

# Science Infos

## Paralysie Cérébrale

N°37 JUIN-2017



FONDATION  
PARALYSIE CÉRÉBRALE  
LA FONDATION MOTRICE



Avec les conseils du service  
Méthodologie des bonnes  
pratiques professionnelles,

En



En collaboration



***Merci à tous pour votre participation et votre aide  
à la diffusion de « ESPaCe »***

**« ESPaCe » (Enquête Satisfaction Paralysie Cérébrale) est la 1ère enquête nationale destinée à améliorer la prise en charge de la rééducation motrice en répondant aux besoins et priorités des enfants et des adultes atteints de Paralysie Cérébrale (PC) ou d'Infirmité Motrice Cérébrale (IMC) et de leur famille**

Grâce à la mobilisation de tous, enfants, adolescents, adultes, tous atteints de Paralysie Cérébrale mais aussi de leurs parents, des professionnels de santé, associations de familles, structures de soins, sociétés savantes, nous avons atteint notre objectif avec 1161 questionnaires reçus (399 enfants, 161 adolescents et 601 adultes).

Les résultats principaux de cette enquête, seront disponibles en fin d'année sur le site de la Fondation. Ils permettront de dresser un état des lieux des soins et de leur organisation, des attentes et priorités d'amélioration de rééducation motrice et d'apporter le point de vue des personnes atteintes et des familles à une réflexion de recommandation de bonne pratique de rééducation motrice. .

Ce projet, élaboré par La Fondation Motrice en partenariat avec des associations de familles (FFAIMC, Hémiparésie, Envoludia), a reçu le soutien de 4 sociétés savantes impliquées dans la prise en charge des personnes atteintes de PC/IMC en France, du Secrétariat d'Etat chargé des personnes handicapées et celui de la Haute autorité de santé. Il s'inscrit dans une démarche de bonne pratique souhaitée par les personnes concernées et leur famille.

Sous l'égide



Avec le soutien financier de



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# Manifestations et congrès

## Octobre 2017

### 32e congrès de la SOFMER

05-07 octobre 2017

Nancy, France

<http://nancy.sofmer2017.com/index.php?pageID=09eb828f52123930a2186e7b5a4db890>

### European Congress of NeuroRehabilitation (ECNR)

24-27 octobre 2017

Lausanne, Suisse

<http://www.ecnr-congress.org/>

## Novembre 2017

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

9-12 Novembre 2017

Malte, Malte

<http://prmcongress2017malta.org/>

### Journées d'études polyhandicap Paralysie cérébrale 2017

16-17 Novembre 2017

Paris, France

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

## Décembre 2017

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

01-02 Décembre 2017

Montpellier, France

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

### Journées d'études annuelles du CDI

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

11-12 décembre 2017

Lyon, France

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

## Mai 2018

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

01-06 mai 2018

Vilnius, Lithanie

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

## Juillet 2018

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

08-12 juillet 2018

Paris, France

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



# Publications scientifiques

## Méthodologie de la recherche

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

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

## Epidémiologie

### +Prévalence – Incidence

#### **Predicting the prevalence of cerebral palsy by severity level in children aged 3 to 15 years across England and Wales by 2020.**

Glinianaia SV , Best KE , Lingam R , Rankin J .

*Dev Med Child Neurol.* 2017 Jun 2. doi: 10.1111/dmcn.13475. [Epub ahead of print]

AIM: To estimate the number of children living with cerebral palsy (CP) in England and Wales in 2013 by severity, and to extrapolate this figure to 2020.

METHOD: Data from the North of England Collaborative Cerebral Palsy Survey for births during the period 1991 to 2000 were restricted to individuals aged at or above 3 years to estimate the prevalence of CP and to calculate 15-year survival by severity according to the number of severe impairments and lifestyle assessment score. The number of 3- to 15-year-olds with CP of different severity in England and Wales was estimated in 2013 and 2019 using actual and nationally projected births.

RESULTS: Cumulative survival estimates up to the age of 16 years in children with CP differ significantly by severity, ranging between 97 per cent and 100 per cent for children with non-severe CP, and between 64 per cent and 67 per cent for those with the most severe CP. By the end of 2013, the estimated number of children aged 3 to 15 years living with CP in England and Wales will be about 20 500 rising to approximately 22 100 by 2020, a 7.5 per cent increase.

INTERPRETATION: Owing to an increasing population, the number of children living with CP in England and Wales will increase by 2020. This will have significant implications for health and social care service planning.

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DOI: 10.1111/dmcn.13475

PMID: 28574167

#### **Prevalence and Causes of Paralysis-United States, 2013.**

Armour BS , Courtney-Long EA , Fox MH , Fredine H , Cahill A .

*Am J Public Health.* 2016 Oct;106(10):1855-7. doi: 10.2105/AJPH.2016.303270. Epub 2016 Aug 23.

OBJECTIVES: To estimate the prevalence and causes of functional paralysis in the United States.

METHODS: We used the 2013 US Paralysis Prevalence & Health Disparities Survey to estimate the prevalence of paralysis, its causes, associated sociodemographic characteristics, and health effects among this population.

RESULTS: Nearly 5.4 million persons live with paralysis. Most persons with paralysis were younger than 65 years (72.1%), female (51.7%), White (71.4%), high school graduates (64.8%), married or living with a partner (47.4%), and unable to work (41.8%). Stroke is the leading cause of paralysis, affecting 33.7% of the population with paralysis, followed by spinal cord injury (27.3%), multiple sclerosis (18.6%), and cerebral palsy (8.3%).

CONCLUSIONS: According to the functional definition, persons living with paralysis represent a large segment of the US population, and two thirds of them are between ages 18 and 64 years. Targeted health promotion that uses inclusion strategies to account for functional limitations related to paralysis can be undertaken in partnership with state and local health departments.

DOI: 10.2105/AJPH.2016.303270

PMID: 27552260 [Indexed for MEDLINE]

## Facteurs de risque – Causes

### **Determinants of developmental outcomes in a very preterm Canadian cohort.**

Synnes A , Luu TM(2), Moddemann D , Church P , Lee D , Vincer M , Ballantyne M , Majnemer A , Creighton D , Yang J , Sauve R , Saigal S(10), Shah P , Lee SK ; Canadian Neonatal Network and the Canadian Neonatal Follow-Up Network.

*Arch Dis Child Fetal Neonatal Ed.* 2017 May;102(3):F235-F234. doi: 10.1136/archdischild-2016-311228. Epub 2016 Oct 6.

OBJECTIVES: Identify determinants of neurodevelopmental outcome in preterm children.

METHODS: Prospective national cohort study of children born between 2009 and 2011 at <29 weeks gestational age, admitted to one of 28 Canadian neonatal intensive care units and assessed at a Canadian Neonatal Follow-up Network site at 21 months corrected age for cerebral palsy (CP), visual, hearing and developmental status using the Bayley Scales of Infant and Toddler Development-Third Edition (Bayley-III). Stepwise regression analyses evaluated the effect of (1) prenatal and neonatal characteristics, (2) admission severity of illness, (3) major neonatal morbidities, (4) neonatal neuroimaging abnormalities, and (5) site on neurodevelopmental impairment (NDI) (Bayley-III score < 85, any CP, visual or hearing impairment), significant neurodevelopmental impairment (sNDI) (Bayley-III < 70, severe CP, blind or hearing aided and sNDI or death).

RESULTS: Of the 3700 admissions without severe congenital anomalies, 84% survived to discharge and of the 2340 admissions, 46% (IQR site variation 38%-51%) had a NDI, 17% (11%-23%) had a sNDI, 6.4% (3.1%-8.6%) had CP, 2.6% (2.5%-13.3%) had hearing aids or cochlear implants and 1.6% (0%-3.1%) had a bilateral visual impairment. Bayley-III composite scores of <70 for cognitive, language and motor domains were 3.3%, 10.9% and 6.7%, respectively. Gestational age, sex, outborn, illness severity, bronchopulmonary dysplasia, necrotising enterocolitis, late-onset sepsis, retinopathy of prematurity, abnormal neuroimaging and site were significantly associated with NDI or sNDI. Site variation ORs for NDI, sNDI and sNDI/death ranged from 0.3-4.3, 0.04-3.5 and 0.12-1.96, respectively.

CONCLUSION: Most preterm survivors are free of sNDI. The risk factors, including site, associated with neurodevelopmental status suggest opportunities for improving outcomes.

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DOI: 10.1136/archdischild-2016-311228

PMID: 27758929 [Indexed for MEDLINE]

Conflict of interest statement: Competing interests None declared.

### **Intake of Caffeinated Soft Drinks before and during Pregnancy, but Not Total Caffeine Intake, Is Associated with Increased Cerebral Palsy Risk in the Norwegian Mother and Child Cohort Study.**

Tollånes MC , Strandberg-Larsen K(2), Eichelberger KY , Moster D , Lie RT , Brantsæter AL , Meltzer HM , Stoltenberg C , Wilcox AJ .

*J Nutr.* 2016 Sep;146(9):1701-6. doi: 10.3945/jn.116.232272. Epub 2016 Aug 3.

BACKGROUND: Postnatal administration of caffeine may reduce the risk of cerebral palsy (CP) in vulnerable low-birth-weight neonates. The effect of antenatal caffeine exposure remains unknown.

OBJECTIVE: We investigated the association of intake of caffeine by pregnant women and risk of CP in their children.

METHODS: The study was based on The Norwegian Mother and Child Cohort Study, comprising >100,000 live-born children, of whom 222 were subsequently diagnosed with CP. Mothers reported their caffeine consumption in questionnaires completed around pregnancy week 17 (102,986 mother-child pairs), week 22 (87,987 mother-child

pairs), and week 30 (94,372 mother-child pairs). At week 17, participants were asked about present and pre-pregnancy consumption. We used Cox regression models to estimate associations between exposure [daily servings (1 serving = 125 mL) of caffeinated coffee, tea, and soft drinks and total caffeine consumption] and CP in children, with nonconsumers as the reference group. Models included adjustment for maternal age and education, medically assisted reproduction, and smoking, and for each source of caffeine, adjustments were made for the other sources.

**RESULTS:** Total daily caffeine intake before and during pregnancy was not associated with CP risk. High consumption ( $\geq 6$  servings/d) of caffeinated soft drinks before pregnancy was associated with an increased CP risk (HR: 1.9; 95% CI: 1.2, 3.1), and children of women consuming 3-5 daily servings of caffeinated soft drinks during pregnancy weeks 13-30 also had an increased CP risk (HR: 1.7; 95% CI: 1.1, 2.8). A mean daily consumption of 51-100 mg caffeine from soft drinks during the first half of pregnancy was associated with a 1.9-fold increased risk of CP in children (HR: 1.9; 95% CI: 1.1, 3.6).

**CONCLUSIONS:** Maternal total daily caffeine consumption before and during pregnancy was not associated with CP risk in children. The observed increased risk with caffeinated soft drinks warrants further investigation.

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DOI: 10.3945/jn.116.232272

PMCID: PMC4997283 [Available on 2017-09-01]

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Conflict of interest statement: 2Author disclosures: MC Tollånes, KStrandberg-Larsen, KY Eichelberger, D Moster, RT Lie, AL Brantsæter, HM Meltzer, C Stoltenberg, and AJ Wilcox, no conflicts of interest.

### **Maternal Prepregnancy BMI and Risk of Cerebral Palsy in Offspring.**

Forthun I (2), Wilcox AJ, Strandberg-Larsen K, Moster D (2), Nohr EA, Lie RT, Surén P, Tollånes MC.

*Pediatrics*. 2016 Oct;138(4). pii: e20160874. Epub 2016 Sep 8.

**OBJECTIVES:** To investigate the association between maternal pre-pregnancy BMI and risk of cerebral palsy (CP) in offspring.

**METHODS:** The study population consisted of 188 788 children in the Mothers and Babies in Norway and Denmark CP study, using data from 2 population-based, prospective birth cohorts: the Norwegian Mother and Child Cohort Study and the Danish National Birth Cohort. Prepregnancy BMI was classified as underweight (BMI <18.5), lower normal weight (BMI 18.5-22.9), upper normal weight (BMI 23.0-24.9), overweight (BMI 25.0-29.9), and obese (BMI  $\geq 30$ ). CP diagnoses were obtained from the national CP registries. Associations between maternal prepregnancy BMI and CP in offspring were investigated by using log-binomial regression models.

**RESULTS:** The 2 cohorts had 390 eligible cases of CP (2.1 per 1000 live-born children). Compared with mothers in the lower normal weight group, mothers in the upper normal group had a 40% excess risk of having a child with CP (relative risk [RR], 1.35; 95% confidence interval [CI], 1.03-1.78). Excess risk was 60% (RR, 1.56; 95% CI, 1.21-2.01) for overweight mothers and 60% (RR, 1.55; 95% CI 1.11-2.18) for obese mothers. The risk of CP increased ~4% for each unit increase in BMI (RR, 1.04; 95% CI, 1.02-1.06). Estimates changed little with adjustment for mother's occupational status, age, and smoking habits.

**CONCLUSIONS:** Higher prepregnancy maternal BMI was associated with increased risk of CP in offspring.

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Conflict of interest statement: POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

### **Neurodevelopmental Disorders or Early Death in Siblings of Children With Cerebral Palsy.**

Tollånes MC, Wilcox AJ(2), Stoltenberg C, Lie RT, Moster D.

*Pediatrics*. 2016 Aug;138(2). pii: e20160269. doi: 10.1542/peds.2016-0269.

**OBJECTIVES:** To explore the presence of shared underlying causes of cerebral palsy (CP) and other neurodevelopmental disorders, by examining risks of other disorders in siblings of children with CP.

**METHODS:** We used Norwegian national registries to identify 1.4 million pairs of full siblings (singletons) and 28 000 sets of twins born from 1967 to 2006, identify stillbirths and neonatal deaths, and find individuals with CP, epilepsy, intellectual disability, autism spectrum disorders, attention-deficit/hyperactivity disorder, blindness, deafness, schizophrenia, and bipolar disorder. Associations between CP in 1 sibling and neurodevelopmental disorders or early death in other siblings were estimated using logistic regression models.

**RESULTS:** There were 5707 neonatal survivors (beyond 28 days) with CP (2.5/1000). These children had substantial comorbidity (eg, 29% had epilepsy). Singleton siblings of (singleton) children with CP had increased risks of neurodevelopmental problems, including epilepsy (odds ratio [OR], 1.8 [95% confidence interval (CI), 1.5-2.5]), intellectual disability (OR, 2.3 [95% CI, 1.8-2.9]), autism spectrum disorders (OR, 1.6 [95% CI, 1.1-2.2]), attention-deficit/hyperactivity disorder (OR 1.3 [95% CI, 1.1-1.6]), blindness (OR 2.4 [95% CI, 1.1-5.4]), and schizophrenia (OR 2.0 [95% CI, 1.2-3.2]). There was no increase in risk of bipolar disorder (OR 1.0 [95% CI, 0.6-1.6]). Families with children with CP also had increased risk of losing another child in the perinatal period (stillbirth OR, 1.8 [95% CI, 1.5-2.3]; neonatal death OR, 1.7 [95% CI, 1.3-2.2]). Associations were stronger within sets of twins.

**CONCLUSIONS:** Siblings of a child with CP were at increased risk for a variety of other neurodevelopmental morbidities, as well as early death, indicating the presence of shared underlying causes.

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PMID: 27443356 [Indexed for MEDLINE]

### **Risk factors for cerebral palsy in PPROM and preterm delivery with intact membranes (.).**

Accordino F , Consonni S , Fedeli T(2), Kullman G , Moltrasio F , Ghidini A , Locatelli A .

*J Matern Fetal Neonatal Med.* 2016 Dec;29(23):3854-9. doi: 10.3109/14767058.2016.1149562. Epub 2016 Feb 26.

**OBJECTIVE:** Gestational age (GA) at delivery and spontaneous prematurity are independent risk factors for cerebral palsy (CP). The aim of this study is to investigate perinatal risk factors for CP in spontaneous preterm delivery.

**METHODS:** A retrospective cohort study of all single pregnancies complicated by spontaneous preterm labor (PTL) or PPROM with delivery at <34 weeks from January 2006 to December 2012 was performed. We compared demographic, obstetric, neonatal, and placental histology variables in cases of spontaneous preterm birth in reference to the development of CP. Statistical analysis included chi-square, one-way ANOVA and logistic regression analysis.  $p < 0.05$  was considered significant.

**RESULTS:** Two hundred sixty-one women were included for this study. Of 249 survivors, 5 babies died during the first year of life, 52 did not fulfill the inclusion criteria for neurologic follow-up, and 24 were lost to follow up. Thus 168 infants in the study cohort underwent neurologic follow-up. We observed 26 cases of CP. Factors related to CP were lower GA at PROM ( $p = 0.007$ ) and longer latency from PPROM to delivery ( $p = 0.002$ ) in the PPROM group, lower GA at delivery ( $p < 0.001$ ) and presence of funisitis ( $p < 0.001$ ) in the PTL group.

