longer than 3 years in 6 patients.

RESULTS: Of 47 lower limbs (in 34 patients) included in the analysis, 15 were managed with IMPL. There were no significant between-group differences at baseline. Surgery was followed in all limbs by significant decreases in kinematic hip flexion and in the Gillette Gait Index. In the IMPL group, significant improvements occurred in clinical hip flexion deformity, walking speed, and step length. The improvement in kinematic hip extension was not significantly different between the two groups. Crouch gait recurred in 3 (8%) patients.

DISCUSSION: The improvement in kinematic hip extension in terminal stance was not significantly influenced by IMPL but was, instead, chiefly dependent on improved knee extension and on the position of the ground reaction vector after SEMLS. IMPL remains indicated only when the clinical hip flexion deformity exceeds  $20^\circ$ . LEVEL OF EVIDENCE: IV, retrospective study.

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PMID: 27050557 [Indexed for MEDLINE]

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

Daunter 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 ( $p=0.001$ ).

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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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PMCID: PMC5610610 [Available on 2018-10-01]

PMID: 28617943 [Indexed for MEDLINE]

### **Long-term outcomes after selective dorsal rhizotomy: a retrospective matched cohort study.**

Munger ME , Aldahondo N , Krach LE , Novacheck TF , Schwartz MH .

*Dev Med Child Neurol.* 2017 Nov;59(11):1196-1203. doi: 10.1111/dmnc.13500. Epub 2017 Aug 8.

AIM: To examine long-term outcomes of selective dorsal rhizotomy (SDR) 10 to 17 years after surgery.

METHOD: Participants who underwent SDR had spastic diplegic cerebral palsy (CP), completed baseline gait analysis, and were 16 to 25 years old at follow-up. Non-SDR participants (i.e. controls) were matched on important clinical parameters at baseline but did not undergo SDR. All study participants completed six surveys assessing pain, quality of life, participation, function, and mobility. Treatment history for lower extremity surgery and antispasticity injections was tabulated. A subset of each study group returned for three-dimensional gait analysis, including kinematics, metabolic energy cost, and physical examination. Gait Deviation Index (GDI) was calculated to measure gait quality.

RESULTS: The study cohort had 24 participants with SDR and 11 without SDR. Of these, 13 patients with SDR (five males, eight females; median [IQR] age 17y 2mo [16y 8mo-17y 9mo]) and eight without SDR (three males, five females; median [IQR] age 19y 2mo [17y 3mo-21y 11mo]) completed baseline and follow-up gait analysis. Spasticity significantly decreased in those with SDR ( $p < 0.05$ ). Gait Deviation Index improved more in participants without SDR than those with SDR ( $\Delta_{\text{non-SDR}} = 12.8$  vs  $\Delta_{\text{SDR}} = 9.1$ ;  $p = 0.01$ ). Compared with the SDR group, participants without SDR underwent significantly more subsequent interventions ( $p < 0.05$ ). INTERPRETATION: Patients in both the SDR and non-SDR groups showed improved gait quality more than 10 years after surgery. Participants without SDR had a larger improvement in gait pathology but underwent significantly more intervention. There were no differences between groups in survey measures. These results suggest differing treatment courses provide similar outcomes into early adulthood.

WHAT THIS PAPER ADDS: Selective dorsal rhizotomy (SDR) and non-SDR groups had significant improvement in gait pathology over time. The non-SDR group had significantly better gait compared with the SDR group at follow-up. The groups had similar levels of energy cost, pain, and quality of life. Non-SDR participants underwent significantly more orthopaedic surgery and antispasticity injections than SDR participants. Use of a clinically similar control group highlights that different treatment courses may result in similar outcomes into young adulthood.

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PMID: 28786493 [Indexed for MEDLINE]

### **Management of spinal infections in children with cerebral palsy.**

Sebaaly A , El Rachkidi R , Yaacoub JJ , Saliba E , Ghanem I .

*Orthop Traumatol Surg Res.* 2016 Oct;102(6):801-5. doi:10.1016/j.otsr.2016.04.015. Epub 2016 Jul 29.

Cerebral palsy patients who undergo posterior spinal instrumentation for scoliosis are at a greater risk of surgical site infection compared to adolescents with idiopathic scoliosis. Many infecting organisms are reported. Risk factors include patients' specific factors, nutritional status as well as surgery related factors. Although surgical management is still controversial, it is always based on irrigation and debridement followed or not by implant removal. The purpose of this paper is to review the pathophysiology of surgical site infection in this patient population and to propose a treatment algorithm, based on a thorough review of the current literature and personal experience.

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DOI: 10.1016/j.otsr.2016.04.015

PMID: 27480292 [Indexed for MEDLINE]

## **Total hip replacement in young non-ambulatory cerebral palsy patients.**

Morin C , Ursu C , Delecourt C .

*Orthop Traumatol Surg Res.* 2016 Nov;102(7):845-849. doi: 10.1016/j.otsr.2016.07.010. Epub 2016 Sep 30.

**INTRODUCTION:** The everyday life of a non-ambulatory adolescent or young adult with cerebral palsy can be severely impaired by a painful or stiff hip. The usual surgical solutions such as proximal femoral resection (PFR) are not entirely satisfactory for pain relief, and are mutilating.

**HYPOTHESIS:** A retrospective study assessed the impact of total hip replacement (THR) on such impairment, on the hypothesis that it is more effective than PFR in relieving pain, without aggravating disability.

**PATIENTS AND METHODS:** The surgical technique consisted in implanting a dual-mobility prosthesis with uncemented acetabular component and cemented femur, after upper femoral shaft shortening and short hip-spica cast immobilization. Forty THRs were performed in 33 patients, including 31 with multiple disability. Follow-up assessment focused on change in functional status, pain, and range of motion.

**RESULTS:** Mean follow-up was 5 years. Pain was more or less entirely resolved. Improvement in range of motion was less striking, and there was no significant change in functional status. There were 2 general, 2 septic and 10 mechanical complications, 6 of which required surgical revision.

**DISCUSSION:** In non-ambulatory cerebral palsy, THR provided much better alleviation of pain than found with PFR treatment. It should be reserved for patients able to withstand fairly long surgery and with femur size compatible with implantation of a femoral component, however small.

**LEVEL OF EVIDENCE:** IV, retrospective study.

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PMID: 27697405 [Indexed for MEDLINE]

## **Réadaptation fonctionnelle**

### **Body mass index and fitness in high-functioning children and adolescents with cerebral palsy: What happened over a decade?**

Zwinkels M , Takken T , Ruyten T , Visser-Meily A , Verschuren O ; Sport-2-Stay-Fit study group.

*Res Dev Disabil.* 2017 Oct 9;71:70-76. doi: 10.1016/j.ridd.2017.09.021. [Epub ahead of print]

**BACKGROUND:** In recent decades, improving fitness has become an important goal in rehabilitation medicine in children and adolescents with cerebral palsy (CP).

**AIMS:** To compare body mass index (BMI), performance-related fitness, and cardiorespiratory fitness of children with CP measured in 2014 with a comparable sample from 2004.

**METHODS AND PROCEDURES:** In total, 25 high-functioning children with CP (i.e., GMFCS I-II) measured in 2004 (13 boys; mean age 13.2 (2.6) years) were matched to 25 children measured in 2014. Outcomes included body mass and BMI, muscle power sprint test (MPST), 10×5m sprint test, and a shuttle run test (SRT). Data of 15 participants from 2004 (10 boys; mean age 12.6 (2.5) years) were matched and analysed for VO<sub>2</sub>peak.

**OUTCOMES AND RESULTS:** Body mass and BMI were higher (both:  $p < 0.05$ ) in the 2014 cohort compared to the 2004 cohort. Further, performance-related fitness was better for the 2014 cohort on the MPST ( $p = 0.004$ ), the 10×5m sprint test ( $p = 0.001$ ), and the SRT ( $p < 0.001$ ). However, there were no differences for VO<sub>2</sub>peak.

**CONCLUSIONS AND IMPLICATIONS:** In high-functioning children with CP, there are positive ecological time trends in performance-related fitness, but not in VO<sub>2</sub>peak between 2004 and 2014. The substantial higher body mass and BMI is alarming and requires further investigation.

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DOI: 10.1016/j.ridd.2017.09.021

PMID: 29024824

### **Development of an EMG-ACC-Based Upper Limb Rehabilitation Training System.**

Ling Liu, Xiang Chen, Zhiyuan Lu, Shuai Cao, De Wu, Xu Zhang.

*IEEE Trans Neural Syst Rehabil Eng.* 2017 Mar;25(3):244-253. doi: 10.1109/TNSRE.2016.2560906. Epub 2016 Apr 29.

This paper focuses on the development of an upper limb rehabilitation training system designed for use by children with cerebral palsy (CP). It attempts to meet the requirements of in-home training by taking advantage of the combination of portable accelerometers (ACC) and surface electromyography (SEMG) sensors worn on the upper limb to capture functional movements. In the proposed system, the EMG-ACC acquisition device works essentially as wireless game controller, and three rehabilitation games were designed for improving upper limb motor function under a clinician's guidance. The games were developed on the Android platform based on a physical engine called Box2D. The results of a system performance test demonstrated that the developed games can respond to the upper limb actions within 210 ms. Positive questionnaire feedbacks from twenty CP subjects who participated in the game test verified both the feasibility and usability of the system. Results of a long-term game training conducted with three CP subjects demonstrated that CP patients could improve in their game performance through repetitive training, and persistent training was needed to improve and enhance the rehabilitation effect. According to our experimental results, the novel multi-feedback SEMG-ACC-based user interface improved the users' initiative and performance in rehabilitation training.

DOI: 10.1109/TNSRE.2016.2560906

PMID: 28113559 [Indexed for MEDLINE]

### **Effects of the Integration of Dynamic Weight Shifting Training Into Treadmill Training on Walking Function of Children with Cerebral Palsy: A Randomized Controlled Study.**

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

*Am J Phys Med Rehabil.* 2017 Nov;*96(11):765-772. doi:10.1097/PHM.0000000000000776.*

**OBJECTIVE:** The aim of the study was to determine whether applying an assistance force to the pelvis and legs during treadmill training can improve walking function in children with cerebral palsy.

**DESIGN:** Twenty-three children with cerebral palsy were randomly assigned to the robotic or treadmill only group. For participants who were assigned to the robotic group, a controlled force was applied to the pelvis and legs during treadmill walking. For participants who were assigned to the treadmill only group, manual assistance was provided as needed. Each participant trained 3 times/wk for 6 wks. Outcome measures included walking speed, 6-min walking distance, and clinical assessment of motor function, which were evaluated before, after training, and 8 wks after the end of training, and were compared between two groups.

**RESULTS:** Significant increases in walking speed and 6-min walking distance were observed after robotic training ( $P = 0.03$ ), but no significant change was observed after treadmill training only. A greater increase in 6-min walking distance was observed after robotic training than that after treadmill only training ( $P = 0.01$ ).

**CONCLUSIONS:** Applying a controlled force to the pelvis and legs, for facilitating weight-shift and leg swing, respectively, during treadmill training may improve walking speed and endurance in children with cerebral palsy.