**CONCLUSIONS:** GA at membrane rupture in PPROM and GA at delivery in PTL are significantly associated with CP. A process leading to neurological damage may be initiated at the moment of membranes rupture in cases of PPROM and at the time of PTL in the group with intact membranes.

DOI: 10.3109/14767058.2016.1149562

PMID: 26919411 [Indexed for MEDLINE]

### **Risk of neurodevelopmental impairment for outborn extremely preterm infants in an Australian regional network.**

Mahoney K , Bajuk B(2), Oei J , Lui K , Abdel-Latif ME ; NICUS Network.

*J Matern Fetal Neonatal Med.* 2017 Jan;30(1):96-102. Epub 2016 Jun 1.

**OBJECTIVE:** To compare neurodevelopmental outcomes at 2-3 years in extremely premature outborn and inborn infants.

**DESIGN:** Population-based retrospective cohort study.

**SETTING:** Geographically defined area of New South Wales (NSW) and the Australian Capital Territory (ACT) served by a network of 10 neonatal intensive care units (NICUs).

**PATIENTS:** All premature infants <29 weeks gestation born between 1998 and 2004 in the setting.

**INTERVENTION:** At 2-3 years, corrected age, 1473 children were assessed with either the Griffiths Mental Developmental Scales (GMDS) or the Bayley Scales of Infant Development (BSID-II).

Science Infos Paralyse Cérébrale, Juin 2017, FONDATION PARALYSIE CEREBRALE 67 rue Vergniaud  
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**MAIN OUTCOME MEASURE:** Moderate/severe functional disability (FD) defined as: developmental delay (GMDS general quotient (GQ) or BSID-II mental developmental index (MDI)) > 2 standard deviations (SD) below the mean; cerebral palsy (CP) requiring aids; sensorineural or conductive deafness (requiring amplification); or bilateral blindness (visual acuity <6/60 in better eye).

**RESULTS:** At 2-3 years, moderate/severe functional disability does not appear to be significantly different between outborn and inborn infants (adjusted OR 0.782; 95% CI 0.424-1.443). However, there were a significant number of outborn infants lost to follow up (23.3% versus 42.9%).

**CONCLUSION:** In this cohort, at 2-3 years follow up neurodevelopmental outcome does not appear to be significantly different between outborn and inborn infants. These results should be interpreted with caution given the limitation of this study.

DOI: 10.3109/14767058.2016.1163675

PMID: 26957041 [Indexed for MEDLINE]

## Lésions - Prévention des lésions

### +Données fondamentales

#### **Caffeine Protects Against Anticonvulsant-Induced Neurotoxicity in the Developing Rat Brain.**

Endesfelder S , Weichelt U(2), Schiller C , Sifringer M , Bendix I , Bühner C .

*Neurotox Res.* 2017 Jun 22. doi: 10.1007/s12640-017-9768-z. [Epub ahead of print]

Phenobarbital is the most commonly used drug for the treatment of neonatal seizures but may induce neurodegeneration in the developing brain. Methylxanthine caffeine is used for the treatment of apnea in newborn infants and appears to be neuroprotective, as shown by antiapoptotic and anti-inflammatory effects in oxidative stress models in newborn rodents and reduced rates of cerebral palsy in human infants treated with caffeine. We hypothesized that caffeine may counteract the proapoptotic effects of phenobarbital in newborn rats. Postnatal day 4 (P4) rats received phenobarbital (50 mg/kg) +/- caffeine (10 mg/kg) for three consecutive days. Brains examined at 6, 12, and 24 h after last injection of phenobarbital showed a drastic increase of apoptotic cell death (TUNEL+), which was attenuated by co-treatment with caffeine at 6 and 24 h but not at 12 h. Phenobarbital also increased protein levels of apoptosis inducing factor (AIF) and cleaved caspase-3, which was reduced by caffeine co-administration at all time points investigated. RNA expression of the pro-inflammatory cytokines TNF $\alpha$ , IFN $\gamma$ , and IL-1 $\beta$ , but not IL-18, was upregulated by phenobarbital. Co-treatment with caffeine significantly decreased these upregulations at all time points investigated, while caffeine without phenobarbital resulted in increased expression of TNF $\alpha$ , IL-1 $\beta$ , and IL-18, but not IFN $\gamma$  at 6 h. Downregulation of the adenosine A1 and A2a receptors, both of which bind caffeine, by 24 h of phenobarbital exposure was partly antagonized by caffeine. These results raise the possibility that the phenobarbital-induced adverse effects could be reduced by a co-treatment with caffeine.

DOI: 10.1007/s12640-017-9768-z

PMID: 28643232

### +Données cliniques

#### **Association of Neurodevelopmental Outcomes and Neonatal Morbidities of Extremely Premature Infants With Differential Exposure to Antenatal Steroids.**

Chawla S , Natarajan G , Shankaran S , Pappas A , Stoll BJ(2), Carlo WA , Saha S , Das A , Laptook AR , Higgins RD ; National Institute of Child Health and Human Development Neonatal Research Network.

*JAMA Pediatr.* 2016 Dec 1;170(12):1164-1172. doi: 10.1001/jamapediatrics.2016.1936.

**Importance:** Many premature infants are born without exposure to antenatal steroids (ANS) or with incomplete courses. This study evaluates the dose-dependent effect of ANS on rates of neonatal morbidities and early childhood neurodevelopmental outcomes of extremely premature infants.

**Objective:** To compare rates of neonatal morbidities and 18- to 22-month neurodevelopmental outcomes of extremely premature infants exposed to no ANS or partial or complete courses of ANS.

**Design, Setting, and Participants:** In this observational cohort study, participants were extremely premature infants (birth weight range, 401-1000 g; gestational age, 22-27 weeks) who were born at participating centers of the National Institute of Child Health and Human Development Neonatal Research Network between January 2006 and December 2011. Data were analyzed between October 2013 and May 2016.

**Main Outcomes and Measures:** Rates of death or neurodevelopmental impairment at 18 to 22 months' corrected age. Neurodevelopmental impairment was defined as the presence of any of the following: moderate to severe cerebral palsy, a cognitive score less than 85 on the Bayley Scales of Infant and Toddler Development III, blindness, or deafness.

**Results:** There were 848 infants in the no ANS group, 1581 in the partial ANS group, and 3692 in the complete ANS group; the mean (SD) birth weights were 725 (169), 760 (173), and 753 (170) g, respectively, and the mean (SD) gestational ages were 24.5 (1.4), 24.9 (2), and 25.1 (1.1) weeks. Of 6121 eligible infants, 4284 (70.0%) survived to 18- to 22-month follow-up, and data were available for 3892 of 4284 infants (90.8%). Among the no, partial, and complete ANS groups, there were significant differences in the rates of mortality (43.1%, 29.6%, and 25.2%, respectively), severe intracranial hemorrhage among survivors (23.3%, 19.1%, and 11.7%), death or necrotizing enterocolitis (48.1%, 37.1%, and 32.5%), and death or bronchopulmonary dysplasia (74.9%, 68.9%, and 65.5%). Additionally, death or neurodevelopmental impairment occurred in 68.1%, 54.4%, and 48.1% of patients in the no, partial, and complete ANS groups, respectively. Logistic regression analysis revealed that complete (odds ratio, 0.63; 95% CI, 0.53-0.76) and partial (odds ratio, 0.77; 95% CI, 0.63-0.95) ANS courses were associated with lower rates of death or neurodevelopmental impairment compared with the no ANS group. The reduction in the rate of death or neurodevelopmental impairment associated with exposure to a complete ANS course may be mediated through a reduction in rates of severe intracranial hemorrhage and/or cystic periventricular leukomalacia in the neonatal period.

**Conclusions and Relevance:** Antenatal steroid exposure was associated with a dose-dependent protective effect against death or neurodevelopmental impairment in extremely preterm infants. The effect was partly mediated by ANS-associated reductions in rates of severe intracranial hemorrhage and/or cystic periventricular leukomalacia. These results support prompt administration of ANS, with the goal of a complete course prior to delivery.

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

DOI: 10.1001/jamapediatrics.2016.1936

PMCID: PMC5294968

PMID: 27723868 [Indexed for MEDLINE]

Conflict of interest statement: Disclosures: None reported.

### **Children with cerebral palsy have altered oscillatory activity in the motor and visual cortices during a knee motor task.**

Kurz MJ (2), Proskovec AL(2), Gehringer JE (2), Heinrichs-Graham E(2), Wilson TW(2).

*Neuroimage Clin.* 2017 May 15;15:298-305. doi: 10.1016/j.nicl.2017.05.008. eCollection 2017.

The neuroimaging literature on cerebral palsy (CP) has predominantly focused on identifying structural aberrations within the white matter (e.g., fiber track integrity), with very few studies examining neural activity within the key networks that serve the production of motor actions. The current investigation used high-density magnetoencephalography to begin to fill this knowledge gap by quantifying the temporal dynamics of the alpha and beta cortical oscillations in children with CP (age = 15.5 ± 3 years; GMFCS levels II-III) and typically developing (TD) children (age = 14.1 ± 3 years) during a goal-directed isometric target-matching task using the knee joint. Advanced beamforming methods were used to image the cortical oscillations during the movement planning and execution stages. Compared with the TD children, our results showed that the children with CP had stronger alpha and beta event-related desynchronization (ERD) within the primary motor cortices, premotor area, inferior parietal lobule, and inferior frontal gyrus during the motor planning stage. Differences in beta ERD amplitude extended through the motor execution stage within the supplementary motor area and premotor cortices, and a stronger alpha ERD was detected in the anterior cingulate. Interestingly, our results also indicated that alpha and beta oscillations were weaker in the children with CP within the occipital cortices and visual MT area during movement execution. These altered alpha and beta oscillations were accompanied by slower reaction times and substantial target matching errors in the children with CP. We also identified that the strength of the alpha and beta ERDs during the motor planning and execution stages were correlated with the motor performance. Lastly, our regression analyses

suggested that the beta ERD within visual areas during motor execution primarily predicted the amount of motor errors. Overall, these data suggest that uncharacteristic alpha and beta oscillations within visuomotor cortical networks play a prominent role in the atypical motor actions exhibited by children with CP.

[Free PMC Article](#)

DOI: 10.1016/j.nicl.2017.05.008

PMCID: PMC5440753

PMID: 28560154

### **Continuous cardiotocography (CTG) as a form of electronic fetal monitoring (EFM) for fetal assessment during labour.**

Alfirevic Z , Devane D(2), Gyte GM , Cuthbert A .Update of

*Cochrane Database Syst Rev.* 2017 Feb 3;2:CD006066. doi: 10.1002/14651858.CD006066.pub3. *Cochrane Database Syst Rev.* 2013 May 31;(5):CD006066.

**BACKGROUND:** Cardiotocography (CTG) records changes in the fetal heart rate and their temporal relationship to uterine contractions. The aim is to identify babies who may be short of oxygen (hypoxic) to guide additional assessments of fetal wellbeing, or determine if the baby needs to be delivered by caesarean section or instrumental vaginal birth. This is an update of a review previously published in 2013, 2006 and 2001.

**OBJECTIVES:** To evaluate the effectiveness and safety of continuous cardiotocography when used as a method to monitor fetal wellbeing during labour. **SEARCH METHODS:** We searched the Cochrane Pregnancy and Childbirth Group Trials Register (30 November 2016) and reference lists of retrieved studies.

**SELECTION CRITERIA:** Randomised and quasi-randomised controlled trials involving a comparison of continuous cardiotocography (with and without fetal blood sampling) with no fetal monitoring, intermittent auscultation intermittent cardiotocography.

**DATA COLLECTION AND ANALYSIS:** Two review authors independently assessed study eligibility, quality and extracted data from included studies. Data were checked for accuracy.

**MAIN RESULTS:** We included 13 trials involving over 37,000 women. No new studies were included in this update. One trial (4044 women) compared continuous CTG with intermittent CTG, all other trials compared continuous CTG with intermittent auscultation. No data were found comparing no fetal monitoring with continuous CTG. Overall, methodological quality was mixed. All included studies were at high risk of performance bias, unclear or high risk of detection bias, and unclear risk of reporting bias. Only two trials were assessed at high methodological quality. Compared with intermittent auscultation, continuous cardiotocography showed no significant improvement in overall perinatal death rate (risk ratio (RR) 0.86, 95% confidence interval (CI) 0.59 to 1.23, N = 33,513, 11 trials, low quality evidence), but was associated with halving neonatal seizure rates (RR 0.50, 95% CI 0.31 to 0.80, N = 32,386, 9 trials, moderate quality evidence). There was no difference in cerebral palsy rates (RR 1.75, 95% CI 0.84 to 3.63, N = 13,252, 2 trials, low quality evidence). There was an increase in caesarean sections associated with continuous CTG (RR 1.63, 95% CI 1.29 to 2.07, N = 18,861, 11 trials, low quality evidence). Women were also more likely to have instrumental vaginal births (RR 1.15, 95% CI 1.01 to 1.33, N = 18,615, 10 trials, low quality evidence). There was no difference in the incidence of cord blood acidosis (RR 0.92, 95% CI 0.27 to 3.11, N = 2494, 2 trials, very low quality evidence) or use of any pharmacological analgesia (RR 0.98, 95% CI 0.88 to 1.09, N = 1677, 3 trials, low quality evidence). Compared with intermittent CTG, continuous CTG made no difference to caesarean section rates (RR 1.29, 95% CI 0.84 to 1.97, N = 4044, 1 trial) or instrumental births (RR 1.16, 95% CI 0.92 to 1.46, N = 4044, 1 trial). Less cord blood acidosis was observed in women who had intermittent CTG, however, this result could have been due to chance (RR 1.43, 95% CI 0.95 to 2.14, N = 4044, 1 trial). Data for low risk, high risk, preterm pregnancy and high-quality trials subgroups were consistent with overall results. Access to fetal blood sampling did not appear to influence differences in neonatal seizures or other outcomes. Evidence was assessed using GRADE. Most outcomes were graded as low quality evidence (rates of perinatal death, cerebral palsy, caesarean section, instrumental vaginal births, and any pharmacological analgesia), and downgraded for limitations in design, inconsistency and imprecision of results. The remaining outcomes were downgraded to moderate quality (neonatal seizures) and very low quality (cord blood acidosis) due to similar concerns over limitations in design, inconsistency and imprecision. **AUTHORS' CONCLUSIONS:** CTG during labour is associated with reduced rates of neonatal seizures, but no clear differences in cerebral palsy, infant mortality or other standard measures of neonatal wellbeing. However, continuous CTG was associated with an increase in caesarean sections and instrumental vaginal births. The challenge

is how best to convey these results to women to enable them to make an informed decision without compromising the normality of labour. The question remains as to whether future randomised trials should measure efficacy (the intrinsic value of continuous CTG in trying to prevent adverse neonatal outcomes under optimal clinical conditions) or effectiveness (the effect of this technique in routine clinical practice). Along with the need for further investigations into long-term effects of operative births for women and babies, much remains to be learned about the causation and possible links between antenatal or intrapartum events, neonatal seizures and long-term neurodevelopmental outcomes, whilst considering changes in clinical practice over the intervening years (one-to-one support during labour, caesarean section rates). The large number of babies randomised to the trials in this review have now reached adulthood and could potentially provide a unique opportunity to clarify if a reduction in neonatal seizures is something inconsequential that should not greatly influence women's and clinicians' choices, or if seizure reduction leads to long-term benefits for babies. Defining meaningful neurological and behavioural outcomes that could be measured in large cohorts of young adults poses huge challenges. However, it is important to collect data from these women and babies while medical records still exist, where possible describe women's mobility and positions during labour and birth, and clarify if these might impact on outcomes. Research should also address the possible contribution of the supine position to adverse outcomes for babies, and assess whether the use of mobility and positions can further reduce the low incidence of neonatal seizures and improve psychological outcomes for women.

DOI: 10.1002/14651858.CD006066.pub3

PMID: 28157275 [Indexed for MEDLINE]

### **Early Imaging and Adverse Neurodevelopmental Outcome in Asphyxiated Newborns Treated With Hypothermia.**

Al Amrani F , Kwan S(2), Gilbert G , Saint-Martin C , Shevell M , Wintermark P .

*Pediatr Neurol.* 2017 May 19. pii: S0887-8994(17)30071-1. doi: 10.1016/j.pediatrneurol.2017.04.025. [Epub ahead of print]

**BACKGROUND:** Brain injury can be identified as early as day two of life in asphyxiated newborns treated with hypothermia, when using diffusion magnetic resonance imaging (MRI). However, it remains unclear whether these diffusion changes can predict future neurodevelopment. This study aimed to determine whether abnormal early diffusion changes in newborns treated with hypothermia are associated with adverse neurodevelopmental outcome at age two years.