**TO CLAIM CME CREDITS:** Complete the self-assessment activity and evaluation online at <http://www.physiatry.org/JournalCME> **CME OBJECTIVES:** Upon completion of this article, the reader should be able to: (1) discuss the importance of physical activity at the participation level (sports programs) for children with cerebral palsy; (2) contrast the changes in walking ability and endurance for children in GMFCS level I, II and III following sports programs; and (3) identify the impact of higher frequency of sports program attendance over time on walking ability. **LEVEL:** Advanced **ACCREDITATION:** The Association of Academic Physiatrists is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians. The Association of Academic Physiatrists designates this Journal-based CME activity for a maximum of 0.5 AMA PRA Category 1 Credit(s)<sup>™</sup>. Physicians should only claim credit commensurate with the extent of their participation in the activity.

DOI: 10.1097/PHM.0000000000000776

PMCID: PMC5648612 [Available on 2018-11-01]

PMID: 28644244 [Indexed for MEDLINE]

### **Including a Lower-Extremity Component during Hand-Arm Bimanual Intensive Training does not Attenuate Improvements of the Upper Extremities: A Retrospective Study of Randomized Trials.**

Saussez G , Brandão MB , Gordon AM , Bleyenheuft Y .

*Front Neurol.* 2017 Sep *26;8:495. doi: 10.3389/fneur.2017.00495. eCollection 2017.*

Hand-Arm Bimanual Intensive Therapy (HABIT) promotes hand function using intensive practice of bimanual functional and play tasks. This intervention has shown to be efficacious to improve upper-extremity (UE) function in children with unilateral spastic cerebral palsy (USCP). In addition to UE function deficits, lower-extremity (LE) function and UE-LE coordination are also impaired in children with USCP. Recently, a new intervention has been introduced in which the LE is simultaneously engaged during HABIT (Hand-Arm Bimanual Intensive Therapy Including Lower Extremities; HABIT-ILE). Positive effects of this therapy have been demonstrated for both the UE and LE function in children with USCP. However, it is unknown whether the addition of this constant LE component during a bimanual intensive therapy attenuates UE improvements observed in children with USCP. This retrospective study, based on multiple randomized protocols, aims to compare the UE function improvements in children with USCP after HABIT or HABIT-ILE. This study included 86 children with USCP who received 90 h of either HABIT (n = 42) or HABIT-ILE (n = 44) as participants in previous studies. Children were assessed before, after, and 4-6 months after intervention. Primary outcomes were the ABILHAND-Kids and the Assisting Hand Assessment. Secondary measures included the Jebsen-Taylor Test of Hand Function, the Pediatric Evaluation of Disability Inventory [(PEDI); only the self-care functional ability domain] and the Canadian Occupational Performance Measure (COPM). Data analysis was performed using two-way repeated-measures analysis of variance with repeated measures on test sessions. Both groups showed similar, significant improvements for all tests (test session effect  $p < 0.001$ ; group  $\times$  test session interaction  $p > 0.05$ ) except the PEDI and COPM. Larger improvements on these tests were found for the HABIT-ILE group (test session effect  $p < 0.001$ ; group  $\times$  test session interaction  $p < 0.05$ ). These larger improvements may be explained by the constant simultaneous UE-LE engagement observed during the HABIT-ILE intervention since many daily living activities included in the PEDI and the COPM goals involve the LE and, more specifically, UE-LE coordination. We conclude that UE improvements in children with USCP are not attenuated by simultaneous UE-LE engagement during intensive intervention. In addition, systematic LE engagement during bimanual intensive intervention (HABIT-ILE) leads to larger functional improvements in activities of daily living involving the LE.

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

DOI: 10.3389/fneur.2017.00495

PMCID: PMC5622919

PMID: 29018400

#### **The impact of an anti-gravity treadmill (AlterG) training on walking capacity and corticospinal tract structure in children with cerebral palsy.**

Azizi S, Marzbani H, Raminfar S, Birgani PM, Rasooli AH, Mirbagheri MM.

*Conf Proc IEEE Eng Med Biol Soc. 2017 Jul;2017:1150-1153. doi:10.1109/EMBC.2017.8037033.*

We studied the effects of an anti-gravity treadmill (AlterG) training on walking capacity and corticospinal tract structure in children with Cerebral Palsy (CP). AlterG can help CP children walk on the treadmill by reducing their weights up to 80% and maintain their balance during locomotion. AlterG training thus has the potential to improve walking capacity permanently as it can provide systematic and intense locomotor training for sufficiently long period of time and produce brain neuroplasticity. AlterG training was given for 45 minutes, three times a week for two months. The neuroplasticity of corticospinal tract was evaluated using Diffusion Tensor Imaging (DTI). The fractional Anisotropy (FA) feature was extracted to quantify structural changes of the corticospinal tract. Walking capacity was evaluated using popular clinical measurements of gait; i.e., walking speed, mobility and balance. The evaluations were done before and after training. Our results revealed that AlterG training resulted in an increase in average FA value of the corticospinal tract following the training. The outcome measures of clinical assessments of gait presented enhanced walking capacity of the CP subjects. Our findings indicated that the improved walking capacity was concurrent with the enhancement of the corticospinal tract structure. The clinical implication is that AlterG training may be considered as a therapeutic tool for permanent gait improvement in CP children.

DOI: 10.1109/EMBC.2017.8037033

PMID: 29060079

#### **Therapeutic Effect Evaluation of Neuromuscular Electrical Stimulation With or Without Strengthening Exercise on Spastic Cerebral Palsy.**

Qi YC, Niu XL, Gao YR, Wang HB, Hu M, Dong LP, Li YZ.

*Clin Pediatr (Phila). 2017 Oct 1:9922817732619. doi: 10.1177/0009922817732619. [Epub ahead of print]*



The aims of this study were to investigate the effect of neuromuscular electrical stimulation (NMES) combined with strengthening exercise on movement in children with spastic cerebral palsy (CP). One hundred children with spastic CP were randomly divided into a treatment group (NMES and strengthening exercise, n = 50) and a control group (only NMES, n = 50). We compared the Comprehensive Spasticity Scale (CSS) score, Gross Motor Function Measure (GMFM) score, and walking speed before treatment and 6 weeks and 3 months after treatment between the 2 groups. There was no difference in CSS score between the treatment and control groups before the therapy ( $12.0 \pm 3.4$  vs  $12.3 \pm 3.6$ ), which decreased much more in the treatment group after 6 weeks ( $7.6 \pm 3.0$  vs  $9.5 \pm 2.8$ ) and 3 months ( $7.4 \pm 2.4$  vs  $9.4 \pm 2.6$ ) with significant differences ( $P < .05$ ). No difference in GMFM score was observed between the treatment and control groups before the therapy ( $44.5 \pm 13.2$  vs  $44.0 \pm 12.6$ ), which increased much more in the treatment group after 6 weeks ( $70.6 \pm 15.2$  vs  $56.7 \pm 14.3$ ) and 3 months ( $71.0 \pm 16.4$  vs  $58.0 \pm 15.6$ ) with significant differences ( $P < .05$ ). The walking speed improved over time, which was the same before the treatment ( $0.43 \pm 0.13$  m/s vs  $0.45 \pm 0.14$  m/s), and was significantly greater in the treatment group than that in the control group (6 weeks:  $0.69 \pm 0.15$  m/s vs  $0.56 \pm 0.12$  m/s,  $P < .05$ ; 3 months:  $0.72 \pm 0.17$  m/s vs  $0.57 \pm 0.18$  m/s,  $P < .05$ ). NMES combined with strengthening exercise was more effective than NMES alone in the recovery of spastic CP.

DOI: 10.1177/0009922817732619

PMID: 28990434

## Orthèses

### **Conservative treatment for equinus deformity in children with cerebral palsy using an adjustable splint-assisted ankle-foot orthosis.**

Chen W, Liu X, Pu F, Yang Y, Wang L, Liu H, Fan Y.

*Medicine (Baltimore)*. 2017 Oct;96(40):e8186. doi: 10.1097/MD.0000000000008186.

**BACKGROUND:** A novel splint, the assisting ankle-foot orthoses (AFO), was developed to provide adjustable sustained stretching to improve conservative treatment for equinus deformities in children with cerebral palsy (CP). The treatment effect was validated by follow-up visits.

**METHODS:** This study involved subjects between 2 and 12 years old, including 28 CP children treated with splint-assisted AFO correction, 30 CP children treated with static AFO correction, and 30 normal children with typical development (TD). Quantitative pedobarographic measurements were taken to evaluate the effect of splint-assisted AFO correction. The heel/forefoot ratio was introduced to indicate the degree of the equinus deformity during treatment. **RESULTS:** The results showed that the heel/forefoot ratios were  $1.41 \pm 0.26$  for the TD children;  $0.65 \pm 0.41$ ,  $1.02 \pm 0.44$ , and  $1.24 \pm 0.51$  for the splint-assisted AFO correction before and after 6-month and 12-month treatments;  $0.59 \pm 0.37$ ,  $0.67 \pm 0.44$ , and  $0.66 \pm 0.42$  for the static AFO correction before and after 6-month and 12-month treatments.

**CONCLUSIONS:** This study suggests that correction with the adjustable splint-assisted AFO is an effective treatment for equinus deformity in CP Children.

#### [Free Article](#)

DOI: 10.1097/MD.0000000000008186

PMID: 28984769 [Indexed for MEDLINE]

## Robots -Exosquelettes

### **A Robotic Exoskeleton for Treatment of Crouch Gait in Children With Cerebral Palsy: Design and Initial Application.**

Lerner ZF, Damiano DL, Park HS, Gravunder AJ, Bulea TC.

*IEEE Trans Neural Syst Rehabil Eng*. 2017 Jun;25(6):650-659. doi:10.1109/TNSRE.2016.2595501. Epub 2016 Jul 27.

Crouch gait, a pathological pattern of walking characterized by excessive knee flexion, is one of the most common gait disorders observed in children with cerebral palsy (CP). Effective treatment of crouch during childhood is critical to maintain mobility into adulthood, yet current interventions do not adequately alleviate crouch in most individuals. Powered exoskeletons provide an untapped opportunity for intervention. The multiple contributors to crouch, including spasticity, contracture, muscle weakness, and poor motor control make design and control of such devices challenging in this population. To our knowledge, no evidence exists regarding the feasibility or efficacy of utilizing motorized assistance to alleviate knee flexion in crouch gait. Here, we present the design of and first results

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from a powered exoskeleton for extension assistance as a treatment for crouch gait in children with CP. Our exoskeleton, based on the architecture of a knee-ankle-foot orthosis, is lightweight (3.2 kg) and modular. On board sensors enable knee extension assistance to be provided during distinct phases of the gait cycle. We tested our device on one six-year-old male participant with spastic diplegia from CP. Our results show that the powered exoskeleton improved knee extension during stance by 18.1° while total knee range of motion improved 21.0°. Importantly, we observed no significant decrease in knee extensor muscle activity, indicating the user did not rely solely on the exoskeleton to extend the limb. These results establish the initial feasibility of robotic exoskeletons for treatment of crouch and provide impetus for continued investigation of these devices with the aim of deployment for long term gait training in this population.

DOI: 10.1109/TNSRE.2016.2595501

PMID: 27479974 [Indexed for MEDLINE]

### **Efficacy of Armeo® Robotic Therapy versus Conventional Therapy on Upper Extremity Function in Children with Hemiplegic Cerebral Palsy.**

El-Shamy SM .