**METHODS:** Asphyxiated newborns treated with hypothermia were enrolled prospectively. They underwent magnetic resonance imaging (MRI) at specific time points over the first month of life, including diffusion-weighted imaging and diffusion-tensor imaging. Apparent diffusion coefficient (ADC) and fractional anisotropy (FA) values were measured in different regions of interest. Adverse neurodevelopmental outcome was defined as cerebral palsy, global developmental delay, and/or seizure disorder around age two years. ADC and FA values were compared between the newborns developing or not developing adverse outcome.

**RESULTS:** Twenty-nine asphyxiated newborns treated with hypothermia were included. Among the newborns developing adverse outcome, ADC values were significantly decreased on days two to three of life and increased around day ten of life in the thalamus, posterior limb of the internal capsule, and the lentiform nucleus. FA values decreased in the same regions around day 30 of life. These newborns also had increased ADC around day ten of life and around day 30 of life, and decreased FA around day 30 of life in the anterior and posterior white matter.

**CONCLUSIONS:** Diffusion changes that were evident as early as day two of life, when the asphyxiated newborns were still treated with hypothermia, were associated with later abnormal neurodevelopmental outcome.

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DOI: 10.1016/j.pediatrneurol.2017.04.025

PMID: 28619376

### **How does the interaction of presumed timing, location and extent of the underlying brain lesion relate to upper limb function in children with unilateral cerebral palsy?**

Mailleux L , Klingels K(2), Fiori S , Simon-Martinez C , Demaerel P , Locus M , Fosseprez E , Boyd RN , Guzzetta A , Ortibus E , Feys H .

*Eur J Paediatr Neurol.* 2017 May 29. pii: S1090-3798(17)31651-3. doi: 10.1016/j.ejpn.2017.05.006. [Epub ahead of print]



**BACKGROUND:** Upper limb (UL) function in children with unilateral cerebral palsy (CP) vary largely depending on presumed timing, location and extent of brain lesions. These factors might exhibit a complex interaction and the combined prognostic value warrants further investigation. This study aimed to map lesion location and extent and assessed whether these differ according to presumed lesion timing and to determine the impact of structural brain damage on UL function within different lesion timing groups.

**MATERIALS AND METHODS:** Seventy-three children with unilateral CP (mean age 10 years 2 months) were classified according to lesion timing: malformations (N = 2), periventricular white matter (PWM, N = 42) and cortical and deep grey matter (CDGM, N = 29) lesions. Neuroanatomical damage was scored using a semi-quantitative MRI scale. UL function was assessed at body function and activity level.

**RESULTS:** CDGM lesions were more pronounced compared to PWM lesions ( $p = 0.0003$ ). Neuroanatomical scores were correlated with a higher degree to UL function in the CDGM group ( $r_s = -0.39$  to  $r_s = -0.84$ ) compared to the PWM group ( $r_{rb} = -0.42$  to  $r_s = -0.61$ ). Regression analysis found lesion location and extent to explain 75% and 65% ( $p < 0.02$ ) respectively, of the variance in AHA performance in the CDGM group, but only 24% and 12% ( $p < 0.03$ ) in the PWM group.

**CONCLUSIONS:** In the CDGM group, lesion location and extent seems to impact more on UL function compared to the PWM group. In children with PWM lesions, other factors like corticospinal tract (re)organization and structural connectivity may play an additional role.

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DOI: 10.1016/j.ejpn.2017.05.006

PMID: 28606752

### **Neonatal diffusion tensor brain imaging predicts later motor outcome in preterm neonates with white matter abnormalities.**

Kim DY , Park HK , Kim NS , Hwang SJ(2), Lee HJ .

*Ital J Pediatr.* 2016 Dec 1;42(1):104.

**BACKGROUND:** White matter (WM) abnormalities associated with prematurity are one of the most important causes of neurological disability that involves spastic motor deficits in preterm newborns. This study aimed to evaluate regional microstructural changes in diffusion tensor imaging (DTI) associated with WM abnormalities.

**METHODS:** We prospectively studied extremely low birth weight (ELBW; <1000 g) preterm infants who were admitted to the Neonatal Intensive Care Unit of Hanyang University Hospital between February 2011 and February 2014. WM abnormalities were assessed with conventional magnetic resonance (MR) imaging and DTI near term-equivalent age before discharge. Region-of-interests (ROIs) measurements were performed to examine the regional distribution of fractional anisotropy (FA) values.

**RESULTS:** Thirty-two out of 72 ELBW infants underwent conventional MR imaging and DTI at term-equivalent age. Ten of these infants developed WM abnormalities associated with prematurity. Five of ten of those with WM abnormalities developed cerebral palsy (CP). DTI in the WM abnormalities with CP showed a significant reduction of mean FA in the genu of the corpus callosum ( $p = 0.022$ ), the ipsilateral posterior limb of the internal capsule ( $p = 0.019$ ), and the ipsilateral centrum semiovale ( $p = 0.012$ ) compared to normal WM and WM abnormalities without CP. In infants having WM abnormalities with CP, early FA values in neonatal DTI revealed abnormalities of the WM regions prior to the manifestation of hemiparesis.

**CONCLUSIONS:** DTI performed at term equivalent age shows different FA values in WM regions among infants with or without WM abnormalities associated with prematurity and/or CP. Low FA values of ROIs in DTI are related with later development of spastic CP in preterm infants with WM abnormalities.

[Free PMC Article](#)

DOI: 10.1186/s13052-016-0309-9

PMCID: PMC5134238

PMID: 27906083 [Indexed for MEDLINE]

### **[Neuroprotection for preterm infants with antenatal magnesium sulphate]. [Article in French]**

Marret S , Ancel PY(2).

*J Gynecol Obstet Biol Reprod (Paris).* 2016 Dec;45(10):1418-1433. doi: 10.1016/j.jgyn.2016.09.028. Epub 2016 Oct 28.

**OBJECTIVE:** To evaluate in preterm born children the neuroprotective benefits and the risks, at short- and long-term outcome, of the antenatal administration of magnesium sulphate (MgSO<sub>4</sub>) in women at imminent risk of preterm delivery.

**MATERIAL AND METHODS:** Computer databases Medline, the Cochrane Library and the recommendations of various international scientific societies.

**RESULTS:** Given the demonstrated benefit of antenatal MgSO<sub>4</sub> intravenous administration on the reduction of cerebral palsy rates and the improvement of motor development in children born preterm, it is recommended for all women whose imminent delivery is expected or programmed before 32 weeks of gestation (WG) (grade A). The analysis of the literature finds no argument for greater benefit of antenatal MgSO<sub>4</sub> administration in sub-groups of gestational age, or depending on the type of pregnancy (single or multiple pregnancy) or with the cause of preterm birth (NP2). Its administration is recommended before 32 WG, if single or multiple pregnancy, whatever the cause of prematurity (grade B). It is recommended 4g loading dose (professional consensus). With a loading dose of 4g intravenous (IV) in 20min, the serum magnesium is lower than with intramuscular suggesting a preference for the IV route (professional consensus). It is proposed to use a maintenance dose of 1g/h until delivery with a maximum recommended duration of 12hours without exceeding a cumulative dose of 50g (professional consensus). These doses are without severe adverse maternal side effects or adverse effects in newborns at short- and medium-term outcome (NP1).

**CONCLUSION:** It is recommended to administer magnesium sulfate to the women at high risk of imminent preterm birth before 32 WG, whether expected or planned (grade A), with a 4g IV loading dose followed by a maintenance dose of 1g/h for 12hours (professional consensus), the pregnancy is single or multiple, whatever the cause of prematurity (professional consensus).

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DOI: 10.1016/j.jgyn.2016.09.028

PMID: 28166926 [Indexed for MEDLINE]

### **[Prevention of preterm birth complications by antenatal corticosteroid administration].[Article in French]**

Schmitz T .

*J Gynecol Obstet Biol Reprod (Paris)*. 2016 Dec;45(10):1399-1417. doi: 10.1016/j.jgyn.2016.09.008. Epub 2016 Oct 21.

**OBJECTIVE:** To evaluate short- and long-term benefits and risks associated with antenatal administration of a single course of corticosteroids and the related strategies: multiple and rescue courses.

**METHODS:** The PubMed database, the Cochrane Library and the recommendations from the French and foreign obstetrical societies or colleges have been consulted.

**RESULTS:** Antenatal administration of a single course of corticosteroids before 34 weeks of gestation is associated in the neonatal period with a significant reduction of respiratory distress syndrome (RDS), intraventricular hemorrhage (IVH), necrotizing enterocolitis (NEC) and death (LE1), and in possibly childhood with a reduction of cerebral palsy and increased psychomotor development index and intact survival (LE3). However, this treatment is associated with alterations of the HPA axis response persisting until 8 weeks after birth (LE2) and possibly with insulin resistance in adulthood (LE3). Antenatal corticosteroid administration after 34 weeks is associated, with high number needed to treat, with reduced respiratory morbidity (LE2), with no significant effect on neurological (LE2) or digestive (LE2) morbidities. Because of a very favourable benefit/risk balance, antenatal administration of a single course of corticosteroids is recommended for women at risk of preterm delivery before 34 weeks (grade A). The minimum gestational age for treatment will depend on the threshold chosen to start neonatal intensive care in maternity units and perinatal networks (Professional consensus). After 34 weeks, evidences are not consistent enough to recommend systematic antenatal corticosteroid treatment (grade B), however, a course might be indicated in the clinical situations associated with the higher risk of "severe" RDS, mainly in case of planned cesarean delivery (gradeC). In case of imminent preterm birth, pre-empting the second betamethasone injection is not recommended (gradeC), because this policy might be associated with increased rates of NEC (LE3). Repeated antenatal corticosteroid administration is associated in the neonatal period with respiratory benefits (LE1) but decreased birth weight (LE1) and, in childhood, with possible neurological impairment (LE2). Therefore, this strategy is not recommended (grade A). Rescue courses are only associated with neonatal respiratory benefits (LE2). Because of the possible adverse effects associated with this strategy when delivery occurs during the 24hours following the first injection and because of the doubts raised by repeated courses, rescue courses are not recommended (Professional

consensus). It is not possible to recommend one corticosteroid (betamethasone or dexamethasone) over another (Professional consensus). In case of contraindication for the intramuscular (IM) route, the intravenous route might be proposed (Professional consensus). The oral route is not recommended (grade A) because of increased rates of IVH and neonatal sepsis in comparison with the IM route (LE1). Either betamethasone as 2 injections of 12mg 24hours apart or dexamethasone as 4 injections of 6mg 12hours apart is recommended (grade A). Antenatal corticosteroid-induced alterations of fetal heart rate and movements should be recognized by the care providers of women at risk of preterm birth to avoid unjustified decision of labor induction or cesarean (Professional consensus). Gestational diabetes and pre-existing diabetes are not contraindication to antenatal corticosteroid therapy (Professional consensus). However, caution should be exercised in women with poorly controlled type 1 diabetes (Professional consensus). The apprehension to provoke maternal or neonatal infection should not delay antenatal corticosteroid administration even in case of preterm premature rupture of membranes (grade A).

CONCLUSION: Antenatal corticosteroid administration is recommended to every woman at risk of preterm delivery before 34 weeks of gestation (grade A). Repeated courses of antenatal corticosteroids are not recommended (grade A). Rescue courses are not recommended (Professional consensus).

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PMID: 27776846 [Indexed for MEDLINE]

### **Optimization of Maternal Magnesium Sulfate Administration for Fetal Neuroprotection: Application of a Prospectively Constructed Pharmacokinetic Model to the BEAM Cohort.**

*J Clin Pharmacol.* 2017 Jun 6. doi: 10.1002/jcph.941. [Epub ahead of print]

Brookfield KF , Elkomy M(2), Su F , Drover DR , Carvalho B .

The aim of the study was to identify the optimal therapeutic maternal magnesium drug exposure and maternal serum concentration to prevent cerebral palsy in the extremely preterm fetus. We applied a previously constructed pharmacokinetic model adjusted for indication to a large cohort of pregnant women receiving magnesium sulfate to prevent cerebral palsy in their preterm offspring at 20 different US academic centers between December 1997 and May 2004. We simulated the population-based individual maternal serum magnesium concentration at the time of delivery and the total magnesium dose for each woman who received magnesium sulfate to determine the relationship between maternal serum magnesium level at the time of delivery and the development of cerebral palsy. Among 1905 women who met inclusion criteria, the incidence of cerebral palsy in the cohort was 3.6% for women who had received magnesium sulfate and 6.4% for controls. The simulated maternal serum concentration at delivery associated with the lowest probability of delivering an infant with cerebral palsy was 4.1 mg/dL (95%CI 3.7 to 4.4). Our population-based estimates of magnesium disposition suggest that to optimize fetal neuroprotection and prevent cerebral palsy, magnesium sulfate administration should target a maternal serum magnesium level between 3.7 and 4.4 mg/dL at delivery.

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DOI: 10.1002/jcph.941

PMID: 28589614

### **Prophylactic Early Erythropoietin for Neuroprotection in Preterm Infants: A Meta-analysis.**

Fischer HS , Reibel NJ , Bühner C , Dame C(2).

*Pediatrics.* 2017 May;139(5). pii: e20164317. doi: 10.1542/peds.2016-4317. Epub 2017 Apr 7.

CONTEXT: Recombinant human erythropoietin (rhEPO) is a promising pharmacological agent for neuroprotection in neonates.

OBJECTIVE: To investigate whether prophylactic rhEPO administration in very preterm infants improves neurodevelopmental outcomes in a meta-analysis of randomized controlled trials (RCTs).

DATA SOURCES: Medline, Embase, and the Cochrane Central Register of Controlled Trials were searched in December 2016 and complemented by other sources. STUDY SELECTION: RCTs investigating the use of rhEPO in preterm infants versus a control group were selected if they were published in a peer-reviewed journal and reported neurodevelopmental outcomes at 18 to 24 months' corrected age. DATA EXTRACTION: Data extraction and analysis followed the standard methods of the Cochrane Neonatal Review Group. The primary outcome was the number of infants with a Mental Developmental Index (MDI) <70 on the Bayley Scales of Infant Development.

Science Infos Paralysie Cérébrale, Juin 2017, [FONDATION PARALYSIE CEREBRALE](http://www.lafondationmotrice.org) 67 rue Vergniaud 19  
75013 Paris - tel +33 1 45 54 03 03 contact: Christine Doumergue [cdoumergue@lafondationmotrice.org](mailto:cdoumergue@lafondationmotrice.org)

Secondary outcomes included a Psychomotor Development Index <70, cerebral palsy, visual impairment, and hearing impairment.

RESULTS: Four RCTs, comprising 1133 infants, were included in the meta-analysis. Prophylactic rhEPO administration reduced the incidence of children with an MDI <70, with an odds ratio (95% confidence interval) of 0.51 (0.31-0.81),  $P < .005$ . The number needed to treat was 14. There was no statistically significant effect on any secondary outcome.

CONCLUSIONS: Prophylactic rhEPO improved the cognitive development of very preterm infants, as assessed by the MDI at a corrected age of 18 to 24 months, without affecting other neurodevelopmental outcomes. Current and future RCTs should investigate optimal dosing and timing of prophylactic rhEPO and plan for long-term neurodevelopmental follow-up.

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DOI: 10.1542/peds.2016-4317

PMID: 28557760

Conflict of interest statement: POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

### **Update on the use of magnesium sulphate for fetal neuroprotection in preterm birth.[Article in English, Spanish]**

Meller CH , Izbizky G , Otaño L .

*Arch Argent Pediatr.* 2015 Aug;113(4):345-51. doi: 10.5546/aap.2015.345.

The administration of magnesium sulphate to mothers at risk for preterm birth for fetal neuroprotection has demonstrated to reduce the risk of cerebral palsy and gross motor dysfunction by 30-40%. Although there is controversy regarding the regimen of administration of magnesium sulphate, the gestational age limit, the extent of its potential benefit or even if it provides any benefit, current evidence is enough to support the use of magnesium sulphate in women at imminent risk for preterm delivery before 32 weeks of gestation. The objective of this study is to describe available evidence and current recommendations regarding neuroprotection with magnesium sulphate.

[Free Article](#)

DOI: 10.5546/aap.2015.345

PMID: 26172011 [Indexed for MEDLINE]

## **Détection – Diagnostic**

### **+Données cliniques**

#### **Evoked potentials recorded during routine EEG predict outcome after perinatal asphyxia.**

Nevalainen P , Marchi V(2), Metsäranta M , Lönnqvist T , Toiviainen-Salo S , Vanhatalo S , Lauronen L .