*Am J Phys Med Rehabil.* 2017 Oct 21. doi: 10.1097/PHM.0000000000000852. [Epub ahead of print]

**OBJECTIVE:** The aim of this study was to examine the efficacy of Armeo® robotic therapy, compared to conventional therapy, on upper extremity function in children with hemiplegic cerebral palsy.

**DESIGN:** Thirty children with hemiplegic cerebral palsy, with ages ranging from 6 to 8 years, were selected for this randomized controlled study and randomly assigned to two groups. The study group (n=15) received 12 weeks of Armeo robotic therapy (45 min/session, 3 days/week) and the control group (n=15) received conventional therapy for the same time period. The measured outcomes were the Modified Ashworth Scale (MAS) and the Quality of Upper Extremity Skills Test (QUEST), measured at baseline and after 12 weeks of intervention.

**RESULTS:** Children in the study group showed significant improvement in the mean values of all the measured variables, compared to those in the control group ( $P < 0.05$ ). Post-intervention MAS scores for the study and control groups were 1.6 (0.3) and 2 (0.5), respectively. Post-interventional QUEST total scores for the study and control groups were 84.6 (2.7) and 79.1 (2), respectively. **CONCLUSIONS:** Armeo robotic therapy is significantly more effective than conventional therapy in improving the upper extremity quality of movement in children with hemiplegic cerebral palsy.

DOI: 10.1097/PHM.0000000000000852

PMID: 29059068

### **Robust Control of a Cable-Driven Soft Exoskeleton Joint for Intrinsic Human-Robot Interaction.**

Jarrett C, McDaid AJ.

*IEEE Trans Neural Syst Rehabil Eng.* 2017 Jul;25(7):976-986. doi:10.1109/TNSRE.2017.2676765. Epub 2017 Mar 1.

A novel, cable-driven soft joint is presented for use in robotic rehabilitation exoskeletons to provide intrinsic, comfortable human-robot interaction. The torque-displacement characteristics of the soft elastomeric core contained within the joint are modeled. This knowledge is used in conjunction with a dynamic system model to derive a sliding mode controller (SMC) to implement low-level torque control of the joint. The SMC controller is experimentally compared with a baseline feedback-linearised proportional-derivative controller across a range of conditions and shown to be robust to un-modeled disturbances. The torque controller is then tested with six healthy subjects while they perform a selection of activities of daily living, which has validated its range of performance. Finally, a case study with a participant with spastic cerebral palsy is presented to illustrate the potential of both the joint and controller to be used in a physiotherapy setting to assist clinical populations.

DOI: 10.1109/TNSRE.2017.2676765

PMID: 28278475 [Indexed for MEDLINE]

### **The Effects of Exoskeleton Assisted Knee Extension on Lower-Extremity Gait Kinematics, Kinetics, and Muscle Activity in Children with Cerebral Palsy.**

Lerner ZF , Damiano DL , Bulea TC .

*Sci Rep.* 2017 Oct 18;7(1):13512. doi: 10.1038/s41598-017-13554-2.

Individuals with cerebral palsy often exhibit crouch gait, a debilitating and inefficient walking pattern marked by excessive knee flexion that worsens with age. To address the need for improved treatment, we sought to evaluate if providing external knee extension assistance could reduce the excessive burden placed on the knee extensor muscles as measured by knee moments. We evaluated a novel pediatric exoskeleton designed to provide appropriately-timed extensor torque to the knee joint during walking in a multi-week exploratory clinical study. Seven individuals (5-19 years) with mild-moderate crouch gait from cerebral palsy (GMFCS I-II) completed the study. For six participants, powered knee extension assistance favorably reduced the excessive stance-phase knee extensor moment present during crouch gait by a mean of 35% in early stance and 76% in late stance. Peak stance-phase knee and hip extension increased by 12° and 8°, respectively. Knee extensor muscle activity decreased slightly during exoskeleton-assisted walking compared to baseline, while knee flexor activity was elevated in some participants. These findings support the use of wearable exoskeletons for the management of crouch gait and provide insights into their future implementation.

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DOI: 10.1038/s41598-017-13554-2

PMCID: PMC5647342

PMID: 29044202

### **WAKE-Up Exoskeleton to Assist Children With Cerebral Palsy: Design and Preliminary Evaluation in Level Walking.**

Patane F, Rossi S, Del Sette F, Taborri J, Cappa P.

*IEEE Trans Neural Syst Rehabil Eng.* 2017 Jul;25(7):906-916. doi:10.1109/TNSRE.2017.2651404. Epub 2017 Jan 11.

This paper presents the modular design and control of a novel compliant lower limb multi-joint exoskeleton for the rehabilitation of ankle knee mobility and locomotion of pediatric patients with neurological diseases, such as Cerebral Palsy (CP). The device consists of an untethered powered knee-ankle-foot orthosis (KAFO), addressed as WAKE-up (Wearable Ankle Knee Exoskeleton), characterized by a position control and capable of operating synchronously and synergistically with the human musculoskeletal system. The WAKE-up mechanical system, control architecture and feature extraction are described. Two test benches were used to mechanically characterize the device. The full system showed a maximum value of hysteresis equal to 8.8% and a maximum torque of 5.6 N m/rad. A pre-clinical use was performed, without body weight support, by four typically developing children and three children with CP. The aims were twofold: 1) to test the structure under weight-bearing conditions and 2) to ascertain its ability to provide appropriate assistance to the ankle and the knee during overground walking in a real environment. Results confirm the effectiveness of the WAKE-up design in providing torque assistance in accordance to the volitional movements especially in the recovery of correct foot landing at the start of the gait cycle.

DOI: 10.1109/TNSRE.2017.2651404

PMID: 28092566 [Indexed for MEDLINE]

### **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

### Thérapies cellulaires

#### **A Dichotomy of Information-Seeking and Information-Trusting: Stem Cell Interventions and Children with Neurodevelopmental Disorders.**

Sharpe K , Di Pietro N , Jacob KJ , Illes J .

*Stem Cell Rev.* 2016 Aug;12(4):438-47. doi: 10.1007/s12015-016-9667-3.

Parents and primary caregivers of children with Cerebral Palsy (CP) and Autism Spectrum Disorder (ASD) are faced with difficult treatment choices and management options for their children. The potential of stem cell technologies as an interventional strategy for CP and ASD has gained attention in the last decade. Information about these interventions varies in quality, resulting in a complex landscape for parent decision making for a child's care. Further complicating this landscape are clinics that advertise these interventions as a legitimate treatment for a fee. In this study, we surveyed individuals who considered taking their child with ASD or CP abroad for stem cell interventions on their use of different sources of stem cell related health information and their level of trust in these sources. Participants reported that while the Internet was their most frequent source of information, it was not well-trusted. Rather, information sources trusted most were researchers and the science journals in which they publish, other parents of children with CP and ASD, and healthcare providers. These findings highlight a dichotomy between information-seeking preferences and information-trusted sources. We discuss the challenges of health science communication and present innovative opportunities to increase communication with trusted and reliable sources as part of an integrated multi-pronged approach.

DOI: 10.1007/s12015-016-9667-3

PMID: 27286955 [Indexed for MEDLINE]

#### **Comparative analysis of curative effect of bone marrow mesenchymal stem cell and bone marrow mononuclear cell transplantation for spastic cerebral palsy.**

Liu X , Fu X , Dai G , Wang X , Zhang Z , Cheng H , Zheng P , AnY .

*J Transl Med.* 2017 Feb 24;15(1):48. doi: 10.1186/s12967-017-1149-0.

BACKGROUND: Bone marrow mesenchymal stem cells (BMMSCs) and bone marrow mononuclear cells (BMMNCs) are both used to treat spastic cerebral palsy. However, the differences in therapeutic effect remain unknown.

METHODS: A total of 105 patients with spastic cerebral palsy were enrolled and randomly assigned to three groups: the BMMSC group, the BMMNC group and the control group. Patients in both transplantation groups received four intrathecal cell injections. Patients in the control group received Bobath therapy. The gross motor function measure (GMFM) and the fine motor function measure (FMFM) were used to evaluate the therapeutic efficacy before transplantation and 3, 6, and 12 months after transplantation.

RESULTS: Three months after cell transplantation, scores in the A dimension of GMFM and the A and C dimensions of FMFM scores in the BMMSC group are all higher than those of the BMMNC and the control groups ( $P < 0.05$ ). Six months after cell transplantation, scores in the A, B dimensions of GMFM and the A, B, C, D, and E dimensions of FMFM scores in the BMMSC group are higher than those of the BMMNC and the control groups ( $P < 0.05$ ). Twelve months after cell transplantation, scores in the A, B, and C dimensions of GMFM and the A, B, C, D, and E dimensions

of FMFM scores in the BMMSC group are all higher than those of the BMMNC and the control groups ( $P < 0.05$ ). No obvious adverse effects were investigated during follow-up.

**CONCLUSIONS:** BMMSC transplantation for the treatment of cerebral palsy is safe and feasible, and can improve gross motor and fine motor function significantly. In addition, compared with BMMNC, the motor function of children improved significantly in terms of gross motor and fine motor functions.

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DOI: 10.1186/s12967-017-1149-0

PMCID: PMC5324263

PMID: 28235424 [Indexed for MEDLINE]

**Effect of Autologous Cord Blood Infusion on Motor Function and Brain Connectivity in Young Children with Cerebral Palsy: A Randomized, Placebo-Controlled Trial.**

Sun JM , Song AW , Case LE , Mikati MA , Gustafson KE , Simmons R , Goldstein R , Petry J , McLaughlin C , Waters-Pick B , Chen LW , Wease S , Blackwell B , Worley G , Troy J , Kurtzberg J .

*Stem Cells Transl Med.* 2017 Oct 28. doi: 10.1002/sctm.17-0102. [Epub ahead of print]

Cerebral palsy (CP) is a condition affecting young children that causes lifelong disabilities. Umbilical cord blood cells improve motor function in experimental systems via paracrine signaling. After demonstrating safety, we conducted a Phase II trial of autologous cord blood (ACB) infusion in children with CP to test whether ACB could improve function (ClinicalTrials.gov, NCT01147653; IND 14360). In this double-blind, placebo-controlled, crossover study of a single intravenous infusion of  $1-5 \times 10^7$  total nucleated cells per kilogram of ACB, children ages 1 to 6 years with CP were randomly assigned to receive ACB or placebo at baseline, followed by the alternate infusion 1 year later. Motor function and magnetic resonance imaging brain connectivity studies were performed at baseline, 1, and 2 years post-treatment. The primary endpoint was change in motor function 1 year after baseline infusion. Additional analyses were performed at 2 years. Sixty-three children (median age 2.1 years) were randomized to treatment ( $n = 32$ ) or placebo ( $n = 31$ ) at baseline. Although there was no difference in mean change in Gross Motor Function Measure-66 (GMFM-66) scores at 1 year between placebo and treated groups, a dosing effect was identified. In an analysis 1 year post-ACB treatment, those who received doses  $\geq 2 \times 10^7$  /kg demonstrated significantly greater increases in GMFM-66 scores above those predicted by age and severity, as well as in Peabody Developmental Motor Scales-2 Gross Motor Quotient scores and normalized brain connectivity. Results of this study suggest that appropriately dosed ACB infusion improves brain connectivity and gross motor function in young children with CP. *Stem Cells Translational Medicine* 2017.

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PMID: 29080265

**Future perspectives of cell therapy for neonatal hypoxic-ischemic encephalopathy.**

Nabetani M , Shintaku H , Hamazaki T .