*Clin Neurophysiol.* 2017 Jul;128(7):1337-1343. doi: 10.1016/j.clinph.2017.04.025. Epub 2017 May 11.

OBJECTIVE: To evaluate the added value of somatosensory (SEPs) and visual evoked potentials (VEPs) recorded simultaneously with routine EEG in early outcome prediction of newborns with hypoxic-ischemic encephalopathy under modern intensive care.

METHODS: We simultaneously recorded multichannel EEG, median nerve SEPs, and flash VEPs during the first few postnatal days in 50 term newborns with hypoxic-ischemic encephalopathy. EEG background was scored into five grades and the worst two grades were considered to indicate poor cerebral recovery. Evoked potentials were classified as absent or present. Clinical outcome was determined from the medical records at a median age of 21 months. Unfavorable outcome included cerebral palsy, severe mental retardation, severe epilepsy, or death.

RESULTS: The accuracy of outcome prediction was 98% with SEPs compared to 90% with EEG. EEG alone always predicted unfavorable outcome when it was inactive ( $n=9$ ), and favorable outcome when it was normal or only mildly abnormal ( $n=17$ ). However, newborns with moderate or severe EEG background abnormality could have either favorable or unfavorable outcome, which was correctly predicted by SEP in all but one newborn (accuracy in this subgroup 96%). Absent VEPs were always associated with an inactive EEG, and an unfavorable outcome. However, presence of VEPs did not guarantee a favorable outcome.

CONCLUSIONS: SEPs accurately predict clinical outcomes in newborns with hypoxic-ischemic encephalopathy and improve the EEG-based prediction particularly in those newborns with severely or moderately abnormal EEG findings.

SIGNIFICANCE: SEPs should be added to routine EEG recordings for early bedside assessment of newborns with hypoxic-ischemic encephalopathy.

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DOI: 10.1016/j.clinph.2017.04.025

PMID: 28570867

### **Fidgety movements in infants born very preterm: predictive value for cerebral palsy in a clinical multicentre setting.**

Datta AN (2), Furrer MA, Bernhardt I, Hüppi PS(2), Borradori-Tolsa C(2), Bucher HU, Latal B, Grunt S, Natalucci G; GM Group.

*Dev Med Child Neurol.* 2017 Jun;59(6):618-624. doi: 10.1111/dmcn.13386. Epub 2017 Jan 19.

AIM: This study assessed predictive values of fidgety movement assessment (FMA) in a large sample of infants born very preterm for developmental abnormalities, in particular for cerebral palsy (CP) at 2 years in an everyday clinical setting.

METHOD: This is a multicentre study of infants born preterm with gestational age lower than 32.0 weeks. FMA was performed at 3 months corrected age; neurodevelopment (Bayley Scales of Infant Development, 2nd edition) and neurological abnormalities were assessed at 2 years. Predictive values of FMA for the development of CP were calculated and combined with abnormalities at cerebral ultrasound.

RESULTS: Five hundred and thirty-five infants (gestational age 28.2wks [standard deviation 1.3wks]) were included. Eighty-one percent showed normal fidgety movements and 19% atypical (82 absent, 21 abnormal) fidgety movements. Absent fidgety movements predicted CP at 2 years with an odds ratio (OR) of 8.9 (95% confidence interval [CI] 4.1-17.0), a combination of atypical fidgety movements and major brain lesion on cerebral ultrasound predicted it with an OR of 17.8 (95% CI 5.2-61.6). Mean mental developmental index of infants with absent fidgety movements was significantly lower ( $p=0.012$ ) than with normal fidgety movements.

INTERPRETATION: Detection of infants at risk for later CP through FMA was good, but less robust when performed in a routine clinical setting; prediction improved when combined with neonatal cerebral ultrasound.

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PMID: 28102574 [Indexed for MEDLINE]

### **Intermittent auscultation (IA) of fetal heart rate in labour for fetal well-being.**

Martis R, Emilia O(2), Nurdianti DS(2), Brown J.

*Cochrane Database Syst Rev.* 2017 Feb 13;2:CD008680. doi: 10.1002/14651858.CD008680.pub2.

BACKGROUND: The goal of fetal monitoring in labour is the early detection of a hypoxic baby. There are a variety of tools and methods available for intermittent auscultation (IA) of the fetal heart rate (FHR). Low- and middle-income countries usually have only access to a Pinard/Laënnec or the use of a hand-held Doppler device. Currently, there is no robust evidence to guide clinical practice on the most effective IA tool to use, timing intervals and length of listening to the fetal heart for women during established labour.

OBJECTIVES: To evaluate the effectiveness of different tools for IA of the fetal heart rate during labour including frequency and duration of auscultation. SEARCH METHODS: We searched the Cochrane Pregnancy and Childbirth Group's Trials Register (19 September 2016), contacted experts and searched reference lists of retrieved articles.

SELECTION CRITERIA: All published and unpublished randomised controlled trials (RCTs) or cluster-RCTs comparing different tools and methods used for intermittent fetal auscultation during labour for fetal and maternal well-being. Quasi-RCTs, and cross-over designs were not eligible for inclusion.

DATA COLLECTION AND ANALYSIS: All review authors independently assessed eligibility, extracted data and assessed risk of bias for each trial. Data were checked for accuracy.

**MAIN RESULTS:** We included three studies (6241 women and 6241 babies), but only two studies are included in the meta-analyses (3242 women and 3242 babies). Both were judged as high risk for performance bias due to the inability to blind the participants and healthcare providers to the interventions. Evidence was graded as moderate to very low quality; the main reasons for downgrading were study design limitations and imprecision of effect estimates. Intermittent Electronic Fetal Monitoring (EFM) using Cardiotocography (CTG) with routine Pinard (one trial) There was no clear difference between groups in low Apgar scores at five minutes (reported as < six at five minutes after birth) (risk ratio (RR) 0.66, 95% confidence interval (CI) 0.24 to 1.83, 633 babies, very low-quality evidence). There were no clear differences for perinatal mortality (RR 0.88, 95% CI 0.34 to 2.25; 633 infants, very low-quality evidence). Neonatal seizures were reduced in the EFM group (RR 0.05, 95% CI 0.00 to 0.89; 633 infants, very low-quality evidence). Other important infant outcomes were not reported: mortality or serious morbidity (composite outcome), cerebral palsy or neurosensory disability. For maternal outcomes, women allocated to intermittent electronic fetal monitoring (EFM) (CTG) had higher rates of caesarean section for fetal distress (RR 2.92, 95% CI 1.78 to 4.80, 633 women, moderate-quality evidence) compared with women allocated to routine Pinard. There was no clear difference between groups in instrumental vaginal births (RR 1.46, 95% CI 0.86 to 2.49, low-quality evidence). Other outcomes were not reported (maternal mortality, instrumental vaginal birth for fetal distress and or acidosis, analgesia in labour, mobility or restriction during labour, and postnatal depression). Doppler ultrasonography with routine Pinard (two trials) There was no clear difference between groups in Apgar scores < seven at five minutes after birth (reported as < six in one of the trials) (average RR 0.76, 95% CI 0.20 to 2.87; two trials, 2598 babies,  $I(2) = 72\%$ , very low-quality evidence); there was high heterogeneity for this outcome. There was no clear difference between groups for perinatal mortality (RR 0.69, 95% CI 0.09 to 5.40; 2597 infants, two studies, very low-quality evidence), or neonatal seizures (RR 0.05, 95% CI 0.00 to 0.91; 627 infants, one study, very low-quality evidence). Other important infant outcomes were not reported (cord blood acidosis, composite of mortality and serious morbidity, cerebral palsy, neurosensory disability). Only one study reported maternal outcomes. Women allocated to Doppler ultrasonography had higher rates of caesarean section for fetal distress compared with those allocated to routine Pinard (RR 2.71, 95% CI 1.64 to 4.48, 627 women, moderate-quality evidence). There was no clear difference in instrumental vaginal births between groups (RR 1.35, 95% CI 0.78 to 2.32, 627 women, low-quality evidence). Other maternal outcomes were not reported. Intensive Pinard versus routine Pinard (one trial) One trial compared intensive Pinard (a research midwife following the protocol in a one-to-one care situation) with routine Pinard (as per protocol but midwife may be caring for more than one woman in labour). There was no clear difference between groups in low Apgar score (reported as < six this trial) (RR 0.90, 95% CI 0.35 to 2.31, 625 babies, very low-quality evidence). There were also no clear differences identified for perinatal mortality (RR 0.56, 95% CI 0.19 to 1.67; 625 infants, very low-quality evidence), or neonatal seizures (RR 0.68, 95% CI 0.24 to 1.88, 625 infants, very low-quality evidence). Other infant outcomes were not reported. For maternal outcomes, there were no clear differences between groups for caesarean section or instrumental delivery (RR 0.70, 95% CI 0.35 to 1.38, and RR 1.21, 95% CI 0.69 to 2.11, respectively, 625 women, both low-quality evidence) Other outcomes were not reported.

**AUTHORS' CONCLUSIONS:** Using a hand-held (battery and wind-up) Doppler and intermittent CTG with an abdominal transducer without paper tracing for IA in labour was associated with an increase in caesarean sections due to fetal distress. There was no clear difference in neonatal outcomes (low Apgar scores at five minutes after birth, neonatal seizures or perinatal mortality). Long-term outcomes for the baby (including neurodevelopmental disability and cerebral palsy) were not reported. The quality of the evidence was assessed as moderate to very low and several important outcomes were not reported which means that uncertainty remains regarding the use of IA of FHR in labour. As intermittent CTG and Doppler were associated with higher rates of caesarean sections compared with routine Pinard monitoring, women, health practitioners and policy makers need to consider these results in the absence of evidence of short- and long-term benefits for the mother or baby. Large high-quality randomised trials, particularly in low-income settings, are needed. Trials should assess both short- and long-term health outcomes, comparing different monitoring tools and timing for IA.

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PMID: 28191626 [Indexed for MEDLINE]

### **Neuroimaging with magnetoencephalography: A dynamic view of brain pathophysiology.**

Wilson TW, Heinrichs-Graham E(2), Proskovec AL, McDermott TJ(2).

*Transl Res.* 2016 Sep;175:17-36. doi: 10.1016/j.trsl.2016.01.007. Epub 2016 Jan 25.

Magnetoencephalography (MEG) is a noninvasive, silent, and totally passive neurophysiological imaging method with excellent temporal resolution (~1 ms) and good spatial precision (~3-5 mm). In a typical experiment, MEG data are acquired as healthy controls or patients with neurologic or psychiatric disorders perform a specific cognitive task, or receive sensory stimulation. The resulting data are generally analyzed using standard electrophysiological methods, coupled with advanced image reconstruction algorithms. To date, the total number of MEG instruments and associated users is significantly smaller than comparable human neuroimaging techniques, although this is likely to change in the near future with advances in the technology. Despite this small base, MEG research has made a significant impact on several areas of translational neuroscience, largely through its unique capacity to quantify the oscillatory dynamics of activated brain circuits in humans. This review focuses on the clinical areas where MEG imaging has arguably had the greatest impact in regard to the identification of aberrant neural dynamics at the regional and network level, monitoring of disease progression, determining how efficacious pharmacologic and behavioral interventions modulate neural systems, and the development of neural markers of disease. Specifically, this review covers recent advances in understanding the abnormal neural oscillatory dynamics that underlie Parkinson's disease, autism spectrum disorders, human immunodeficiency virus (HIV)-associated neurocognitive disorders, cerebral palsy, attention-deficit hyperactivity disorder, cognitive aging, and post-traumatic stress disorder. MEG imaging has had a major impact on how clinical neuroscientists understand the brain basis of these disorders, and its translational influence is rapidly expanding with new discoveries and applications emerging continuously.

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DOI: 10.1016/j.trsl.2016.01.007

PMCID: PMC4959997 [Available on 2017-09-01]

PMID: 26874219 [Indexed for MEDLINE]

### **Prognostic Accuracy of Electroencephalograms in Preterm Infants: A Systematic Review.**

Fogtmann EP , Plomgaard AM(2), Greisen G(2), Gluud C .

*Pediatrics*. 2017 Feb;139(2). pii: e20161951. doi: 10.1542/peds.2016-1951.

CONTEXT: Brain injury is common in preterm infants, and predictors of neurodevelopmental outcome are relevant.

OBJECTIVE: To assess the prognostic test accuracy of the background activity of the EEG recorded as amplitude-integrated EEG (aEEG) or conventional EEG early in life in preterm infants for predicting neurodevelopmental outcome.

DATA SOURCES: The Cochrane Library, PubMed, Embase, and the Cumulative Index to Nursing and Allied Health Literature.

STUDY SELECTION: We included observational studies that had obtained an aEEG or EEG within 7 days of life in preterm infants and reported neurodevelopmental outcomes 1 to 10 years later.

DATA EXTRACTION: Two reviewers independently performed data extraction with regard to participants, prognostic testing, and outcomes.

RESULTS: Thirteen observational studies with a total of 1181 infants were included. A meta-analysis was performed based on 3 studies (267 infants). Any aEEG background abnormality was a predictor of abnormal outcome. For prediction of a developmental quotient <70 points, cerebral palsy, or death, the pooled sensitivity was 0.83 (95% confidence interval, 0.69-0.92) and specificity 0.83 (95% confidence interval, 0.77-0.87).

LIMITATIONS: All studies were at high risk of bias. Heterogeneity was evident among the studies with regard to the investigated aEEG and EEG variables, neurodevelopmental outcomes, and cutoff values.

CONCLUSIONS: aEEG or EEG recorded within the first 7 days of life in preterm infants may have potential as a predictor for later neurodevelopmental outcome. We need high-quality studies to confirm these findings. Meanwhile, the prognostic value of aEEG and EEG should be used only as a scientific tool.

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DOI: 10.1542/peds.2016-1951

PMID: 28143915 [Indexed for MEDLINE]

### **Survival and Neurodevelopmental Outcomes of Preterms Resuscitated With Different Oxygen Fractions.**

Boronat N , Aguar M , Rook D(2), Iriondo M , Brugada M , Cernada M , Nuñez A , Izquierdo M , Cubells E , Martinez M , Parra A , van Goudoever H , Vento M .

*Pediatrics*. 2016 Dec;138(6). pii: e20161405. Epub 2016 Nov 16.

**BACKGROUND AND OBJECTIVES:** Stabilization of preterm infants after birth frequently requires oxygen supplementation. At present the optimal initial oxygen inspiratory fraction (Fio<sub>2</sub>) for preterm stabilization after birth is still under debate. We aimed to compare neurodevelopmental outcomes of extremely preterm infants at 24 months corrected age randomly assigned to be stabilized after birth with an initial Fio<sub>2</sub> of 0.3 versus 0.6 to 0.65 in 3 academic centers from Spain and the Netherlands.

**METHODS:** Randomized, controlled, double-blinded, multicenter, international clinical trial enrolling preterm infants <32 weeks' gestation assigned to an initial Fio<sub>2</sub> of 0.3 (Lowox group) or 0.6 to 0.65 (Hiox group). During stabilization, arterial pulse oxygen saturation and heart rate were continuously monitored and Fio<sub>2</sub> was individually titrated to keep infants within recommended ranges. At 24 months, blinded researchers used the Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III) to assess visual acuity, neurosensory deafness, and language skills.

**RESULTS:** A total of 253 infants were recruited and 206 (81.4%) completed follow-up. No differences in perinatal characteristics, oxidative stress, or morbidities during the neonatal period were assessed. Mortality at hospital discharge or when follow-up was completed didn't show differences between the groups. No differences regarding Bayley-III scale scores (motor, cognitive, and language composites), neurosensorial handicaps, cerebral palsy, or language skills between groups were found.

**CONCLUSIONS:** The use of an initial lower (0.3) or higher (0.6-0.65) Fio<sub>2</sub> during stabilization of extremely preterm infants in the delivery room does not influence survival or neurodevelopmental outcomes at 24 months. Copyright © 2016 by the American Academy of Pediatrics.

DOI: 10.1542/peds.2016-1405

PMID: 27940687 [Indexed for MEDLINE]

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

### **Clinical tools designed to assess motor abilities in children with cerebral palsy.**

Pavão SL , Silva FP , Dusing SC(2), Rocha NA .

*Dev Neurorehabil.* 2017 Apr;20 :149-159. doi: 10.3109/17518423.2016.1150359. Epub 2016 Mar 28.

**OBJECTIVE:** This systematic review aimed to list the tools used by rehabilitation professionals to test motor abilities in children with cerebral palsy (CP), to determine if these tools have psychometric properties specifically measured for CP, and to identify the main characteristics of these tools.