*Pediatr Res.* 2017 Oct 10. doi: 10.1038/pr.2017.260. [Epub ahead of print]

Neonatal ischemic brain injury causes permanent motor-deficit cerebral palsy. Hypoxic-ischemic encephalopathy (HIE) is a very serious condition that can result in death and disability. In 1997, we reported that irreversible neuronal cell damage is induced by the elevation of intracellular Ca ion concentration that has occurred in sequence after excess accumulation of the excitatory neurotransmitter glutamate during ischemia. We also reported that hypothermia was effective in treating ischemic brain damage in rats by suppressing energy loss and raising intracellular Ca ion concentration. Following the 2010 revised International Liaison Committee on Resuscitation guideline, our group developed the Guideline for the treatment of Hypothermia in Japan, and we started online case registry in January 2012. However, therapeutic hypothermia must be initiated within the first 6 h after birth. By contrast, cell therapy may have a much longer therapeutic time window because it might reduce apoptosis/oxidative stress and enhance the regenerative process. In 2014, we administered autologous umbilical cord blood stem cell (UCBC) therapy for neonatal HIE, for the first time in Japan. We enrolled five full-term newborns with moderate to

severe HIE. Our autologous UCBC therapy is leading to new protocols for prevention of ischemic brain damage. Pediatric Research accepted article preview online, 10 October 2017.

doi:10.1038/pr.2017.260.

DOI: 10.1038/pr.2017.260

PMID: 29016557

### **Neuroregenerative potential of intravenous G-CSF and autologous peripheral blood stem cells in children with cerebral palsy: a randomized, double-blind, cross-over study.**

Rah WJ , Lee YH , Moon JH , Jun HJ , Kang HR , Koh H , Eom HJ , Lee JY , Lee YJ , Kim JY , Choi YY , Park K , Kim MJ , Kim SH .

*J Transl Med.* 2017 Jan 21;15(1):16. doi: 10.1186/s12967-017-1120-0.

**OBJECTIVE:** We performed a randomized, double-blind, cross-over study to assess the neuroregenerative potential of intravenous granulocyte colony-stimulating factor (G-CSF) followed by infusion of mobilized peripheral blood mononuclear cells (mPBMCs) in children with cerebral palsy (CP).

**METHODS:** Children with non-severe CP were enrolled in this study. G-CSF was administered for 5 days, then mPBMCs were collected by apheresis and cryopreserved. One month later (M1), recipients were randomized to receive either mPBMCs or a placebo infusion, and these treatment groups were switched at 7 months (M7) and observed for another 6 months (M13). We assessed the efficacy of treatment by evaluating neurodevelopmental tests, as well as by brain magnetic resonance imaging-diffusion tensor imaging (MRI-DTI) and (18)F-fluorodeoxyglucose (FDG) brain positron emission tomography-computed tomography (PET-CT) scanning to evaluate the anatomical and functional changes in the brain.

**RESULTS:** Fifty-seven patients aged  $4.3 \pm 1.9$  (range 2-10) years and weighing  $16.6 \pm 4.9$  (range 11.6-56.0) kg were enrolled in this study. The administration of G-CSF as well as the collection and reinfusion of mPBMCs were safe and tolerable. The yield of mPBMCs was comparable to that reported in studies of pediatric donors without CP and patients with nonhematologic diseases. 42.6% of the patients responded to the treatment with higher neurodevelopmental scores than would normally be expected. In addition, larger changes in neurodevelopment test scores were observed in the 1 month after G-CSF administration (M0-M1) than during the 6 months after reinfusion with mPBMCs or placebo (M1-M7 or M7-M13). Patients who received G-CSF followed by mPBMC infusion at 7 months (T7 group) demonstrated significantly more neurodevelopmental improvement than patients who received G-CSF followed by mPBMC infusion at 1 month (T1 group). In contrast to the results of neurodevelopment tests, the results of MRI-DTI at the end of this study showed greater improvement in the T1 group. Although we observed metabolic changes to the cerebellum, thalamus and cerebral cortex in the (18)F-FDG brain PET-CT scans, there were no significant differences in such changes between the mPBMC and placebo group or between the T1 and T7 group.

**CONCLUSIONS:** Neurodevelopmental improvement was seen in response to intravenous G-CSF followed by mPBMC reinfusion, particularly to the G-CSF alone even without mPBMC reinfusion. Further studies using a larger number of mPBMCs for the infusion which could be collected by repeated cycles of apheresis or using repeated cycles of G-CSF alone, are needed to clarify the effect of mPBMC reinfusion or G-CSF alone

(Trial registration: ClinicalTrials.gov, NCT02983708.

Registered 5 December, 2016, retrospectively registered).

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

DOI: 10.1186/s12967-017-1120-0

PMCID: PMC5251252

PMID: 28109298 [Indexed for MEDLINE]

### **Outcomes of autologous bone marrow mononuclear cells for cerebral palsy: an open label uncontrolled clinical trial.**

Nguyen LT , Nguyen AT , Vu CD , Ngo DV , Bui AV .

*BMC Pediatr.* 2017 Apr 12;17(1):104. doi: 10.1186/s12887-017-0859-z.

**BACKGROUND:** Stem cell therapy has emerged as a promising method for improving motor function of patients with cerebral palsy. The aim of this study is to assess the safety and effectiveness of autologous bone marrow mononuclear stem cell transplantation in patients with cerebral palsy related to oxygen deprivation.

Science Infos Paralysie Cérébrale, Octobre 2017, [FONDATION PARALYSIE CEREBRALE](#) 67 rue Vergniaud 46 75013 Paris - tel +33 1 45 54 03 03 contact: Christine Doumergue [cdoumergue@lafondationmotrice.org](mailto:cdoumergue@lafondationmotrice.org)

**METHODS:** An open label uncontrolled clinical trial was carried out at Vinmec International Hospital. The intervention consisted of two administrations of stem cells, the first at baseline and the second 3 months later. Improvement was monitored at 3 months and 6 months after the first administration of stem cells, using the Gross Motor Function Measure (GMFM) and Modified Ashworth Score which measures muscle tone.

**RESULTS:** No severe complications were recorded during the study. After transplantation, 12 patients encountered fever without infections and 9 patients experienced vomiting which was easily managed with medications. Gross motor function was markedly improved 3 months or 6 months after stem cell transplantation than at baseline. The post-transplantation GMFM-88 total score, each of its domains and the GMFM-66 percentile were all significantly higher (p-value < 0.001). Muscle spasticity also reduced significantly after transplantation (p-value < 0.001). The therapy was equally effective regardless of sex, age and GMFCS level (p-value > 0.05). **CONCLUSION:** Autologous bone marrow mononuclear cell transplantation appears to be a safe and effective therapy for patients with cerebral palsy. **TRIAL REGISTRATION:** ClinicalTrials.gov Identifier: NCT02569775 . Retrospectively registered on October 15, 2015.

DOI: 10.1186/s12887-017-0859-z

PMCID: PMC5389089

PMID: 28403842 [Indexed for MEDLINE]

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### **Stem cell therapy for cerebral palsy.**

Dan B.

*Dev Med Child Neurol.* 2016 May;58(5):424. doi: 10.1111/dmcn.13121.

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DOI: 10.1111/dmcn.13121

PMID: 27103186 [Indexed for MEDLINE]

## **Langage - Communication**

### **Testing an AAC system that transforms pictograms into natural language with persons with cerebral palsy.**

Pahisa-Solé J , Herrera-Joancomartí J .

*Assist Technol.* 2017 Oct 18. doi: 10.1080/10400435.2017.1393844. [Epub ahead of print]

In this paper, we describe a compansion system that transforms the telegraphic language that comes from the use of pictogram-based Augmentative and Alternative Communication (AAC) into natural language. The system was tested with 4 participants with severe cerebral palsy and ranging degrees of linguistic competence and intellectual disabilities. Participants had used pictogram-based AAC at least for the past 30 years each and presented a stable linguistic profile. During tests, which consisted in a total of 40 sessions, participants were able to learn new linguistic skills, such as the use of basic verb tenses, while using the compansion system, which proved a source of motivation. The system can be adapted to the linguistic competence of each person and required no learning curve during tests when none of its special features, like gender, number, verb tense or sentence type modifiers, were used. Furthermore, qualitative and quantitative results showed a mean communication rate increase of 41,59%, compared to the same communication device without the compansion system, and an overall improvement in the communication experience when the output is in natural language. Tests were conducted in Catalan and Spanish.

DOI: 10.1080/10400435.2017.1393844

## **Douleur**

### **Defining mild, moderate, and severe pain in young people with physical disabilities.**

Miró J , de la Vega R , Solé E , Racine M , Jensen MP , Gálan S , Engel JM .

*Disabil Rehabil.* 2017 Jun;39(11):1131-1135. doi: 10.1080/09638288.2016.1185469. Epub 2016 Jun 13.

**PURPOSE:** The purpose of this study is to identify the cutoffs that are most suitable for classifying average and worst pain intensity as being mild, moderate, or severe in young people with physical disabilities.

**METHOD:** Survey study using a convenience sample of 113 young people (mean age = 14.19; SD = 2.9; age range: 8-20) with physical disabilities (namely, spinal cord injury, cerebral palsy, spina bifida, limb deficiency (acquired or congenital), or neuromuscular disease).

**RESULTS:** The findings support a non-linear association between pain intensity and pain interference. In addition, the optimal cutoffs for classifying average and worst pain as mild, moderate, or severe differed. For average pain, the best cutoffs were the following: 0-3 for mild, 4-6 for moderate, and 7-10 for severe pain, whereas the optimal classification for worst pain was 0-4 for mild, 5-6 for moderate, and 7-10 for severe pain.

**CONCLUSIONS:** The findings provide important information that may be used to help make decisions regarding pain treatment in young people with disabilities and also highlight the need to use different cutoffs for classifying pain intensity in young people with disabilities than those that have been suggested for adults with chronic pain. Implications for rehabilitation Most clinical guidelines make treatment recommendations based on classifications of pain intensity as being mild, moderate, and severe that do not have a clear cut association with pain intensity ratings. Cutoffs that are deemed to be the most appropriate for classifying pain intensity as mild, moderate, and severe appear to depend, at least in part, on the pain population that is being studied and pain domain that is being used. This work helps to advance our knowledge regarding the meaning of pain intensity ratings in young people with physical disabilities. Clinicians can use this information to make empirically guided decisions regarding when to intervene in young people with disabilities and chronic pain.

DOI: 10.1080/09638288.2016.1185469

PMCID: PMC5553452 [Available on 2018-06-01]

PMID: 27291566 [Indexed for MEDLINE]

### **Physiological and Behavioral Responses to Calibrated Noxious Stimuli Among Individuals with Cerebral Palsy and Intellectual Disability.**

Benromano T , Pick CG , Merick J , Defrin R .

*Pain Med.* 2017 Mar 1;18(3):441-453. doi: 10.1093/pm/pnw155.

**Objective:** As individuals with intellectual disability (ID) due to cerebral palsy (CP) are at high risk of experiencing pain, measuring their pain is crucial for adequate treatment. While verbal reports are the gold standard in pain measurements, they may not be sufficient in ID. The aim was to detect behavioral/autonomic responses that may indicate the presence and intensity of pain in individuals with CP and ID, using calibrated stimuli, here for the first time.