**METHOD:** Web of Science, PEDro, PubMed/MEDLINE, Science Direct, and SciELO databases were searched to identify the tools. PubMed/MEDLINE was then searched to identify the studies assessing those tools' psychometric properties. The agreement-based standards for the selection of health measurement tools and the Terwee criteria were used to assess the quality and the results of each included study, respectively.

**RESULTS:** Eighteen tools were identified. The psychometric properties of many of the tools used with children with CP have not been evaluated for this population.

**CONCLUSION:** The psychometric properties evaluated often have a poor methodological quality of measurement. Overall, we suggest the tools with most empirical support to evaluate children with CP.

DOI: 10.3109/17518423.2016.1150359

PMID: 27019351 [Indexed for MEDLINE]

### **Dependence of Gait Deviation on Weight-Bearing Asymmetry and Postural Instability in Children with Unilateral Cerebral Palsy.**

Domagalska-Szopa M , Szopa A(2), Czamara A .

*PLoS One.* 2016 Oct 27;11(10):e0165583. doi: 10.1371/journal.pone.0165583. eCollection 2016.

Postural control deficits have been suggested to be a major component of gait disorders in children with cerebral palsy. The purpose of this study was to investigate the relationship between postural stability and treadmill walking, in children with unilateral cerebral palsy, by defining dependence between the posturographic weight-bearing distribution and center of pressure (CoP) sway during quiet standing with Gillette Gait Index and the 16 distinct gait parameters that composed the Gillette Gait Index. Forty-five children with unilateral cerebral palsy from 7-12 years of age were included in this study. A posturographic procedure and 3-dimensional instrumented gait analysis was



developed. In general, across the entire tested group, the significant correlations concerned only the asymmetry of the weight bearing and a few of the distinct gait parameters that compose the Gillette Gait Index; moreover, correlation coefficients were low. The division of subjects into two clinical subgroups: children that exhibited a tendency to overload (1) and to underload (2) the affected body side, modified the results of the explored relationships. Our findings revealed that the difficulties experienced by children with hemiplegia while controlled in a standing position result from tendency to excessively or insufficiently load the affected lower limbs, and thus establishes a direct relationship with inadequate affected peak ankle DF in both stance and swing gait phases. Given the presented relationship between postural instability and deviation of the particular gait parameters in children with unilateral cerebral palsy, a follow-up study will be needed to determine the therapeutic approaches that will be most effective in promoting increased improvement in gait pattern, as well as the static and dynamic balance in standing.

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DOI: 10.1371/journal.pone.0165583

PMCID: PMC5082807

PMID: 27788247 [Indexed for MEDLINE]

Conflict of interest statement: The authors have declared that no competing interests exist.

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

Geerdink Y , Aarts P , Van Der Holst M(2), Lindeboom R , Van Der Burg J , Steenbergen B , Geurts AC .  
*Dev Med Child Neurol.* 2017 May 29. doi: 10.1111/dmcn.13449. [Epub ahead of print]

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

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

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

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DOI: 10.1111/dmcn.13449

PMID: 28555780

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

De Laet T , Papageorgiou E(2), Nieuwenhuys A(2), Desloovere K(2) .

*PLoS One.* 2017 Jun 1;12(6):e0178378. doi: 10.1371/journal.pone.0178378. eCollection 2017.

**BACKGROUND:** This study aimed to improve the automatic probabilistic classification of joint motion gait patterns in children with cerebral palsy by using the expert knowledge available via a recently developed Delphi-consensus study. To this end, this study applied both Naïve Bayes and Logistic Regression classification with varying degrees of usage of the expert knowledge (expert-defined and discretized features). A database of 356 patients and 1719 gait trials was used to validate the classification performance of eleven joint motions.

**HYPOTHESES:** Two main hypotheses stated that: (1) Joint motion patterns in children with CP, obtained through a Delphi-consensus study, can be automatically classified following a probabilistic approach, with an accuracy similar to clinical expert classification, and (2) The inclusion of clinical expert knowledge in the selection of relevant gait

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features and the discretization of continuous features increases the performance of automatic probabilistic joint motion classification.

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

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### **Duruöz Hand Index: Is it valid and reliable in children with unilateral cerebral palsy?**

Sanal-Top C , Karadag-Saygi E , Saçaklıdır R , Duruöz MT .

*Dev Neurorehabil.* 2017 Jun 12;1-5. doi: 10.1080/17518423.2017.1326536. [Epub ahead of print]

**PURPOSE:** To investigate the validity and reliability of the Duruöz Hand Index (DHI) in patients with unilateral cerebral palsy (CP).

**METHODS:** Assessments of patients (n = 23) were performed using the Modified Ashworth Scale (MAS), the Manual Ability Classification System (MACS), the grip and pinch strength tests, and DHI. Following the data collection, retest of DHI was administered telephonically within a 2-week period.

**RESULTS:** Test-retest reliability and internal consistency of DHI were found to be excellent with a Cronbach's alpha value of 0.93 and an intraclass correlation coefficient value of 0.94. The correlation between the DHI and MACS was detected significantly high ( $r = 0.840$ ,  $p < 0.010$ ). The DHI also correlated with grip and pinch strength in the affected side ( $r = -0.459$ ,  $p < 0.050$ ;  $r = -0.509$ ,  $p < 0.050$ ).

**CONCLUSIONS:** DHI is a valid and reliable questionnaire for patients with unilateral CP.

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PMID: 28604242

### **Effects of hip joint centre mislocation on gait kinematics of children with cerebral palsy calculated using patient-specific direct and inverse kinematic models.**

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

*Gait Posture.* 2017 Jun 4;57:154-160. doi: 10.1016/j.gaitpost.2017.06.002. [Epub ahead of print]

Joint kinematics can be calculated by Direct Kinematics (DK), which is used in most clinical gait laboratories, or Inverse Kinematics (IK), which is mainly used for musculoskeletal research. In both approaches, joint centre locations are required to compute joint angles. The hip joint centre (HJC) in DK models can be estimated using predictive or functional methods, while in IK models can be obtained by scaling generic models. The aim of the current study was to systematically investigate the impact of HJC location errors on lower limb joint kinematics of a clinical population using DK and IK approaches. Subject-specific kinematic models of eight children with cerebral palsy were built from magnetic resonance images and used as reference models. HJC was then perturbed in 6mm steps within a 60mm cubic grid, and kinematic waveforms were calculated for the reference and perturbed models. HJC perturbations affected only hip and knee joint kinematics in a DK framework, but all joint angles were affected when using IK. In the DK model, joint constraints increased the sensitivity of joint range-of-motion to HJC location errors. Mean joint angle offsets larger than 5° were observed for both approaches (DK and IK), which were larger than previously reported for healthy adults. In the absence of medical images to identify the HJC, predictive or functional methods with small errors in anterior-posterior and medial-lateral directions and scaling procedures minimizing HJC location errors in the anterior-posterior direction should be chosen to minimize the impact on joint kinematics.

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PMID: 28641160

### **Functional outcomes in children and young people with dyskinetic cerebral palsy.**

Monbaliu E , De La Peña MG , Ortibus E , Molenaers G , Deklerck J , Feys H .

*Dev Med Child Neurol.* 2017 Jun;59(6):634-640. doi: 10.1111/dmcn.13406. Epub 2017 Mar 8.

AIM: This cross-sectional study aimed to map the functional profile of individuals with dyskinetic cerebral palsy (CP), to determine interrelationships between the functional classification systems, and to investigate the relationship of functional abilities with dystonia and choreoathetosis severity.

METHODS: Fifty-five children (<15y) and young people (15-22y) (30 males, 25 females; mean age 14y 6mo, standard deviation 4y 1mo) with dyskinetic CP were assessed using the Gross Motor Function Classification System (GMFCS), Manual Ability Classification System (MACS), Communication Function Classification System (CFCS), Eating and Drinking Ability Classification System (EDACS), and Viking Speech Scale (VSS), as well as the Dyskinesia Impairment Scale.

RESULTS: Over 50 per cent of the participants exhibited the highest limitation levels in GMFCS, MACS, and VSS. Better functional abilities were seen in EDACS and CFCS. Moderate to excellent interrelationship was found among the classification scales. All scales had significant correlation ( $r_s = 0.65 - 0.81$ ) with dystonia severity except for CFCS in the young people group. Finally, only MACS ( $r_s = 0.40$ ) and EDACS ( $r_s = 0.55$ ) in the young people group demonstrated significant correlation with choreoathetosis severity.

INTERPRETATION: The need for inclusion of speech, eating, and drinking in the functional assessment of dyskinetic CP is highlighted. The study further supports the strategy of managing dystonia in particular at a younger age followed by choreoathetosis in a later stage.

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### **Functional status and amount of hip displacement independently affect acetabular dysplasia in cerebral palsy.**

Chung MK , Zulkarnain A , Lee JB , Cho BC , Chung CY , Lee KM , Sung KH , Park MS .

*Dev Med Child Neurol.* 2017 Jul;59(7):743-749. doi: 10.1111/dmcn.13437. Epub 2017 Apr 22.

AIM: Acetabular dysplasia is the one of main causes of hip displacement in patients with cerebral palsy (CP). Although several studies have shown a relationship between hip displacement and acetabular dysplasia, relatively few have evaluated the association between quantitative acetabular dysplasia and related factors, such as Gross Motor Function Classification System (GMFCS) level.

METHOD: We performed a morphometric analysis of the acetabulum in patients with CP using multiplanar reformation of computed tomography data. The three directional acetabular indices (anterosuperior, superolateral, and posterosuperior) were used to evaluate acetabular dysplasia. Consequently, linear mixed-effects models were used to adjust for related factors such as age, sex, GMFCS level, and migration percentage.

RESULTS: A total of 176 patients (mean age 9y 5mo, range 2y 4mo-19y 6mo; 104 males, 72 females) with CP and 55 typically developing individuals (mean age 13y 6mo, range 2y 5mo-19y 10mo; 37 males, 18 females) in a comparison group were enrolled in this study. Statistical modelling showed that all three directional acetabular indices independently increased with GMFCS level ( $p < 0.001$ ) and migration percentage ( $p < 0.001$ ).

INTERPRETATION: Acetabular dysplasia was independently affected by both the amount of hip displacement and the GMFCS level. Thus, physicians should consider not only the migration percentage but also three-dimensional evaluation in patients at high GMFCS levels.

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### **Gait analysis: clinical facts.**

Baker R , Esquenazi A, Benedetti MG, Desloovere K.

*Eur J Phys Rehabil Med.* 2016 Aug;52(4):560-74.

Gait analysis is a well-established tool for the quantitative assessment of gait disturbances providing functional diagnosis, assessment for treatment planning, and monitoring of disease progress. There is a large volume of

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literature on the research use of gait analysis, but evidence on its clinical routine use supports a favorable cost-benefit ratio in a limited number of conditions. Initially gait analysis was introduced to clinical practice to improve the management of children with cerebral palsy. However, there is good evidence to extend its use to patients with various upper motor neuron diseases, and to lower limb amputation. Thereby, the methodology for properly conducting and interpreting the exam is of paramount relevance. Appropriateness of gait analysis prescription and reliability of data obtained are required in the clinical environment. This paper provides an overview on guidelines for managing a clinical gait analysis service and on the principal clinical domains of its application: cerebral palsy, stroke, traumatic brain injury and lower limb amputation.

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PMID: 27618499 [Indexed for MEDLINE]

### **Gross Motor Function Measure Evolution Ratio: Use as a Control for Natural Progression in Cerebral Palsy.**

Marois P , Marois M , Pouliot-Laforte A , Vanasse M , Lambert J , Ballaz L .

*Arch Phys Med Rehabil.* 2016 May;97(5):807-814.e2. doi: 10.1016/j.apmr.2015.07.024. Epub 2015 Aug 18.

**OBJECTIVE:** To develop a new way to interpret Gross Motor Function Measure (GMFM-66) score improvement in studies conducted without control groups in children with cerebral palsy (CP).

**DESIGN:** The curves, which describe the pattern of motor development according to the children's Gross Motor Function Classification System level, were used as historical control to define the GMFM-66 expected natural evolution in children with CP. These curves have been modeled and generalized to fit the curve to particular children characteristics.

**SETTING:** Research center.

**PARTICIPANTS:** Not applicable.

**INTERVENTIONS:** Not applicable.

**MEAN OUTCOME MEASURES:** Not applicable.

**RESULTS:** Assuming that the GMFM-66 score evolution followed the shape of the Rosenbaum curves, by taking into account the age and GMFM-66 score of children, the expected natural evolution of the GMFM-66 score was predicted for any group of children with CP who were <8 years old. Because the expected natural evolution could be predicted for a specific group of children with CP, the efficacy of a treatment could be determined by comparing the GMFM-66 score evolution measured before and after treatment with the expected natural evolution for the same period. A new index, the Gross Motor Function Measure Evolution Ratio, was defined as follows: Gross Motor Function Measure Evolution Ratio=measured GMFM-66 score change/expected natural evolution.

**CONCLUSIONS:** For practical or ethical reasons, it is almost impossible to use control groups in studies evaluating effectiveness of many therapeutic modalities. The Gross Motor Function Measure Evolution Ratio gives the opportunity to take into account the expected natural evolution of the gross motor function of children with CP, which is essential to accurately interpret the therapy effect on the GMFM-66.

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### **Hands Support and Postural Oscillation During Sit-to-Stand Movement in Children With Cerebral Palsy and Typical Children.**

Pavão SL , Rocha NACF .

*J Mot Behav.* 2017 Jun 23:1-8. doi: 10.1080/00222895.2017.1327410. [Epub ahead of print]

The authors aimed to compare the weight bearing on hands during sit-to-stand (STS) movement in children with cerebral palsy (CP) and typical children (TC), verify its effect on postural oscillation, and analyze the relationship between weight bearing on hands and postural oscillation. Twenty children with CP (Gross Motor Function Classification System levels I and II) and 35 TC performed STS with and without anterior hands support. Mann-Whitney test compared weight bearing between groups. Wilcoxon test investigated differences in postural oscillation between the conditions with and without anterior hand support for both groups. The Spearman correlation tested the relationship between weight-bearing and postural oscillation during the hand support condition. Children with CP bore more weight on hands than TC to perform STS. The hand support reduced postural oscillation during the second phase of STS in both groups. In the CP group, greater weight bearing was related with

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lower postural oscillation in the beginning of STS. Although children with CP were able to perform STS without support, they bore more weight on their hands to perform the task than TC. Moreover, children with CP and TC use mechanical and somatosensory information to modulate their postural control during STS in different ways.

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PMID: 28644922

### **Inertial Sensors to Assess Gait Quality in Patients with Neurological Disorders: A Systematic Review of Technical and Analytical Challenges.**

Vienne A , Barrois RP , Buffat S , Ricard D , Vidal PP .

*Front Psychol.* 2017 May 18;8:817. doi: 10.3389/fpsyg.2017.00817. eCollection 2017.

Gait disorders are major causes of falls in patients with neurological diseases. Understanding these disorders allows prevention and better insights into underlying diseases. InertiaLocoGraphy (ILG) -the quantification of gait by using inertial measurement units (IMUs) -shows great potential to address this public health challenge, but protocols vary widely and normative values of gait parameters are still unavailable. This systematic review critically compares ILG protocols, questions features extracted from inertial signals and proposes a semeiological analysis of clinimetric characteristics for use in neurological clinical routine. For this systematic review, PubMed, Cochrane and EMBASE were searched for articles assessing gait quality by using IMUs that were published from January 1, 2014 to August 31, 2016. ILG was used to assess gait in a wide range of neurological disorders - including Parkinson disease, mild cognitive impairment, Alzheimer disease, cerebral palsy, and cerebellar atrophy - as well as in the faller or frail older population and in people presenting rheumatological pathologies. However, results have not yet been driving changes in clinical practice. One reason could be that studies mainly aimed at comparing pathological gait to healthy gait, but there is stronger need for semiological descriptions of gait perturbation, severity or prognostic assessment. Furthermore, protocols used to assess gait using IMUs are too many. Likely, outcomes are highly heterogeneous and difficult to compare across large panels of studies. Therefore, homogenization is needed to foster the use of ILG to assess gait quality in neurological routine practice. The pros and cons of each protocol are emphasized so that a compromise can be reached. As well, analysis of seven complementary clinical criteria (springiness, sturdiness, smoothness, steadiness, stability, symmetry, synchronization) is advocated.

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PMCID: PMC5435996

PMID: 28572784

### **Inter- and intrarater clinician agreement on joint motion patterns during gait in children with cerebral palsy.**

Nieuwenhuys A , Papageorgiou E , Molenaers G , Monari D , de Laet T , Desloovere K .

*Dev Med Child Neurol.* 2017 Jul;59(7):750-755. doi: 10.1111/dmcn.13404. Epub 2017 Feb 22.