**Subjects:** Thirteen adults with CP and ID (CPID), 15 healthy controls (HC), and 5 adults with CP with no ID (CPNID).

**Methods:** Subjects received pressure stimuli of various intensities. Self-reports (using a pyramid scale), facial expressions (retrospectively analyzed with Facial Action Coding System = FACS), and autonomic function (heart rate, heart rate variability, pulse, galvanic skin response) were analyzed. **Results:** Self-reports and facial expressions but not the autonomic function exhibited stimulus-response relationship to pressure stimulation among all groups. The CPID group had increased pain ratings and facial expressions compared with controls. In addition, the increase in facial expressions along the increase in noxious stimulation was larger than in controls. Freezing in response to pain was frequent in CPID.

**Conclusions:** 1) Individuals with CP and ID have increased responses to pain; 2) facial expressions and self-reports, but not autonomic variables can reliably indicate their pain intensity; 3) the pyramid scale is suitable for self-report in this population. Although facial expressions may replace verbal reports, increased facial expressions at rest among these individuals may mask pain, especially at lower intensities.

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PMID: 27473634 [Indexed for MEDLINE]

## **Autres Troubles / Troubles concomitants**

### **✚ Troubles respiratoires**

#### **Mechanical Insufflation-Exsufflation Versus Conventional Chest Physiotherapy in Children With Cerebral Palsy.**

Siriwat R , Deerojanawong J , Sritippayawan S , Hantragool S , Cheanprapai P .

*Respir Care.* 2017 Oct 24. pii: respcare.05663. doi: 10.4187/respcare.05663. [Epub ahead of print]



**BACKGROUND:** The cough mechanism is often impaired in children with quadriplegic spastic cerebral palsy, accounting for the high prevalence of pneumonia and atelectasis requiring prolonged hospitalization. Conventional chest physiotherapy (CPT) is a current technique recommended at the onset of lower-respiratory infections in cerebral palsy. Previous studies have demonstrated the usefulness of mechanical insufflation-exsufflation (MI-E) in children with neuromuscular disease. To date, there has been no study of MI-E in children with quadriplegic spastic cerebral palsy. The objective of the study is to compare the efficacy in reducing hospital stay and improvement of atelectasis between MI-E and CPT in children with quadriplegic spastic cerebral palsy with lower-respiratory infections.

**METHODS:** This study is a randomized controlled trial. Children with quadriplegic spastic cerebral palsy, age 6 months to 18 y, admitted for lower-respiratory infections and/or atelectasis at King Chulalongkorn Memorial Hospital between June 1, 2014, and March 31, 2015, were recruited. Those with pneumothorax, severe pneumonia, active tuberculosis, and shock were excluded. Children were randomized into the MI-E or CPT group. The MI-E group received MI-E (3 therapies/d), and the CPT group received CPT (1 therapy/d). Vital signs per protocol and chest radiograph as needed were recorded. **RESULTS:** There were 22 children enrolled in the study, 11 in the MI-E and 11 in the CPT group. Demographic data were comparable in both groups. The length of hospital stay was similar in both groups (MI-E 4-24 d vs CPT 6-42 d,  $P = .15$ ). There were 17 subjects with atelectasis (MI-E [ $n = 9$ ] versus CPT [ $n = 8$ ]). In this atelectasis subgroup, MI-E had shortened therapy time when compared with CPT ( $2.9 \pm 0.8$  d vs  $3.9 \pm 0.6$  d,  $P = .01$ ). No complications were observed.

**CONCLUSIONS:** MI-E is proven to be beneficial in shortening the duration of airway clearance in children with quadriplegic spastic cerebral palsy presenting with lower-respiratory infections and atelectasis. MI-E is a safe and efficient intervention for airway clearance.

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DOI: 10.4187/respcare.05663

PMID: 29066586

### **Prevalence of symptoms associated with respiratory illness in children and young people with cerebral palsy.**

Blackmore AM , Bear N , Blair E , Gibson N , Jalla C , Langdon K , Moshovis L , Steer K , Wilson AC .

*Dev Med Child Neurol.* 2016 Jul;58(7):780-1. doi: 10.1111/dmcn.13016.

#### [Free Article](#)

DOI: 10.1111/dmcn.13016

PMID: 27307196 [Indexed for MEDLINE]

### **Pulmonary Rehabilitation in a Patient with Bronchiectasis and Underlying Cerebral Palsy: A Case Report.**

Yoon SY , Kim YW , Choi JY .

*PM R.* 2017 Oct 5. pii: S1934-1482(17)31357-6. doi: 10.1016/j.pmrj.2017.09.009.[Epub ahead of print]

Bronchiectasis is a chronic pulmonary disease characterized by the permanent dilatation of the airways, with recurrent infections. As the disease progresses, extrapulmonary symptoms manifest. If the patient with bronchiectasis has an underlying central nervous system disease such as cerebral palsy (CP), extrapulmonary functions decline faster. The co-occurrence of these two diseases may make care more complex, and there have been no reports about pulmonary rehabilitation (PR) in this class of patients. Here, we present a patient with bronchiectasis and underlying CP who showed marked improvement of pulmonary function and clinical symptoms after 6 weeks of a patient-specific intensive PR program. Copyright © 2017 American Academy of Physical Medicine and Rehabilitation.

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DOI: 10.1016/j.pmrj.2017.09.009

PMID: 28988977

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

### **Development of a new instrument for determining the level of chewing function in children.**

Serel Arslan S , Demir N , Barak Dolgun A , Karaduman AA .

*J Oral Rehabil.* 2016 Jul;43(7):488-95. doi: 10.1111/joor.12399. Epub 2016 Apr 4.

Science Infos Paralyse Cérébrale, Octobre 2017, **FONDATION PARALYSIE CEREBRALE** 67 rue Vergniaud 49  
75013 Paris - tel +33 1 45 54 03 03 contact: Christine Doumergue [cdoumergue@lafondationmotrice.org](mailto:cdoumergue@lafondationmotrice.org)

This study aimed to develop a chewing performance scale that classifies chewing from normal to severely impaired and to investigate its validity and reliability. The study included the developmental phase and reported the content, structural, criterion validity, interobserver and intra-observer reliability of the chewing performance scale, which was called the Karaduman Chewing Performance Scale (KCPS). A dysphagia literature review, other questionnaires and clinical experiences were used in the developmental phase. Seven experts assessed the steps for content validity over two Delphi rounds. To test structural, criterion validity, interobserver and intra-observer reliability, two swallowing therapists evaluated chewing videos of 144 children (Group I: 61 healthy children without chewing disorders, mean age of  $42.38 \pm 9.36$  months; Group II: 83 children with cerebral palsy who have chewing disorders, mean age of  $39.09 \pm 22.95$  months) using KCPS. The Behavioral Pediatrics Feeding Assessment Scale (BPFAS) was used for criterion validity. The KCPS steps arranged between 0-4 were found to be necessary. The content validity index was 0.885. The KCPS levels were found to be different between groups I and II ( $\chi^2 = 123.286$ ,  $P < 0.001$ ). A moderately strong positive correlation was found between the KCPS and the subscales of the BPFAS ( $r = 0.444-0.773$ ,  $P < 0.001$ ). An excellent positive correlation was detected between two swallowing therapists and between two examinations of one swallowing therapist ( $r = 0.962$ ,  $P < 0.001$ ;  $r = 0.990$ ,  $P < 0.001$ , respectively). The KCPS is a valid, reliable, quick and clinically easy-to-use functional instrument for determining the level of chewing function in children.

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PMID: 27043312 [Indexed for MEDLINE]

### **Does L-Tryptophan supplementation reduce chewing deficits in an experimental model of cerebral palsy?**

Lacerda DC , Manhães-de-Castro R , Ferraz-Pereira KN , Toscano AE .

*Nutr Neurosci.* 2017 Oct 23;1-2. doi: 10.1080/1028415X.2017.1391934. [Epub ahead of print]

Children with cerebral palsy commonly present with feeding difficulties that result from multiple orofacial sequelae, especially deficits in mastication. A previous study demonstrated that perinatal protein undernutrition accentuated the chewing impact in an experimental model of cerebral palsy. Therefore, the present study investigated whether nutritional manipulation reversed or minimized the chewing sequelae in cerebral palsy. We emphasized the relevance of evaluating the therapeutic potential of nutrients, especially tryptophan supplementation, to reduce the chewing deficits that are typical of this syndrome. Clarification of the role of nutrients may help in the development of new treatment strategies for these children.

DOI: 10.1080/1028415X.2017.1391934

PMID: 29058562

### **Gingivitis and salivary osmolality in children with cerebral palsy.**

Santos MT , Ferreira MC , Guaré RO , Diniz MB , Rösing CK , Rodrigues JA , Duarte DA .

*Int J Paediatr Dent.* 2016 Nov;26(6):463-470. doi: 10.1111/ipd.12220. Epub 2016 Jan 4.

**AIM:** To investigate the influence of salivary osmolality on the occurrence of gingivitis in children with cerebral palsy (CP).

**DESIGN:** A total of 82 children with spastic CP were included in this cross-sectional study. Oral motor performance and gingival conditions were evaluated. Unstimulated saliva was collected using cotton swabs, and salivary osmolality was measured using a freezing point depression osmometer. Spearman's coefficient, receiver operating characteristic (ROC), and multiple logistic regression analyses were performed.

**RESULTS:** Strong correlation ( $r > 0.7$ ) was determined among salivary osmolality, salivary flow rate, visible plaque, dental calculus, and the occurrence of gingivitis. The area under the ROC to predict the influence of salivary osmolality on the occurrence of gingivitis was 0.88 (95% CI 0.81-0.96;  $P < 0.001$ ). The cutoff value of 84.5 for salivary osmolality presented good sensitivity and specificity, both higher than 77%. The proportion of children presenting salivary osmolality  $\leq 84.5$  mOsm/kgH<sub>2</sub>O and gingivitis was 22.5%, whereas for the group presenting osmolality  $> 84.5$  mOsm/kgH<sub>2</sub>O, the proportion of children with gingivitis was 77.5%. Salivary osmolality above 84.5 increased the likelihood of gingivitis fivefold, whereas each additional 0.1 mL of salivary flow reduced the likelihood of gingivitis by 97%.

**CONCLUSION:** Gingivitis occurs more frequently in children with CP showing increased values of salivary osmolality.

Science Infos Paralysie Cérébrale, Octobre 2017, **FONDATION PARALYSIE CEREBRALE** 67 rue Vergniaud 50 75013 Paris - tel +33 1 45 54 03 03 contact: Christine Doumergue [cdoumergue@lafondationmotrice.org](mailto:cdoumergue@lafondationmotrice.org)

### **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 Nov;59(11):1181-1187. doi: 10.1111/dmcn.13498. Epub 2017 Sep 6.

**AIM:** To determine the most accurate parent-reported indicators for detecting (1) feeding/swallowing difficulties and 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.

**WHAT THIS PAPER ADDS:** Parent-reported indicators can detect feeding/swallowing difficulties and undernutrition in children with cerebral palsy. Most accurate screening questions were 0-10 scales for 'difficulty eating' and 'difficulty drinking'. Supplementation of these scales with additional indicators would improve detection.

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### **Reliability and validity of a tool to measure the severity of tongue thrust in children: the Tongue Thrust Rating Scale.**

Serel Arslan S , Demir N , Karaduman AA .