**AIM:** This study aimed to quantify the inter- and intrarater clinician agreement on joint motion patterns in children with spastic cerebral palsy (CP), which were recently specified by a Delphi consensus study. It also examined whether experience with three-dimensional gait analysis (3DGA) is a prerequisite for using the patterns.

**METHOD:** The experimental group consisted of 82 patients with CP (57 males, 25 females; uni-/bilateral CP [n=27/55]; Gross Motor Function Classification System levels I to III; mean age 9y 5mo [range 4y-18y]). Thirty-two clinicians were split into 'experienced' and 'inexperienced' rater groups. Each rater was asked to classify 3DGA reports of 27 or 28 patients twice. Inter- and intrarater agreement on 49 joint motion patterns was estimated using percentage of agreement and kappa statistics.

**RESULTS:** Twenty-eight raters completed both classification rounds. Intrarater agreement was 'substantial' to 'almost perfect' for all joints ( $0.64 < \kappa < 0.91$ ). Interrater agreement reached similar results ( $0.63 < \kappa < 0.86$ ), except for the knee patterns during stance ( $\kappa = 0.49$ , 'moderate agreement'). Experienced raters performed significantly better on patterns of the knee during stance and ankle during swing. **INTERPRETATION:** Apart from some specific knee patterns during stance and ankle patterns during swing, the results suggested that clinicians could use predefined joint motion patterns in CP with good confidence, even in case of limited experience with 3DGA.

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### **Interval setting selection affects ambulatory activity outputs in children with cerebral palsy.**

Stevens WR Jr , Tulchin-Francis K .

*Gait Posture*. 2017 May 23;57:69-73. doi: 10.1016/j.gaitpost.2017.05.020. [Epub ahead of print]

**INTRODUCTION:** Accelerometer based devices have been widely used to assess the ambulatory activity of children with and without functional disabilities. Many researchers who utilize the StepWatch Activity Monitor (SAM) collect at a 60second (60sec) interval setting. The purpose of this study was to assess the effect of SAM interval settings on ambulatory activity outputs in children with cerebral palsy (CP) and typically developing youth.

**METHODS:** Participants wore a SAM which recorded the number of strides every 10seconds (10s) for one week. Raw 10s data was downsampled to combine strides into 60sec intervals. Strides were ensembled into walking bouts with the Intensity/Duration calculated as a percentage of Total Ambulatory Time (TAT).

**RESULTS:** Twenty-eight children with CP (14 boys; avg. 12 yrs. 4 mths.; GMFCS Level I n=4, Level II n=19, Level III n=5) completed testing and 28 age matched typically developing youth (14 boys; avg. 12 yrs. 6 mths.) were included. Using the 10sec interval, ~80% of walking bouts in both groups were less than or equal to 60s. Data recorded at 60sec intervals had higher daily TAT but fewer walking bouts. In children with CP, daily steps were higher using the 60sec interval. At the Easy intensity, the 60sec interval reported an increased volume of Long duration walking, and it rarely identified any Moderate+ intensity activity. **CONCLUSIONS:** 60sec interval data overestimated low intensity and long duration ambulatory activity. It is imperative that investigators choose a finer interval setting (10sec) to maximize the detection of gait transitions and rest periods which are critical in describing community ambulation of patients with cerebral palsy.

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PMID: 28578136

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### **Pathological and physiological muscle co-activation during active elbow extension in children with unilateral cerebral palsy.**

Sarcher A , Raison M , Leboeuf F , Perrouin-Verbe B , Brochard S , Gross R .

*Clin Neurophysiol*. 2017 Jan;128(1):4-13. doi: 10.1016/j.clinph.2016.10.086. Epub 2016 Oct 29.

**OBJECTIVE:** To address the roles and mechanisms of co-activation in two flexor/extensor pairs during elbow extension in children with cerebral palsy (CP).

**METHODS:** 13 Typically Developing (TD) and 13 children with unilateral spastic CP performed elbow extension/flexion at different speeds. Elbow angle and velocity were recorded using a 3D motion analysis system. The acceleration and deceleration phases of extension were analyzed. Co-activation of the brachioradialis/triceps and biceps/triceps pairs was computed for each phase from surface electromyographic signals. Statistical analysis involved linear mixed effects models and Spearman rank correlations.

**RESULTS:** During the acceleration phase, there was strong co-activation in both muscle pairs in the children with CP, which increased with speed. Co-activation was weak in the TD children and it was not speed-dependent. During the deceleration phase, co-activation was strong and increased with speed in both groups; co-activation of brachioradialis/triceps was stronger in children with CP, and was negatively correlated with extension range and positively correlated with flexor spasticity.

**CONCLUSIONS:** Abnormal patterns of co-activation in children with CP were found throughout the entire movement. Co-activation was specific to the movement phase and to each flexor muscle.

**SIGNIFICANCE:** Co-activation in children with CP is both physiological and pathological. Copyright © 2016 International Federation of Clinical Neurophysiology. Published by Elsevier Ireland Ltd. All rights reserved.

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PMID: 27866118 [Indexed for MEDLINE]

### **Perspectives on classification of selected childhood neurodisabilities based on a review of literature.**

Jeevanantham D , Bartlett D .

*Dev Neurorehabil*. 2017 May;20(4):194-206. doi: 10.3109/17518423.2016.1139009. Epub 2016 Apr 8.

**PURPOSE:** Classifying children with heterogeneous health conditions is challenging. The purposes of this perspective are to explore the prevailing classifications in children with the three selected neurodisabilities using the underlying framework of ICF/ICF-CY, explore the utility of the identified classifications, and make recommendations aimed at improving classifications.

**METHODS:** A literature search on six databases and Google was conducted. Articles published between the years 2000 and 2013 were included if they provided information on classification of cerebral palsy (CP), and/or developmental coordination disorder (DCD) and/or autism spectrum disorders (ASD).

**RESULTS:** Children with DCD and ASD are classified using combinations of multiple measures. The classifications in CP meet more of the proposed criteria for utility than those in DCD and ASD.

**CONCLUSION:** None of the existing classifications addressed all the criteria. The heterogeneity associated with the selected neurodisabilities poses major challenges. Further work is required to establish improved classifications.

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PMID: 27057781 [Indexed for MEDLINE]

### **Physical strain: a new perspective on walking in cerebral palsy.**

Balemans AC , Bolster E , Brehm MA , Dallmeijer AJ .

*Arch Phys Med Rehabil.* 2017 Jun 5. pii: S0003-9993(17)30380-5. doi: 10.1016/j.apmr.2017.05.004. [Epub ahead of print]

**OBJECTIVE:** The objectives of this study in children and adolescents with cerebral palsy (CP) were to 1) describe physical strain of walking, 2) describe the proportion of participants walking above the anaerobic threshold and 3) describe 4 phenotypes of physical strain of walking based on deviations in aerobic capacity and walking energy cost (EC).

**DESIGN:** Cohort **SETTING:** Academic medical center **PARTICIPANTS:** Thirty-seven participants (13y5mo(4y0mo)) with CP (Gross Motor Function Classification System (GMFCS) levels I[n=13], II[N=17] and III[N=7]) and 20 typically developing participants (TD) (11y8mo(3y5mo)).

**INTERVENTIONS:** Not applicable **MAIN OUTCOME MEASURE(S):** Oxygen consumption (VO<sub>2</sub>walk), speed and EC were determined during walking at comfortable speed. Peak oxygen uptake (VO<sub>2</sub>peak) and anaerobic threshold were measured during a maximal cycling exercise test. Aerobic capacity was decreased if <10(th) percentile and EC was increased if >3SD's. Physical strain was defined as [VO<sub>2</sub>walk/VO<sub>2</sub>peak]\*100. **RESULTS:** Participants with CP had a higher physical strain (GMFCS levels I:55±12%, II:62±17% and III:78±14%) than TD (40±11%, p<0.001). 43% of the participants with CP showed a VO<sub>2</sub>walk at or higher than their anaerobic threshold compared to 10% in TD (p=0.007). Phenotypes showed that a decreased VO<sub>2</sub>peak [N=9] or an increased EC [N=9] lead to 18-20% higher physical strain, while a combination [N=12] leads to 40% increase.

**CONCLUSIONS:** Children and adolescents with CP walk at a high physical strain, approximating intense exercise and a considerable part walks around or above their anaerobic threshold, probably explaining fatigue and reduced walking distance. Both an increased EC and/or a decreased VO<sub>2</sub>peak contribute to high physical strain in children or adolescents with CP. The different causes of high physical strain in CP require different intervention strategies.

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PMID: 28596080

### **Psychometric evaluation of the Posture and Postural Ability Scale for children with cerebral palsy.**

Rodby-Bousquet E , Persson-Bunke M , Czuba T .

*Clin Rehabil.* 2016 Jul;30(7):697-704. doi: 10.1177/0269215515593612. Epub 2015 Jun 30.

**OBJECTIVE:** To evaluate construct validity, internal consistency and inter-rater reliability of the Posture and Postural Ability Scale for children with cerebral palsy.

**DESIGN:** Evaluation of psychometric properties.

**SETTING:** Five child rehabilitation centres in the south of Sweden, in November 2013 to March 2014.

**SUBJECTS:** A total of 29 children with cerebral palsy (15 boys, 14 girls), 6-16 years old, classified at Gross Motor Function Classification System (GMFCS) levels II (n = 10), III (n = 7), IV (n = 6) and V (n = 6). **MAIN MEASURES:** Three

independent raters (two physiotherapists and one orthopaedic surgeon) assessed posture and postural ability of all children in supine, prone, sitting and standing positions, according to the Posture and Postural Ability Scale. Construct validity was evaluated based on averaged values for the raters relative to known-groups in terms of GMFCS levels. Internal consistency was analysed with Cronbach's alpha and corrected Item-Total correlation. Inter-rater reliability was calculated using weighted kappa scores.

**RESULTS:** The Posture and Postural Ability Scale showed construct validity and median values differed between GMFCS levels ( $p < 0.01$ ). There was a good internal consistency ( $\alpha = 0.95-0.96$ ; item-total correlation =  $0.55-0.91$ ), and an excellent inter-rater reliability (kappa score =  $0.77-0.99$ ).

**CONCLUSION:** The Posture and Postural Ability Scale shows high psychometric properties for children with cerebral palsy, as previously seen when evaluated for adults. It enables detection of postural deficits and asymmetries indicating potential need for support and where it needs to be applied.

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DOI: 10.1177/0269215515593612

PMID: 26130659 [Indexed for MEDLINE]

### **Real-time ultrasound elastography of the Achilles tendon in patients with cerebral palsy: is there a correlation between strain ratio and biomechanical indicators?**

Öztürk M , Sayinbatur B .

*J Med Ultrason (2001)*. 2017 Jun 27. doi: 10.1007/s10396-017-0800-y. [Epub ahead of print]

**PURPOSE:** Our aim was to comparatively investigate the strain ratio and thickness of the Achilles tendon in children with cerebral palsy (CP), and to elucidate whether there is a correlation between biomechanical features of the Achilles tendon and strain ratio.

**METHODS:** A total of 155 participants (72 CP patients and 83 healthy controls) who underwent real-time elastography of both Achilles tendons were studied. A linear transducer (4.8-11.0 MHz) was used to obtain the images. Correlation analysis between age, length, and thickness of the Achilles tendon, and strain ratio (SR) was performed by means of Pearson correlation and Spearman's rho tests.

**RESULTS:** Comparison of results obtained from CP patients and controls showed that the length of the Achilles tendon was shorter ( $p < 0.001$ ) and SR was higher ( $p < 0.001$ ) in CP patients. In CP patients, there was a positive correlation between SR and age and between SR and the thickness and length of the Achilles tendon ( $p < 0.001$  for all). Furthermore, the length of the tendon and age were positively associated ( $p < 0.001$ ). ROC analysis revealed that the cut-off value for SR was 1.89.

**CONCLUSION:** The results of the present study demonstrated that real-time elastography can constitute a simple, practical, and noninvasive method for evaluation of the elasticity of the Achilles tendon in children with CP.

DOI: 10.1007/s10396-017-0800-y

PMID: 28656513

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

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

*Dev Med Child Neurol*. 2017 May 29. doi: 10.1111/dmcn.13465. [Epub ahead of print]

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

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

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

**INTERPRETATION:** Ad-AHA scores are consistent across different raters and occasions. The good alternate-form reliability indicates that the different test activities can be used interchangeably in adolescents with unilateral CP.



Differences greater than or equal to 5 AHA-units can be considered a change beyond measurement error. The use of logit based AHA-units makes change comparable for persons at different ability levels.

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PMID: 28555755

### **Reliability, validity, and norms of the 2-min walk test in children with and without neuromuscular disorders aged 6-12.**

Pin TW , Choi HL .

*Disabil Rehabil.* 2017 Mar 3:1-7. doi: 10.1080/09638288.2017.1294208. [Epub ahead of print]

**PURPOSE:** The 2-min walk test may be more appropriate functional exercise test for young children. This study aimed to examine the 2-min walk test's reliability; validity; and minimal clinically important difference; and to establish norms for children aged 6-12.

**METHODS:** Sixty-one healthy children were recruited to examine the 2-min walk test's reliability. Forty-six children with neuromuscular disorders (63% cerebral palsy) were recruited to test the validity. The normative study involved 716 healthy children without neuromuscular disorders (male = 51%, female = 49%). They walked at a self-selected speed for 2 min along a smooth, flat path 15 m in length.

**RESULTS:** The mean distance covered in the 2-min walk test was 152.8 m (SD =27.5). No significant difference was found in the children's test-retest results ( $p > 0.05$ ). The intra- and inter-rater reliability were high (all intra-class correlation coefficients  $>0.8$ ). All children, except one with neuromuscular disorders, completed the 2-min walk test, of which the minimal clinically important difference at 95% confidence interval was 23.2 m for the entire group, 15.7 m for children walking with aids, and 16.6 m for those walking independently.

**CONCLUSIONS:** The 2-min walk test is a feasible, reliable, and valid exercise test for children with and without neuromuscular disorders aged 6-12. The first normative references and minimal clinically important difference for children with neuromuscular disorders were established for children of this age group. Implications for rehabilitation The 2-min walk test is a feasible, safe, reliable, and valid time-based walk test for children aged 6-12 years. Normative references have been established for healthy children aged 6-12 years. Minimal clinically important difference at 95% confidence interval were calculated for children with neuromuscular disorders who walked without aids (i.e., independent and stand-by supervision) and those who walked with aids equal to 16.6 and 15.7 m, respectively. Distance covered by the healthy children in the 2 min did not correlate with age, gender, height, and weight of the children.

DOI: 10.1080/09638288.2017.1294208

PMID: 28637155

### **Short-term balance training with computer-based feedback in children with cerebral palsy: A feasibility and pilot randomized trial.**

Saxena S , Rao BK , Senthil KD .

*Dev Neurorehabil.* 2017 Apr;20(3):115-120. doi: 10.3109/17518423.2015.1116635. Epub 2016 Feb 18.

**OBJECTIVE:** To assess the feasibility of using short-term balance training with computer-based visual feedback (BTVF) and its effect on standing balance in children with bilateral spastic cerebral palsy (BSCP).

**METHODS:** Out of the fourteen children with BSCP (mean age = 10.31 years), seven children received four sessions of BTVF (two such sessions/day, each session = 15 min) in comparison to the control group that received standard care. Feasibility was measured as percentages of recruitment, retention and safety and balance was measured using a posturography machine as sway velocity (m/s) and velocity moment (m/s(2)) during quiet standing.

**RESULTS:** No serious adverse events occurred in either group. There were no differences in the retention percentages and in any clinical outcome measure between both groups. **CONCLUSION:** Use of BTVF is feasible in children with BSCP but further investigation is required to estimate a dose-effect relationship.

DOI: 10.3109/17518423.2015.1116635

PMID: 26889691 [Indexed for MEDLINE]

## **Spasticity Measurement Based on Tonic Stretch Reflex Threshold in Children with Cerebral Palsy Using the PediAnklebot.**

Germanotta M , Taborri J , Rossi S , Frascarelli F , Palermo E , Cappa P , Castelli E , Petrarca M .  
*Front Hum Neurosci.* 2017 May 29;11:277. doi: 10.3389/fnhum.2017.00277. eCollection 2017.