*J Oral Rehabil.* 2017 Feb;44(2):119-124. doi: 10.1111/joor.12471.

This study aimed to develop a scale called Tongue Thrust Rating Scale (TTRS), which categorised tongue thrust in children in terms of its severity during swallowing, and to investigate its validity and reliability. The study describes the developmental phase of the TTRS and presented its content and criterion-based validity and interobserver and intra-observer reliability. For content validation, seven experts assessed the steps in the scale over two Delphi rounds. Two physical therapists evaluated videos of 50 children with cerebral palsy (mean age,  $57.9 \pm 16.8$  months), using the TTRS to test criterion-based validity, interobserver and intra-observer reliability. The Karaduman Chewing Performance Scale (KCPS) and Drooling Severity and Frequency Scale (DSFS) were used for criterion-based validity. All the TTRS steps were deemed necessary. The content validity index was 0.857. A very strong positive correlation was found between two examinations by one physical therapist, which indicated intra-observer reliability ( $r = 0.938$ ,  $P < 0.001$ ). A very strong positive correlation was also found between the TTRS scores of two physical therapists, indicating interobserver reliability ( $r = 0.892$ ,  $P < 0.001$ ). There was also a strong positive correlation between the TTRS and KCPS ( $r = 0.724$ ,  $P < 0.001$ ) and a very strong positive correlation between the TTRS scores and DSFS ( $r = 0.822$  and  $r = 0.755$ ;  $P < 0.001$ ). These results demonstrated the criterion-based validity of the TTRS. The TTRS is a valid, reliable and clinically easy-to-use functional instrument to document the severity of tongue thrust in children.

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## Nutrition

### **Gastroesophageal Reflux in Neurologically Impaired Children: What Are the Risk Factors?**

Kim S , Koh H , Lee JS .

*Gut Liver.* 2017 Mar 15;11(2):232-236. doi: 10.5009/gnl16150.

**Background/Aims:** Neurologically impaired patients frequently suffer from gastrointestinal tract problems, such as gastroesophageal reflux disease (GERD). In this study, we aimed to define the risk factors for GERD in neurologically impaired children.

**Methods:** From May 2006 to March 2014, 101 neurologically impaired children who received 24-hour esophageal pH monitoring at Severance Children's Hospital were enrolled in the study. The esophageal pH finding and the clinical characteristics of the patients were analyzed. **Results:** The reflux index was higher in patients with abnormal electroencephalography (EEG) results than in those with normal EEG results ( $p=0.027$ ). Mitochondrial disease was associated with a higher reflux index than were epileptic disorders or cerebral palsy ( $p=0.009$ ). Patient gender, feeding method, scoliosis, tracheostomy, and baclofen use did not lead to statistical differences in reflux index. Age of onset of neurological impairment was inversely correlated with DeMeester score and reflux index. Age at the time of examination, the duration of the disease, and the number of antiepileptic drugs were not correlated with GER severity.

**Conclusions:** Early-onset neurological impairment, abnormal EEG results, and mitochondrial disease are risk factors for severe GERD.

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PMCID: PMC5347647

PMID: 27840365 [Indexed for MEDLINE]

### **Subjective Global Nutritional Assessment: A Reliable Screening Tool for Nutritional Assessment in Cerebral Palsy Children.**

Minocha P , Sitaraman S , Choudhary A , Yadav R .

*Indian J Pediatr.* 2017 Oct 12. doi: 10.1007/s12098-017-2501-3. [Epub ahead of print]

**OBJECTIVE:** To determine the prevalence of undernutrition in children with cerebral palsy and to compare subjective and objective methods of nutritional assessment.

**METHODS:** This was a hospital based analytical observational study in which 180 children of cerebral palsy, aged 1-12 y, attending tertiary level hospital, Jaipur from March, 2012 through March, 2013 were included. Subjective assessment was done by questionnaire (Subjective Global Nutritional Assessment; SGNA) in which questions related to nutrition history and physical examination, signs of fat, muscle wasting and edema was done while objective assessment was done by weight, height and triceps skinfold thickness (TSFT) measurements.

**RESULTS:** In this study prevalence of undernutrition by subjective method (SGNA) was 76.67% while by objective measurement (weight, height, TSFT) was 48.89%, 77.78% 35.18% respectively. There was fair to moderate agreement between the SGNA and objective assessments including weight and height ( $k = 0.341$ ,  $p = 0.000$ ;  $k = 0.337$ ,  $p = 0.000$  respectively) while for TSFT agreement between both methods was poor ( $k = 0.092$ ,  $p = 0.190$ ). In the index study, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of SGNA was for weight was 95%, 37%, 56%, 90%; for height 84%, 50%, 85%, 47%; for TSFT 81%, 30%, 38%, 75% respectively.

**CONCLUSIONS:** The prevalence of undernutrition is high in cerebral palsy children. SGNA can be a reliable tool for assessing nutritional status in children with cerebral palsy and is a simple, comprehensive, noninvasive, and cost-effective tool for screening undernutrition in children of cerebral palsy.

DOI: 10.1007/s12098-017-2501-3

PMID: 29022211

## Troubles urinaires

### **Bladder and bowel continence in bilateral cerebral palsy: A population study.**

Wright AJ , Fletcher O , Scrutton D , Baird G .

*J Pediatr Urol.* 2016 Dec;12(6):383.e1-383.e8. doi: 10.1016/j.jpurol.2016.05.027. Epub 2016 Jun 11.

**INTRODUCTION:** The attainment of continence is an important milestone in all children, including those with disability.

**OBJECTIVE:** To describe the age of bladder and bowel continence in children with bilateral cerebral palsy (BCP), and the association with intellectual impairment (II) and severity of motor disability.

**PATIENTS AND METHODS:** The parents of 346 children with BCP were interviewed as part of a population-based prospective study of the children at 3, 7, and 17 years of age. The age of bladder and bowel continence by day and night was ascertained and compared with controls from the Avon Longitudinal Study of Parents and Children (ALSPAC).

**RESULTS:** The median age for daytime bladder and bowel continence in BCP children was 5.4 years compared with 2.4 years in the controls. At 13.8 years of age, 59.4% of BCP children and 99% of controls were continent by day. In BCP children, there was no difference between the attainment of daytime bladder and bowel control. Night-time bladder and bowel control was slower and less completely attained, with 50% of BCP children continent by the age of 11.8 years compared with 3 years in control children. At 13.8 years of age, 51.9% of BCP children compared with 99.4% of controls were continent for bowel and bladder at night. Gross Motor Functional Classification Score (GMFCS) and intellectual ability (IA) (II) were strongly associated with continence attainment ( $P < 0.0001$ ), but gender was not.

**DISCUSSION:** Delayed and less complete continence attainment was noted in other clinic series of children with cerebral palsy (including hemiplegics) and children with II. Severity of motor disability (GMFCS), and II impacted on other aspects of toilet training, such as: motivation, understanding, communication, and independence skills. The presence of neurogenic bladder and bowel dysfunction can occur in all levels of GMFCS. Thus, there are many reasons that can prevent continence attainment.

**CONCLUSIONS:** Children with BCP achieved day and night-time bladder and bowel continence more slowly and less completely than controls, with 60.8% being continent by day and 54.6% by night at the age of 17 years. The majority of BCP children who were continent by day had achieved this by the age of 5.5 years (86%). At least 88% of BCP children with GMFCS I/II and normal, specific or mild learning impairment were continent for bladder and bowel by day and night. Expectations should be shared with parents, and failure to attain expected continence should be actively investigated.

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PMID: 27448847 [Indexed for MEDLINE]

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

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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## Qualité de vie et rapport au monde

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

#### Comparing parent and child reports of health-related quality of life and their relationship with leisure participation in children and adolescents with Cerebral Pals.

Longo E , Badia M , Begoña Orgaz M , Gómez-Vela M .

*Res Dev Disabil.* 2017 Oct 17;71:214-222. doi: 10.1016/j.ridd.2017.09.020. [Epub ahead of print]

The aim of this study was to examine the level of agreement between reports of health-related quality of life (HR-QoL) obtained from children and adolescents with cerebral palsy (CP) and their parents. We also examined the relationships between child and parent perception of the different domains of HR-QoL and participation dimensions. Sixty-nine children and adolescents with CP and their parents separately completed parallel forms of the KIDSCREEN questionnaire. The Spanish version of the Children's Assessment of Participation and Enjoyment (CAPE) was completed by the child/adolescent. Concordance between the children's and the parents' HR-QoL scores was analyzed via Pearson and intraclass correlations. Differences in means were tested using paired Student's t-tests. Chi-square tests were using to assess the incidence of personal variables in the agreement and disagreement of children-parents' responses. The relationships between HR-QoL and leisure participation was confirmed with Pearson's correlation coefficients. Correlations between child and parent HR-QoL scores were small in 7 domains, medium in 2 and large in the Social Support & Peers domain. Children reported significantly better HR-QoL than their parents did. Participation was positively associated with specific domains of HR-QoL, but only weakly, and there were discrepancies between parent and child reports of HR-QoL. These findings provide interesting information about the importance of hearing the voices of children and adolescents with CP to promote HR-QoL and leisure participation.

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DOI: 10.1016/j.ridd.2017.09.020

PMID: 29055241

#### How available to European children and young people with cerebral palsy are features of their environment that they need?

Espín-Tello SM , Colver A ; SPARCLE group.

*Res Dev Disabil.* 2017 Oct 4;71:1-10. doi: 10.1016/j.ridd.2017.09.018. [Epub ahead of print]

BACKGROUND: The UN Convention on the Rights of Persons with Disabilities requires accessibility to the physical and social environments. However, individuals with cerebral palsy (CP) have many difficulties in accessing the environment they need for functional independence and social inclusion.

AIMS: To examine the availability of environmental features which children with CP need for optimal participation, and whether availability changed for them between ages 8-12 and 13-17 years.

METHODS: The sample is the 594 children with CP, born 31/07/1991-01/04/1997, who took part in the SPARCLE study at age 8-12 (SPARCLE 1) and again at 13-17 years (SPARCLE 2). Participants were randomly sampled from population registers of children with CP in eight European regions; one further region recruited from multiple sources. Data about environment were captured with the European Child Environment Questionnaire (60 items). Differences in availability of environmental features between childhood and adolescence were assessed using

McNemar's test; differences between regions were assessed by ranking regions. Differences in availability between regions were assessed by ranking regions.

RESULTS: For seven environmental features significantly ( $p < 0.01$ ) fewer individuals needed the feature in SPARCLE 2 than in SPARCLE 1, whilst for two features more individuals needed the feature. Nine features in SPARCLE 1 and six features in SPARCLE 2 were available to less than half the participants who needed them. Eight features showed significantly ( $p < 0.01$ ) higher availability in SPARCLE 2 than in SPARCLE 1 (enlarged rooms, adapted toilet, modified kitchen and hoists at home, adapted toilets and lifts at school, an adequate vehicle, grants for home modifications) while none showed significantly lower availability. The relative rankings of the better and less good regions persisted from the age 8-12 year age group to the 13-17 year age group.

CONCLUSIONS: Needed environmental features are unavailable to many children at ages 8-12 and 13-17 years. This lack of availability is more pronounced in some regions than others, which probably results from their policy, legislative and statutory frameworks.