Nowadays, objective measures are becoming prominent in spasticity assessment, to overcome limitations of clinical scales. Among others, Tonic Stretch Reflex Threshold (TSRT) showed promising results. Previous studies demonstrated the validity and reliability of TSRT in spasticity assessment at elbow and ankle joints in adults. Purposes of the present study were to assess: (i) the feasibility of measuring TSRT to evaluate spasticity at the ankle joint in children with Cerebral Palsy (CP), and (ii) the correlation between objective measures and clinical scores. A mechatronic device, the pediAnklebot, was used to impose 50 passive stretches to the ankle of 10 children with CP and 3 healthy children, to elicit muscles response at 5 different velocities. Surface electromyography, angles, and angular velocities were recorded to compute dynamic stretch reflex threshold; TSRT was computed with a linear regression through angles and angular velocities. TSRTs for the most affected side of children with CP resulted into the biomechanical range ( $95.7 \pm 12.9^\circ$  and  $86.7 \pm 17.4^\circ$  for Medial and Lateral Gastrocnemius, and  $75.9 \pm 12.5^\circ$  for Tibialis Anterior). In three patients, the stretch reflex was not elicited in the less affected side. TSRTs were outside the biomechanical range in healthy children. However, no correlation was found between clinical scores and TSRT values. Here, we demonstrated the capability of TSRT to discriminate between spastic and non-spastic muscles, while no significant outcomes were found for the dorsiflexor muscle.

### **Free PMC Article**

DOI: 10.3389/fnhum.2017.00277

PMCID: PMC5447033

PMID: 28611612

## **Stability of the Gross Motor Function Classification System in children and adolescents with cerebral palsy: a retrospective cohort registry study.**

Alriksson-Schmidt A , Nordmark E , Czuba T , Westbom L .

*Dev Med Child Neurol.* 2017 Jun;59(6):641-646. doi: 10.1111/dmcn.13385. Epub 2017 Jan 13.

**AIM:** To investigate the stability and to determine factors that affect change in the Gross Motor Function Classification System (GMFCS) in a sample from the total population with cerebral palsy (CP) in two regions of Sweden.

**METHOD:** Retrospective cohort registry study based on the follow-up programme for CP. Children with CP and a minimum of two GMFCS ratings were included. Subtype, sex, ages at GMFCS ratings, time between ratings, number of ratings, assessor change, and birth cohort were analysed in relation to initial GMFCS levels, with descriptive statistics and logistic regression models.

**RESULTS:** Ninety-three per cent (n=736) of children with CP born between 1990 and 2007 were included, resulting in 7922 assessments between 1995 and 2014. Fifty-six per cent of the children received the same GMFCS rating at all assessments, with a median of 11 individual GMFCS ratings (range 2-21) and a median of three different assessors (range 1-10). Changes were often transient; downward change (higher performance) was more likely in GMFCS levels II and III than in the other levels. The probability of upward change (lower performance) was lowest in unilateral spastic CP.

**INTERPRETATION:** The results support the stability of the GMFCS shown previously and add new information on the properties of the classification.

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DOI: 10.1111/dmcn.13385

PMID: 28083887 [Indexed for MEDLINE]

## **The association between the maximum step length test and the walking efficiency in children with cerebral palsy.**

Kimoto M , Okada K , Sakamoto H , Kondou T .

*J Phys Ther Sci.* 2017 May;29(5):822-827. doi: 10.1589/jpts.2017.822. Epub 2017 May 16.

[Purpose] To improve walking efficiency could be useful for reducing fatigue and extending possible period of walking in children with cerebral palsy (CP). For this purpose, current study compared conventional parameters of

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gross motor performance, step length, and cadence in the evaluation of walking efficiency in children with CP. [Subjects and Methods] Thirty-one children with CP (21 boys, 10 girls; mean age, 12.3 ± 2.7 years) participated. Parameters of gross motor performance, including the maximum step length (MSL), maximum side step length, step number, lateral step up number, and single leg standing time, were measured in both dominant and non-dominant sides. Spatio-temporal parameters of walking, including speed, step length, and cadence, were calculated. Total heart beat index (THBI), a parameter of walking efficiency, was also calculated from heartbeats and walking distance in 10 minutes of walking. To analyze the relationships between these parameters and the THBI, the coefficients of determination were calculated using stepwise analysis. [Results] The MSL of the dominant side best accounted for the THBI ( $R^2=0.759$ ). [Conclusion] The MSL of the dominant side was the best explanatory parameter for walking efficiency in children with CP.

[Free PMC Article](#)

DOI: 10.1589/jpts.2017.822

PMCID: PMC5462680

PMID: 28603353

### **The Sarah evaluation scale for children and adolescents with cerebral palsy: description and results.**

Pinto KS , Carvalho CG , Nakamoto L , Nunes LG .

*Braz J Phys Ther.* 2016 Mar 22;20(3):267-74. doi: 10.1590/bjpt-rbf.2014.0156.

**BACKGROUND:** Assessments of motor-functional aspects in cerebral palsy are crucial to rehabilitation programs.

**OBJECTIVE:** To introduce the Sarah motor-functional evaluation scale and to report the initial results of its measurement properties. This scale was created based on the experience of the Sarah Network of Rehabilitation Hospitals in the care of children and adolescents with cerebral palsy.

**METHOD:** Preliminary results concerning the measurement properties of the scale were obtained via assessment of 76 children and adolescents with cerebral palsy. Experts' opinions were used to determine an expected empirical score by age group and to differentiate severity levels.

**RESULTS:** The scale exhibited a high Cronbach's alpha coefficient (0.95). Strong correlation was observed with experts' classification for severity levels (0.81 to 0.97) and with the scales Gross Motor Function Measure and Pediatric Evaluation of Disability Inventory (0.80 to 0.98). Regression analysis detected a significant relationship between the scale score and the severity of the child's motor impairment. The inter-rater reliability was also strong (intraclass correlation coefficient ranging from 0.98 to 0.99). The internal responsiveness of the scale score was confirmed by significant differences between longitudinal evaluations (paired Student's t test with  $p<0.01$ ; standardized response mean of 0.60).

**CONCLUSION:** The Sarah scale provides a valid measure for assessing the motor skills and functional performance of children and adolescents with cerebral palsy. The preliminary results showed that the Sarah scale has potential for use in routine clinical practice and rehabilitation units.

DOI: 10.1590/bjpt-rbf.2014.0156

PMCID: PMC4946843

PMID: 27437718 [Indexed for MEDLINE]

### **The Influence of the Unaffected Hip on Gait Kinematics in Patients With Hemiplegic Cerebral Palsy.**

Tretiakov M , Do KP, Aiona M.

*J Pediatr Orthop.* 2017 Apr/May;37(3):217-221. doi: 10.1097/BPO.0000000000000620.

**BACKGROUND:** Hemiplegic cerebral palsy (HCP) patients have transverse-plane gait deviations that may include the "uninvolved" side. The aim of this study is to quantify the static rotational profile, the dynamic position during gait and determine whether any correlations between the involved and uninvolved side exist.

**METHODS:** A total of 171 subjects that met the inclusion criteria of HCP and no prior history of bony surgery were reviewed. Clinical and gait measurements were analyzed and compared between subjects and a population of typically developing (TD) children.

**RESULTS:** Among children with HCP, static internal hip rotation of the affected limb was strongly correlated to static internal hip rotation on the unaffected limb ( $r=0.543$ ,  $P<0.0001$ ). There were 100 patients with maximum static internal rotation  $\geq 66\%$  of the total arc of motion in the affected hip. These subjects showed significant differences of static range of motion measures of the affected hip compared with TD. They also showed statistical significant

differences between the dynamic measures of the affected limb of HCP and TD for mean pelvic rotation, mean hip rotation, and mean knee progression. In these 100 subjects, 23 patients had a maximum static internal rotation  $\geq 66\%$  of the total arc of motion on the unaffected hip and there were 77 subjects with  $< 66\%$  static internal rotation. Pelvic rotation and hip rotation were statistically different between these 2 groups, but knee progression angle was not significant.

**CONCLUSIONS:** The "unaffected" side in patients with HCP influence gait kinematics. If static internal hip rotation exceeds 66% of the total arc of motion, almost all studied static and gait parameters were abnormal in HCP children, regardless if it was the affected side. Compensations on the "unaffected" side seem to be somewhat limited if the anatomic alignment is significantly asymmetric. This may be 1 reason pelvic transverse-plane changes after femoral rotation osteotomy are unpredictable.

**LEVEL OF EVIDENCE:** Level II.

DOI: 10.1097/BPO.0000000000000620

PMID: 28278135 [Indexed for MEDLINE]

### **Electromyography Data Processing Impacts Muscle Synergies during Gait for Unimpaired Children and Children with Cerebral Palsy.**

Shuman BR , Schwartz MH , Steele KM .

*Front Comput Neurosci.* 2017 Jun 6;11:50. doi: 10.3389/fncom.2017.00050. eCollection 2017.

Muscle synergies calculated from electromyography (EMG) data identify weighted groups of muscles activated together during functional tasks. Research has shown that fewer synergies are required to describe EMG data of individuals with neurologic impairments. When considering potential clinical applications of synergies, understanding how EMG data processing impacts results and clinical interpretation is important. The aim of this study was to evaluate how EMG signal processing impacts synergy outputs during gait. We evaluated the impacts of two common processing steps for synergy analyses: low pass (LP) filtering and unit variance scaling. We evaluated EMG data collected during barefoot walking from five muscles of 113 children with cerebral palsy (CP) and 73 typically-developing (TD) children. We applied LP filters to the EMG data with cutoff frequencies ranging from 4 to 40 Hz (reflecting the range reported in prior synergy research). We also evaluated the impact of normalizing EMG amplitude by unit variance. We found that the total variance accounted for (tVAF) by a given number of synergies was sensitive to LP filter choice and decreased in both TD and CP groups with increasing LP cutoff frequency (e.g., 9.3 percentage points change for one synergy between 4 and 40 Hz). This change in tVAF can alter the number of synergies selected for further analyses. Normalizing tVAF to a z-score (e.g., dynamic motor control index during walking, walk-DMC) reduced sensitivity to LP cutoff. Unit variance scaling caused comparatively small changes in tVAF. Synergy weights and activations were impacted less than tVAF by LP filter choice and unit variance normalization. These results demonstrate that EMG signal processing methods impact outputs of synergy analysis and z-score based measures can assist in reporting and comparing results across studies and clinical centers.

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DOI: 10.3389/fncom.2017.00050

PMCID: PMC5460588

PMID: 28634449

## **Cognition**

### **Intelligence, Functioning, and Related Factors in Children with Cerebral Palsy.**

Türkoğlu G , Türkoğlu S , Çelik C , Uçan H .

*Noro Psikiyatr Ars.* 2017 Mar;54(1):33-37. doi: 10.5152/npa.2015.12676. Epub 2017 Mar 1.

**INTRODUCTION:** Cerebral palsy (CP) is the most common significant motor impairment in childhood. CP is defined as a primary disorder of posture and movement; however, intellectual impairment is prevalent in children with CP. The purpose of this study was to examine the intelligence level associated with gross motor function and hand function, type of CP, the presence of comorbid disorders such as epilepsy, and other factors.

**METHODS:** In total, 107 children with CP were included. Age, gender, prenatal/natal/postnatal risk factors, type of CP, and presence of other neurodevelopmental disorders were recorded as demographic findings. Intellectual

functions of the patients were determined by clinical assessment, adaptive function of daily life, and individualized, standardized intelligence testing. The gross motor function and hand function of the patients were classified using the "Gross Motor Function Classification System" and "Bimanual Fine Motor Function" measurements, respectively. RESULTS: The mean age of the patients was 8.10±3.43 years (2-16 years). The study included 63 (58.9%) male patients and 44 (41.1%) female patients. During clinical typing, 80.4% of the patients were spastic, 11.2% were mixed, 4.7% were dyskinetic, and 3.7% were ataxic. Intellectual functioning tests found 26.2% of the children within the intellectual norm and that 10% of the children had a borderline intellectual disability, 16% of them had a mild intellectual disability, 17% of them had a moderate intellectual disability, and 30.8% of them had a severe intellectual disability. No significant relationship was determined between the CP type and intellectual functioning ( $p>0.05$ ). Intellectual functioning was found to be significantly correlated with hand functions and motor levels ( $p<0.001$ ). Factors related with intellectual functioning were neonatal convulsion, epilepsy, and speech disorders. CONCLUSION: Intelligence assessment should be an essential part of CP evaluation and research. There is not enough reliable knowledge, unanimity regarding validity data, and population-specific norms in the intelligence assessments of children with CP. Research is required to assess properly intelligence for children with CP.

### [Free PMC Article](#)

DOI: 10.5152/npa.2015.12676

PMCID: PMC5439469

PMID: 28566956

Conflict of interest statement: Conflict of Interest: No conflict of interest was declared by the authors.

### **Whole-brain structural connectivity in dyskinetic cerebral palsy and its association with motor and cognitive function.**

Ballester-Plané J, Schmidt R, Laporta-Hoyos O, Junqué C, Vázquez É, Delgado I, Zubiaurre-Elorza L, Macaya A, Póo P, Toro E, de Reus MA, van den Heuvel MP, Pueyo R.  
*Hum Brain Mapp.* 2017 Jun 13. doi: 10.1002/hbm.23686. [Epub ahead of print]

Dyskinetic cerebral palsy (CP) has long been associated with basal ganglia and thalamus lesions. Recent evidence further points at white matter (WM) damage. This study aims to identify altered WM pathways in dyskinetic CP from a standardized, connectome-based approach, and to assess structure-function relationship in WM pathways for clinical outcomes. Individual connectome maps of 25 subjects with dyskinetic CP and 24 healthy controls were obtained combining a structural parcellation scheme with whole-brain deterministic tractography. Graph theoretical metrics and the network-based statistic were applied to compare groups and to correlate WM state with motor and cognitive performance. Results showed a widespread reduction of WM volume in CP subjects compared to controls and a more localized decrease in degree (number of links per node) and fractional anisotropy (FA), comprising parieto-occipital regions and the hippocampus. However, supramarginal gyrus showed a significantly higher degree. At the network level, CP subjects showed a bilateral pathway with reduced FA, comprising sensorimotor, intraparietal and fronto-parietal connections. Gross and fine motor functions correlated with FA in a pathway comprising the sensorimotor system, but gross motor also correlated with prefrontal, temporal and occipital connections. Intelligence correlated with FA in a network with fronto-striatal and parieto-frontal connections, and visuoperception was related to right occipital connections. These findings demonstrate a disruption in structural brain connectivity in dyskinetic CP, revealing general involvement of posterior brain regions with relative preservation of prefrontal areas. We identified pathways in which WM integrity is related to clinical features, including but not limited to the sensorimotor system. *Hum Brain Mapp*, 2017. © 2017 Wiley Periodicals, Inc.

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DOI: 10.1002/hbm.23686

PMID: 28608616

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

### **Exercise interventions for cerebral palsy.**

Ryan JM, Cassidy EE, Noorduyn SG, O'Connell NE.

**BACKGROUND:** Cerebral palsy (CP) is a neurodevelopmental disorder resulting from an injury to the developing brain. It is the most common form of childhood disability with prevalence rates of between 1.5 and 3.8 per 1000 births reported worldwide. The primary impairments associated with CP include reduced muscle strength and reduced cardiorespiratory fitness, resulting in difficulties performing activities such as dressing, walking and negotiating stairs. Exercise is defined as a planned, structured and repetitive activity that aims to improve fitness, and it is a commonly used intervention for people with CP. Aerobic and resistance training may improve activity (i.e. the ability to execute a task) and participation (i.e. involvement in a life situation) through their impact on the primary impairments of CP. However, to date, there has been no comprehensive review of exercise interventions for people with CP.

**OBJECTIVES:** To assess the effects of exercise interventions in people with CP, primarily in terms of activity, participation and quality of life. Secondary outcomes assessed body functions and body structures. Comparators of interest were no treatment, usual care or an alternative type of exercise intervention.

**SEARCH METHODS:** In June 2016 we searched CENTRAL, MEDLINE, Embase, nine other databases and four trials registers.

**SELECTION CRITERIA:** We included randomised controlled trials (RCTs) and quasi-RCTs of children, adolescents and adults with CP. We included studies of aerobic exercise, resistance training, and 'mixed training' (a combination of at least two of aerobic exercise, resistance training and anaerobic training).

**DATA COLLECTION AND ANALYSIS:** Two review authors independently screened titles, abstracts and potentially relevant full-text reports for eligibility; extracted all relevant data and conducted 'Risk of bias' and GRADE assessments.