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DOI: 10.1016/j.ridd.2017.09.018

PMID: 28987966

### **Longitudinal study showed that the quality of life of Finnish adolescents with cerebral palsy continued to be relatively good.**

Böling S, Varho T, Haataja L.

*Acta Paediatr.* 2017 Oct 20. doi: 10.1111/apa.14123. [Epub ahead of print]

AIM: This longitudinal study examined what perceptions paediatric patients with cerebral palsy (CP) and their caregivers had of the patient's quality of life (QoL). It examined changing trends as children with CP became adolescents and examined the feasibility of the Finnish version of the CP QOL-Teen questionnaire.

METHODS: Carried out in autumn 2015, this study formed part of the multi-centre Finnish national CP project and aimed to validate the CP QOL-Teen questionnaire, which was posted to 54 adolescents and their caregivers. They included 24 who had responded to CP QOL-Child questionnaire in 2013.

RESULTS: The questionnaires were returned by 27 pairs of adolescents and caregivers and one extra caregiver also responded. Of these, 24 pairs had taken part in the 2013 survey. The internal consistencies of the sum variables were found to be acceptable in all cases. Overall QoL showed an average score of 81.8 on a scale from 0-100. Adolescents reported significantly higher QoL than their caregivers. There were no significant differences between the responses of the children and adolescents.

CONCLUSION: We showed that QoL was relatively good in childhood and adolescence. The Finnish version of the CP QOL-Teen questionnaire was an appropriate clinical tool for assessing QoL. This article is protected by copyright. All rights reserved.

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DOI: 10.1111/apa.14123

PMID: 29055066

### **Parenting Intervention Combined With Acceptance and Commitment Therapy: A Trial With Families of Children With Cerebral Palsy.**

Whittingham K, Sanders MR, McKinlay L, Boyd RN.

*J Pediatr Psychol.* 2016 Jun;41(5):531-42. doi: 10.1093/jpepsy/jsv118. Epub 2015 Dec 24.

OBJECTIVE: To examine the effects of Stepping Stones Triple P (SSTP) and Acceptance and Commitment Therapy (ACT) on child functioning, quality of life, and parental adjustment.

METHOD: 67 parents (97.0% mothers) of children (64.2% male; mean age  $5.3 \pm 3.0$  years) with cerebral palsy participated in a randomized controlled trial with three groups: wait-list control, SSTP, and SSTP + ACT. This article details the secondary outcomes.

RESULTS: In comparison with wait-list, the SSTP + ACT group showed increased functional performance and quality of life as well as decreased parental psychological symptoms. No differences were found for parental confidence. No differences were found between SSTP and wait-list or between SSTP and SSTP + ACT.

CONCLUSIONS: ACT-integrated parenting intervention may be an effective way to target child functioning, quality of life, and parental adjustment.

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PMID: 26702629 [Indexed for MEDLINE]

### **Predictors of parent-reported quality of life of adolescents with cerebral palsy: A longitudinal study.**

Rapp M , Eisemann N , Arnaud C , Ehlinger V , Fauconnier J , Marcelli M , Michelsen SI , Nystrand M , Colver A , Thyen U .

*Res Dev Disabil.* 2017 Mar;62:259-270. doi: 10.1016/j.ridd.2016.12.005. Epub 2017 Jan 19.

AIM: Parent-reporting is needed to examine Quality of Life (QoL) of children with cerebral palsy (CP) across all severities. This study examines whether QoL changes between childhood and adolescence, and what predicts adolescent QoL.

METHOD: SPARCLE is a European cohort study of children with CP, randomly sampled from population databases. Of 818 8-12-year-olds joining the study, 594 (73%) were revisited as 13-17-year-olds. The subject of this report is the 551 (316 boys, 235 girls) where the same parent reported QoL on both occasions using KIDSCREEN-52 (transformed Rasch scale, mean 50, SD 10 per domain). Associations were assessed using linear regression.

RESULTS: Between childhood and adolescence, average QoL reduced in six domains (1.3-3.8 points,  $p < 0.01$ ) and was stable in three (Physical wellbeing, Autonomy, Social acceptance). Socio-demographic factors had little predictive value. Childhood QoL was a strong predictor of all domains of adolescent QoL. Severe impairments of motor function, IQ or communication predicted higher adolescent QoL on some domains; except that severe motor impairment predicted lower adolescent QoL on the Autonomy domain. More psychological problems and higher parenting stress in childhood and their worsening by adolescence predicted lower QoL in five and eight domains respectively; contemporaneous pain in seven domains. The final model explained 30%-40% of variance in QoL, depending on domain.

INTERPRETATION: In general, impairment severity and socio-demographic factors were not predictors of lower adolescent QoL. However, pain, psychological problems and parenting stress were predictors of lower adolescent QoL in most domains. These are modifiable factors and addressing them may improve adolescent QoL.

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DOI: 10.1016/j.ridd.2016.12.005

PMID: 28110883 [Indexed for MEDLINE]

### **Proxy-reported quality of life in adolescents and adults with dyskinetic cerebral palsy is associated with executive functions and cortical thickness.**

Laporta-Hoyos O , Ballester-Plané J , Póo P , Macaya A , Meléndez-Plumed M , Vázquez E , Delgado I , Zubiaurre-Elorza L , Botellero VL , Narberhaus A , Toro-Tamargo E , Segarra D , Pueyo R .

*Qual Life Res.* 2017 May;26(5):1209-1222. doi: 10.1007/s11136-016-1433-0. Epub 2016 Oct 20.

PURPOSE: Quality of life (QOL) is a key outcome for people with cerebral palsy (CP), and executive functioning is an important predictor of QOL in other health-related conditions. Little is known about this association in CP or about its neural substrate. We aim to analyze the influence of executive functioning (including cognitive flexibility) as well as that of other psychological, motor, communication and socioeconomic variables on QOL and to identify neuroanatomical areas related to QOL in adolescents and adults with CP.

METHODS: Fifty subjects diagnosed with dyskinetic CP (mean age 25.96 years) were recruited. Their caregivers completed the primary caregiver proxy report version of the CP QOL-Teen questionnaire. Motor status, communication, IQ, four executive function domains, anxiety/depression and socioeconomic status were evaluated. Correlations and multiple linear regression models were used to relate CP QOL domains and total score to these variables. Thirty-six participants underwent an MRI assessment. Correlations were examined between cortical thickness and CP QOL total score and between cortical thickness and variables that might predict the CP QOL total score.

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**RESULTS:** Executive functions predict scores in four domains of CP QOL (General well-being and participation, Communication and physical health, Family health and Feelings about functioning) in the regression model. Among the cognitive domains that comprise executive function, only cognitive flexibility measured in terms of performance on the Wisconsin card sorting test (WCST) predicts the CP QOL total score. Monthly income, fine motor functioning and communication ability predict scores on the domains Access to services and Family Health, Feelings about functioning and School well-being, respectively. The clusters resulting from the correlation between cortical thickness and both CP QOL total score and WCST performance overlapped in the posterior cingulate and precuneus cortices. **CONCLUSIONS:** Cognitive flexibility predicts proxy report CP QOL-Teen total score in dyskinetic CP. This relationship has its anatomical correlate in the posterior cingulate and precuneus cortices.

DOI: 10.1007/s11136-016-1433-0

PMID: 27766516 [Indexed for MEDLINE]

### **Sensory processing disorders in children with cerebral palsy.**

Pavão SL, Rocha NA.

*Infant Behav Dev.* 2017 Feb;46:1-6. doi: 10.1016/j.infbeh.2016.10.007. Epub 2016 Nov 17.

**OBJECTIVE:** To evaluate sensory processing in children with CP using the Sensory Profile questionnaire and to compare results with the ones of children with typical development (TD).

**METHODS:** We assessed sensory processing of 59 TD children and 43 CP children using the Sensory Profile, a standardized parent reporting measure that records children's responses to sensory events in daily life. Mann-Whitney test was used to compare the results of sensory processing evaluation among the groups. Bonferroni correction was applied.

**RESULTS:** We found differences in sensory processing between groups in 16 out of the 23 categories evaluated in the Sensory Profile.

**CONCLUSION:** Our results pointed out to the existence of disturbances in the processing of sensory information in CP. Based on the importance of the sensory integration process for motor function, the presence of such important disturbances draw the attention to the implementation of sensory therapies which improve function in these children.

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PMID: 27866043 [Indexed for MEDLINE]

### **When I do, I become someone: experiences of occupational performance in young adults with cerebral palsy.**

Bergqvist L, Öhrvall AM, Himmelmann K, Peny-Dahlstrand M.

*Disabil Rehabil.* 2017 Oct 17:1-7. doi: 10.1080/09638288.2017.1390696. [Epub ahead of print]

**PURPOSE:** Persons with cerebral palsy, even if they have relatively good motor functions, have a lower level of independence and participation in everyday activities than persons of the same age without disabilities. However, there are few descriptions of how persons with cerebral palsy themselves perceive their performance of activities in everyday life. The aim of this study was to describe the perceptions that young adults with cerebral palsy have of occupational performance in everyday life.

**METHODS:** This qualitative interview study includes 10 participants with cerebral palsy classified with Manual Ability Classification System level I-II, aged 19-30 years. The data were analyzed using a phenomenographic approach.

**RESULTS:** The interviews resulted in five categories: "Important to do"; "Demanding but can be facilitated"; "Excludes or includes"; "Diminishes me or makes me grow"; and "Comes at a price".

**CONCLUSIONS:** The young adults with cerebral palsy consider that, despite life being so demanding, it is extremely important to perform activities themselves and to feel included, as this enables personal growth. Hence, it is necessary to advance intervention methods based on personally important activities to enable individuals with cerebral palsy to find their own way to perform activities. Further research is needed to increase opportunities for individuals with cerebral palsy to perform everyday activities without too much fatigue and struggle. Implications for Rehabilitation For young adults with cerebral palsy it is extremely important to perform everyday activities independently; by Doing activities they form their identity. Intervention models aimed to enable persons with cerebral palsy to be involved and find their own way to perform everyday activities should be emphasized. Attention must be paid to how mental fatigue is manifested in persons with cerebral palsy. To build self-awareness and self-

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efficacy, individuals with cerebral palsy need information, early in life, about cerebral palsy and the multifaceted difficulties the disability might lead to.

DOI: 10.1080/09638288.2017.1390696

PMID: 29041822

## Transition à l'âge adulte - Vieillesse

### **Disparities in Life Course Outcomes for Transition-Aged Youth with Disabilities.**

Acharya K, Meza R, Msall ME.

*Pediatr Ann.* 2017 Oct 1;46(10):e371-e376. doi: 10.3928/19382359-20170918-01.

Close to 750,000 youth with special health care needs transition to adult health care in the United States every year; however, less than one-half receive transition-planning services. Using the "F-words" organizing framework, this article explores life course outcomes and disparities in transition-aged youth with disabilities, with a special focus on youth with autism, Down syndrome, and cerebral palsy. Despite the importance of transition, a review of the available literature revealed that (1) youth with disabilities continue to have poor outcomes in all six "F-words" domains (ie, function, family, fitness, fun, friends, and future) and (2) transition outcomes vary by race/ethnicity and disability. Professionals need to adopt a holistic framework to examine transition outcomes within a broader social-ecological context, as well as implement evidence-based transition practices to help improve postsecondary outcomes of youth with disabilities. [*Pediatr Ann.* 2017;46(10):e371-e376.].

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DOI: 10.3928/19382359-20170918-01

PMID: 29019631

### **Normative Values of Physical Examinations Commonly Used for Cerebral Palsy.**

Moon SJ, Choi Y, Chung CY, Sung KH, Cho BC, Chung MK, Kim J, Yoo MS, Lee HM, Park MS.

*Yonsei Med J.* 2017 Nov;58(6):1170-1176. doi: 10.3349/ymj.2017.58.6.1170.

**PURPOSE:** The aim of this study was to establish normative values and to identify age-related change in physical examinations that are commonly used while evaluating patients with cerebral palsy (CP).

**MATERIALS AND METHODS:** One hundred four healthy volunteers (mean age 36 years, standard deviation 15 years) were enrolled and divided into four age groups: 13-20, 21-35, 36-50, and 51 years and older. The eighteen physical examination tests for CP were selected by five orthopedic surgeons in consensus-building session. The measurements were taken by three orthopedic surgeons.

**RESULTS:** There was no significant difference in the measures of physical examination among all the age groups, except for the Staheli test ( $p=0.002$ ). The post hoc test revealed that the mean hip extension was  $2.7^\circ$  higher in the 13-20-year-old group than in the other age groups. The bilateral popliteal angle had a tendency to increase in those over 36-years-old. There were 31 participants (30%) with a unilateral popliteal angle greater than  $40^\circ$ .

**CONCLUSION:** We documented normative values that can be widely used for evaluating CP in patients 13 years and older.

#### [Free Article](#)

DOI: 10.3349/ymj.2017.58.6.1170

PMCID: PMC5653482 [Available on 2017-11-01]

PMID: 29047241

## Activité physique

### **Evidence for increasing physical activity in children with physical disabilities: a systematic review.**

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 [Science Infos Paralysie Cérébrale](#), Octobre 2017, [FONDATION PARALYSIE CEREBRALE](#) 67 rue Vergniaud 58 75013 Paris - tel +33 1 45 54 03 03 contact: Christine Doumergue [cdoumergue@lafondationmotrice.org](mailto:cdoumergue@lafondationmotrice.org)

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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### **External Match Loads of Footballers With Cerebral Palsy: A Comparison Among Sport Classes.**

Yanci J , Castillo D , Iturricastillo A , Urbán T , Reina R .

*Int J Sports Physiol Perform.* 2017 Oct 16;1-23. doi: 10.1123/ijsp.2017-0042. [Epub ahead of print]

**PURPOSE:** The aim of this study was to determine and to compare the external match load (ML), according to sport class (FT) of footballers with cerebral palsy (CP) during the International Federation of CP Football (IFCPF) World Championships Qualification Tournament.

**METHODS:** Forty-two international male footballers with CP participated in the data collection. The footballers with CP were classified according to their FT in three groups (i.e. FT5/6, FT7, and FT8). External ML (i.e. total distance covered, distance covered at different speeds, accelerations, decelerations, player load, peak metabolic power and changes of directions) were collected for both halves during official matches with Global Positioning System (GPS) devices.

**RESULTS:** The results of this study showed that players with lower impairment (FT8) covered more distance (ES = .30-.60) at high-intensity running (HIR: 13.0-18.0 km·h<sup>-1</sup>) and sprinting (SPR: > 18.0 km·h<sup>-1</sup>), and performed more (ES = .29-1.08) accelerations, decelerations and CODs at high intensity in matches than other players (i.e. FT5/6 and FT7 groups).

**CONCLUSION:** Because high-intensity actions are relevant to football performance, and there are differences due to players' impairments, the IFCPF classification protocols should include high-intensity actions during the technical assessment as part of the procedures for determining the sport class of football players with CP.

DOI: 10.1123/ijsp.2017-0042

PMID: 29035588

### **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/dmnc.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,

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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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## **Prise en charge et Accompagnant/Accompagnement**

### **Caregiving burden of children with chronic diseases.**

Piran P , Khademi Z , Tayari N , Mansouri N .

*Electron Physician. 2017 Sep 25;9(9):5380-5387. doi: 10.19082/5380. eCollection2017 Sep.*

BACKGROUND: The care demands of children with chronic diseases can affect caregivers' health by imposing caregiving burden to them. The health status of caregivers plays a vital role in the quality of care provided to such children and in their quality of life.

OBJECTIVE: To determine caregiving burden in caregivers and to identify relevant influential factors.

METHODS: In this cross-sectional study, a total number of 249 caregivers of children with chronic diseases who referred to hospitalization and ambulatory departments of Bandar Abbas, Iran in 2016 were selected using convenience sampling method. The main caregivers who were older than 18 years and provided care to a sick child for at least three months consecutively were included. Caregiving burden was measured using the Caregiver Burden Scale. Data was analyzed SPSS 16 using descriptive statistics, Spearman's correlation coefficient and Mann-Whitney U test.

RESULTS: Mean score of caregiving burden was 1.98 which was close to moderate level. The highest caregiving burden was observed in general strain dimension (2.35), and cerebral palsy imposed the maximum burden to caregivers (2.24). Correlation coefficient revealed that perceived caregiving burden was in connection with children's and caregivers' age, duration of disease and caregiving, child's level of disability, number of family members and income level ( $p<0.05$ ). Mann-Whitney U test showed that female caregivers, villagers, and caregivers dealing with more than one patient experienced higher burden ( $p<0.05$ ).

CONCLUSION: Different variables can increase caregiving burden. Therefore, planning for holistic and family-centered interventions to decrease caregiving burden is necessary for health care providers.

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DOI: 10.19082/5380

PMCID: PMC5633241

PMID: 29038725

### **Comparing emergency department presentations among children with cerebral palsy with general childhood presentations: a data linkage study.**

Meehan E , Williams K , Reid SM , Freed GL , Babl FE , Sewell JR , Vidmar S , Donath S , Reddihough DS .

*Dev Med Child Neurol. 2017 Nov;59(11):1188-1195. doi: 10.1111/dmnc.13518. Epub2017 Aug 8.*

AIM: The aims of this study were to estimate the proportion of emergency department presentations attributable to children with cerebral palsy (CP), investigate the frequency of emergency department presentations in a CP cohort, and compare emergency department presentations among children with CP with those of other children.

METHOD: This was a retrospective cohort study. The Victorian Cerebral Palsy Register was linked to the Victorian Emergency Minimum Dataset. Data on emergency department presentations for the CP cohort occurring between 2007 and 2014 and population control data were obtained.

RESULTS: The CP cohort ( $n=1748$ ) had 7015 emergency department presentations during the 7-year period, accounting for 0.4% of the 1.69 million age-specific presentations during that time. The number of annual

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presentations per 1000 children rose with increasing CP severity. Compared with presentations among the general population, higher proportions of presentations among the CP cohort were preceded by ambulance arrivals (27% vs 8%), triaged as urgent (66% vs 32%), and required hospital admission (38% vs 12%).

INTERPRETATION: The marked differences in presentations between the CP cohort and the general population in the proportions that were urgent and required ambulance arrivals and hospital admissions was an important finding. Strategies to ensure appropriate use of services, including encouragement to seek earlier assistance from primary care providers, may prevent problems escalating to the need for urgent care.

WHAT THIS PAPER ADDS: Children with cerebral palsy (CP) account for 0.4% of childhood emergency department presentations. More emergency department presentations among children with CP require ambulance arrival. More CP emergency department presentations are urgent and require hospital admission. Traditional emergency department triage scales seem less accurate for this group.

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PMID: 28786475 [Indexed for MEDLINE]

### **Long-time sickness absence among parents of pre-school children with cerebral palsy, spina bifida and down syndrome: a longitudinal study.**

Brekke I, Früh EA, Kvarme LG, Holmstrøm H.

*BMC Pediatr.* 2017 Jan 18;17(1):26. doi: 10.1186/s12887-016-0774-8.

BACKGROUND: Taking care of a child with special needs can be draining and difficult and require a lot of parental time and resources. The present study investigated the long-term sickness absence of parents who have children with spina bifida, cerebral palsy and Down syndrome compared to that of parents without a child with special needs.

METHODS: The sample consisted of primiparae women who gave birth between 2001 and 2005 and the fathers of the children (N = 202,593). Data were obtained from the Medical Birth Registry of Norway (MBRN), which is linked to the Central Population Register, education and income registries and Historical Event Database (FD-Trygd) of Statistics Norway (SSB). The linkage data provide longitudinal data, together with annual updates on children and their parents. Statistical analyses were performed using difference-in-difference (DD) study design.

RESULTS: Caring for a child with special needs affected maternal sickness absence, particularly in the first year after the birth. The level of sickness absence of mothers caring for a child with spina bifida and cerebral palsy was greater than that of mothers caring for a child with Down syndrome. In contrast, the sickness absence of fathers caring for a child with special needs was, on average, comparable to that of fathers without a special-needs child in the post-birth period.

CONCLUSIONS: Caring for a child with special needs affected the long-term sickness absence of mothers but not fathers. The findings indicate that the burden of care in the case of children with special needs falls especially on the mother.

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DOI: 10.1186/s12887-016-0774-8

PMCID: PMC5242016

PMID: 28100193 [Indexed for MEDLINE]

## **Technologie - Domotique**

### **Comparison of seating, powered characteristics and functions and costs of electrically powered wheelchairs in a general population of users.**

Dolan MJ , Bolton MJ , Henderson GI .

*Disabil Rehabil Assist Technol.* 2017 Oct 26:1-6. doi:10.1080/17483107.2017.1393701. [Epub ahead of print]

PURPOSE: To profile and compare the seating and powered characteristics and functions of electrically powered wheelchairs (EPWs) in a general user population including equipment costs.

METHOD: Case notes of adult EPW users of a regional NHS service were reviewed retrospectively. Seating equipment complexity and type were categorized using the Edinburgh classification. Powered characteristics and functions, including control device type, were recorded.

RESULTS: 482 cases were included; 53.9% female; mean duration EPW use 8.1 years (SD 7.4); rear wheel drive 88.0%; hand joystick 94.8%. Seating complexity: low 73.2%, medium 18.0%, high 8.7%. Most prevalent diagnoses: multiple sclerosis (MS) 25.3%, cerebral palsy (CP) 18.7%, muscular dystrophy (8.5%). Compared to CP users, MS users were significantly older at first use, less experienced, more likely to have mid-wheel drive and less complex seating. Additional costs for muscular dystrophy and spinal cord injury users were 3-4 times stroke users.

CONCLUSIONS: This is the first large study of a general EPW user population using a seating classification. Significant differences were found between diagnostic groups; nevertheless, there was also high diversity within each group. The differences in provision and the equipment costs across diagnostic groups can be used to improve service planning. Implications for Rehabilitation At a service planning level, knowledge of a population's diagnostic group and age distribution can be used to inform decisions about the number of required EPWs and equipment costs and specialised seating (including review) clinics. At a user level, purchasing decisions about powered characteristics and functions of EPWs and specialised seating equipment need to be taken on a case by case basis because of the diversity of users' needs within diagnostic and age groups. The additional equipment costs for SCI and MD users are several times those of stroke users and add between 60 and 70% of the cost of basic provision. Compared to CP users, it is more important for MS users to be regularly reviewed for both specialist seating and EPW control ability. This is due to the progressive nature of the condition.

DOI: 10.1080/17483107.2017.1393701

PMID: 29072545



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