**MAIN RESULTS:** We included 29 trials (926 participants); 27 included children and adolescents up to the age of 19 years, three included adolescents and young adults (10 to 22 years), and one included adults over 20 years. Males constituted 53% of the sample. Five trials were conducted in the USA; four in Australia; two in Egypt, Korea, Saudi Arabia, Taiwan, the Netherlands, and the UK; three in Greece; and one apiece in India, Italy, Norway, and South Africa. Twenty-six trials included people with spastic CP only; three trials included children and adolescents with spastic and other types of CP. Twenty-one trials included people who were able to walk with or without assistive devices, four trials also included people who used wheeled mobility devices in most settings, and one trial included people who used wheeled mobility devices only. Three trials did not report the functional ability of participants. Only two trials reported participants' manual ability. Eight studies compared aerobic exercise to usual care, while 15 compared resistance training and 4 compared mixed training to usual care or no treatment. Two trials compared aerobic exercise to resistance training. We judged all trials to be at high risk of bias overall. We found low-quality evidence that aerobic exercise improves gross motor function in the short term (standardised mean difference (SMD) 0.53, 95% confidence interval (CI) 0.02 to 1.04, N = 65, 3 studies) and intermediate term (mean difference (MD) 12.96%, 95% CI 0.52% to 25.40%, N = 12, 1 study). Aerobic exercise does not improve gait speed in the short term (MD 0.09 m/s, 95% CI -0.11 m/s to 0.28 m/s, N = 82, 4 studies, very low-quality evidence) or intermediate term (MD -0.17 m/s, 95% CI -0.59 m/s to 0.24 m/s, N = 12, 1 study, low-quality evidence). No trial assessed participation or quality of life following aerobic exercise. We found low-quality evidence that resistance training does not improve gross motor function (SMD 0.12, 95% CI -0.19 to 0.43, N = 164, 7 studies), gait speed (MD 0.03 m/s, 95% CI -0.02 m/s to 0.07 m/s, N = 185, 8 studies), participation (SMD 0.34, 95% CI -0.01 to 0.70, N = 127, 2 studies) or parent-reported quality of life (MD 12.70, 95% CI -5.63 to 31.03, n = 12, 1 study) in the short term. There is also low-quality evidence that resistance training does not improve gait speed (MD -0.03 m/s, 95% CI -0.17 m/s to 0.11 m/s, N = 84, 3 studies), gross motor function (SMD 0.13, 95% CI -0.30 to 0.55, N = 85, 3 studies) or participation (MD 0.37, 95% CI -6.61 to 7.35, N = 36, 1 study) in the intermediate term. We found low-quality evidence that mixed training does not improve gross motor function (SMD 0.02, 95% CI -0.29 to 0.33, N = 163, 4 studies) or gait speed (MD 0.10 m/s, -0.07 m/s to 0.27 m/s, N = 58, 1 study) but does improve participation (MD 0.40, 95% CI 0.13 to 0.67, N = 65, 1 study) in the short-term. There is no difference between resistance training and aerobic exercise in terms of the effect on gross motor function in the short term (SMD 0.02, 95% CI -0.50 to 0.55, N = 56, 2 studies, low-quality evidence). Thirteen trials did not report adverse events, seven reported no adverse events, and nine reported non-serious adverse events. **AUTHORS' CONCLUSIONS:** The quality of evidence for all conclusions is low to very low. As included trials have small sample sizes, heterogeneity may be underestimated, resulting in

considerable uncertainty relating to effect estimates. For children with CP, there is evidence that aerobic exercise may result in a small improvement in gross motor function, though it does not improve gait speed. There is evidence that resistance training does not improve gait speed, gross motor function, participation or quality of life among children with CP. Based on the evidence available, exercise appears to be safe for people with CP; only 55% of trials, however, reported adverse events or stated that they monitored adverse events. There is a need for large, high-quality, well-reported RCTs that assess the effectiveness of exercise in terms of activity and participation, before drawing any firm conclusions on the effectiveness of exercise for people with CP. Research is also required to determine if current exercise guidelines for the general population are effective and feasible for people with CP.

DOI: 10.1002/14651858.CD011660.pub2

PMID: 28602046

### **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 Jun 2. doi: 10.1111/dmcn.13480. [Epub ahead of print]

**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.

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DOI: 10.1111/dmcn.13480

PMID: 28574172

### **Recommendations for the rehabilitation of children with cerebral palsy. Je l'aurais mis au début de Traitement Rééducation Motrice**

Castelli E , Fazzi E; SIMFER-SINPIA Intersociety Commission.

*Eur J Phys Rehabil Med.* 2016 Oct;52(5):691-703. Epub 2015 Dec 1.

The SINPIA-SIMFER (Italian Society of Child and Adolescent Neuropsychiatry -Italian Society of Physical Medicine and Rehabilitation) Intersociety Commission was set up in December 2000 and is composed of members from both scientific societies, who are experts in the field of rehabilitation of patients with cerebral palsy (CP). In accordance with the indications of the Italian Health Ministry's Planning Department, in 1999 this Commission was entrusted with the task of drawing up "Guidelines for the Rehabilitation of Children Affected by Cerebral Palsy", and to successively revise and update it every five years. The present document is a summary of the latest update, drawn up through meetings of the Intersociety Commission, held in 2012 and 2013, and discussed and approved at the annual SINPIA-SIMFER meeting held in Brindisi in October 2013. The current version of the Recommendations extends and updates the previous one, also addressing new areas of intervention and adding some in-depth analysis. The document as a whole is not so much a proposal for treatment updated on the basis of advancing knowledge in the field of rehabilitation of CP, as a presentation of the method that should be applied by professionals seeking to define the most appropriate intervention and treatment strategies. The text is the offspring of a process of careful exchanges, which have been conducted in a collegial and collaborative fashion among professionals working in different fields (rehabilitation medicine and child neuropsychiatry) and in healthcare settings at different levels (ranging from first-level local settings to third-level national ones) and of different types (affiliated outpatient clinics and centers, local health authorities, hospitals, "IRCCS" research hospitals, universities).

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## Free Article

PMID: 26629842 [Indexed for MEDLINE]

### **Spasticity Video Challenge: A Look at Methods for Addressing Difficult Cases.**

Alter KE , Gormley M Jr , Patel AT .

*PM R. 2017 Jun 19. pii: S1934-1482(17)30669-X. doi: 10.1016/j.pmrj.2017.06.012.Epub ahead of print]*

As seen in this CME online activity (available at <http://courses.elseviercme.com/spasticity/662e>), treatment of patients with spasticity due to upper motor neuron syndromes, including traumatic brain injury, stroke, and cerebral palsy, is multifaceted, involving chemodenervation, systemic medications, surgical therapy, rehabilitation efforts, and home care. Optimal care begins with the recognition that each patient's impairments are unique and must be assessed carefully to determine the impact of muscle overactivity, loss of dexterity, and weakness on passive and active function in the context of the patients' goals. While botulinum toxin plays a major role in providing symptomatic relief and functional improvement from hypertonia, it should rarely be used as a standalone treatment. Copyright © 2017 American Academy of Physical Medicine and Rehabilitation.

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DOI: 10.1016/j.pmrj.2017.06.012

PMID: 28634003

### **Pharmacologie Efficacite Tolérance**

#### **AbobotulinumtoxinA: A Review in Pediatric Lower Limb Spasticity.**

Syed YY .

*Paediatr Drugs. 2017 Jun 16. doi: 10.1007/s40272-017-0242-4. [Epub ahead of print]*

AbobotulinumtoxinA (Dysport®) is currently the only botulinum toxin A formulation approved by the US FDA for the treatment of lower limb spasticity in pediatric patients aged  $\geq 2$  years. Intramuscular abobotulinumtoxinA was approved based on the results of a pivotal phase 3 trial in children with lower limb spasticity due to cerebral palsy. In this trial, a single treatment cycle with abobotulinumtoxinA 10-15 U/kg/leg injected into the gastrocnemius and soleus muscles significantly improved ankle plantar flexor muscle tone (primary endpoint), with abobotulinumtoxinA recipients showing a significant response to treatment relative to placebo. AbobotulinumtoxinA treatment also improved spasticity grade. The improvements in muscle tone and spasticity were associated with an improved ability to attain functional goals. Clinical benefits of abobotulinumtoxinA treatment lasted for 16-22 weeks in most patients, and were maintained with multiple treatment cycles during 1 year in an open-label extension study. AbobotulinumtoxinA was generally well tolerated, with a relatively low incidence of treatment-related adverse events. In summary, abobotulinumtoxinA is an effective and generally well tolerated treatment option for children with lower limb spasticity.

DOI: 10.1007/s40272-017-0242-4

PMID: 28623614

#### **Effects of botulinum toxin serotype A on sleep problems in children with cerebral palsy and on mothers sleep quality and depression.**

Binay Safer V , Ozbudak Demir S, Ozkan E, Demircioglu Guneri F.

*Neurosciences (Riyadh). 2016 Oct;21(4):331-337. doi: 10.17712/nsj.2016.4.20160207.*

**OBJECTIVE:** To evaluate botulinum toxin serotype A (BoNT-A) effects on sleep problems in children with cerebral palsy (CP) and on mothers' sleep quality and depression at multiple time points.

**METHODS:** This is a single center, cross sectional, and observational study was conducted to assess children with CP who were admitted. We recruited children with CP who were admitted to Ministry of Health Physical Medicine and Rehabilitation Training and Research Hospital, Ankara, Turkey between September 2012 and April 2014 for the BoNT-A injection for lower limb spasticity. Sleep quality of children with CP were determined at baseline and at the first, third and sixth month after the BoNT-A injection. Sleep quality Pittsburgh Sleep Quality Index (PSQI) and depression (by Beck Depression Inventory-II Turkish version) in mothers were also assessed.



RESULTS: Twenty-four children with CP (7.05+/-2.69 years) underwent final assessment. Their bedtime resistance (11.71+/-3.26 versus (vs) 10+/-2.75,  $p<0.01$ ), sleep anxiety (8.00+/-2.57 vs. 7.13+/-2.27,  $p=0.046$ ) and daytime sleepiness (11.67+/-2.14 vs. 10.25+/-1.96,  $p<0.01$ ) were significantly improved in the first month after the BoNT-A injection. In accordance with this, PSQI and BDI scores of the mothers decreased in the first month after the BoNT-A injection. Thereafter, BDI scores continued to decrease, whereas PSQI slightly increased in the third month.

CONCLUSION: The BoNT-A injection for spasticity in children with CP may have the potential to improve sleep quality in children with CP and their primary caregiver, the mother, as well as to reduce depression in the mother.

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PMCID: PMC5224431

PMID: 27744462 [Indexed for MEDLINE]

### **Image-guided intrathecal baclofen pump catheter implantation: a technical note and case series.**

Robinson S , Robertson FC , Dasenbrock HH , O'Brien CP , Berde C , Padua H .

*J Neurosurg Spine.* 2017 May;26(5):621-627. doi: 10.3171/2016.8.SPINE16263. Epub 2017 Feb 3.

OBJECTIVE Medically refractory spasticity and dystonia are often alleviated with intrathecal baclofen (ITB) administration through an indwelling catheter inserted in the lumbar spine. In patients with cerebral palsy, however, there is a high incidence of concomitant neuromuscular scoliosis. ITB placement may be technically challenging in those who have severe spinal deformity or who have undergone prior instrumented thoracolumbar fusion. Although prior reports have described drilling through the lumbar fusion mass with a high-speed bur, as well as IT catheter implantation at the foramen magnum or cervical spine, these approaches have notable limitations. To the authors' knowledge, this is the first report of ITB placement using cone beam CT (CBCT) image guidance to facilitate percutaneous IT catheterization.

METHODS Data were prospectively collected on patients treated between November 2012 and June 2014. In the interventional radiology suite, general anesthesia was induced and the patient was positioned prone. Imaging was performed to identify the optimal trajectory. Percutaneous puncture was performed at an entry site with image-guided placement of a sheathed needle. CBCT provided real-time 2D projections and 3D reconstructions for detailed volumetric imaging. A biopsy drill was passed through the sheath, and subsequently a Tuohy needle was advanced intrathecally. The catheter was threaded cephalad under fluoroscopic visualization. After tip localization and CSF flow were confirmed, the stylet was replaced, the external catheter tubing was wrapped sterilely in a dressing, and the patient was transported to the operating room. After lateral decubitus positioning of the patient, the IT catheter was exposed and connected to the distal abdominal tubing with typical pump placement.

RESULTS Of 15 patients with Gross Motor Function Classification System Levels IV and V cerebral palsy and instrumented thoracolumbar fusion, 8 had predominantly spasticity, and 7 had mixed spasticity and dystonia. The mean age of patients was 20.1 years (range 13-27 years). Nine patients underwent initial catheter and pump placement, and 6 underwent catheter replacement. The procedure was technically successful, with accurate spinal catheter placement in all patients. The median hospital stay was 4 days (IQR 3-5 days). One patient had an early postoperative urinary tract infection. With a mean follow-up of 25.8 months (median 26, range 18-38 months), no CSF leakage or catheter failure occurred. One late infection due to *Pseudomonas aeruginosa* (requiring pump explantation) occurred at 4 months, probably secondary to recurrent urinary tract infections.

CONCLUSIONS Image-guided CBCT navigation resulted in accurate percutaneous placement of the IT catheter for ITB pumps in patients with prior instrumented thoracolumbar fusion. The multimodality approach is an alternate technique that may be used for IT catheter insertion in patients with complex lumbar spine anatomy, extending the potential to provide safe, durable ITB therapy in this population.

DOI: 10.3171/2016.8.SPINE16263

PMID: 28156208 [Indexed for MEDLINE]

### **Sonographic and clinical effects of botulinum toxin Type A combined with extracorporeal shock wave therapy on spastic muscles of children with cerebral palsy.**

Picelli A , La Marchina E , Gajofatto F , Pontillo A , Vangelista A , Filippini R , Baricich A , Cisari C , Smania N .

*Dev Neurorehabil.* 2017 Apr;20(3):160-164. doi: 10.3109/17518423.2015.1105320. Epub 2016 Feb 18.

OBJECTIVE: The aim of this study was to compare the combined sonographic and clinical effects of botulinum toxin type A (BoNT-A) and extracorporeal shock wave therapy (ESWT) versus BoNT-A alone in children with cerebral palsy.

Science Infos Paralysie Cérébrale, Juin 2017, [FONDATION PARALYSIE CEREBRALE](#) 67 rue Vergniaud 41  
75013 Paris - tel +33 1 45 54 03 03 contact: Christine Doumergue [cdoumergue@lafondationmotrice.org](mailto:cdoumergue@lafondationmotrice.org)

**METHODS:** Ten children with spastic cerebral palsy were randomly assigned to one of two groups. Group 1 received BoNT-A injection into the spastic muscles of the affected limbs plus three ESWT sessions. Group 2 received BoNT-A alone. Assessment was performed before and 1 month after injection. Sonographic outcomes were injected muscles echo intensity and their hardness percentage, and clinical outcomes the modified Ashworth scale and the Tardieu scale.

**RESULTS:** At 1-month evaluation, significant differences in the injected muscles percentage of hardness ( $P = 0.021$ ) and the modified Ashworth scale ( $P = 0.001$ ) were found between groups.

**CONCLUSIONS:** Our results support the hypothesis that the combined effects of BoNT-A and ESWT derive from their respective action on neurological and non-neural rheological components in spastic muscles.

DOI: 10.3109/17518423.2015.1105320

PMID: 26890193 [Indexed for MEDLINE]

### **The effect of botulinum toxin A (Botox) injections used to treat limb spasticity on speech patterns in children with dysarthria and cerebral palsy: A report of two cases.**

Workinger MS , Kent RD , Meilahn JR .

*J Pediatr Rehabil Med.* 2017 May 19;10(2):137-143. doi: 10.3233/PRM-170433.

Botulinum toxin A (Btx-A) injections are used to treat limb spasticity in children with cerebral palsy (CP) resulting in improved gross and fine motor control. This treatment has also been reported to have additional functional effects, but the effect of treatment on speech has not been reported. This report presents results of longitudinal speech evaluation of two children with CP given injections of Btx-A for treatment of limb spasticity. Speech evaluations were accomplished at baseline (date of injections) and 4- and 10-weeks post-injections. Improvements in production of consonants, loudness control, and syllables produced per breath were found. Parental survey also suggested improvements in subjects' speech production and willingness to speak outside the testing situation. Future larger studies are warranted to assess the nature of the changes observed related to Btx-A.

DOI: 10.3233/PRM-170433

PMID: 28582880

### **Treatment with botulinum toxin in children with cerebral palsy: a qualitative study of parents' experiences.**

Lorin K , Forsberg A .

*Child Care Health Dev.* 2016 Jul;42(4):494-503. doi: 10.1111/cch.12350. Epub 2016 May 19.

**BACKGROUND:** In children with cerebral palsy everyday movements such as walking, standing and using one's hands can be difficult to perform because of spasticity. Botulinum neurotoxin type A (BoNT-A) are often used to reduce spasticity. The aim of this study was to describe how parents of children with cerebral palsy experienced the child's treatment with BoNT-A, how the child was affected by the treatment and how spasticity affected the child.

**METHODS:** A qualitative study in which 15 parents of children (6-13 years old) with cerebral palsy were interviewed about their experiences of the BoNT-A treatment. The children had received several BoNT-A treatments. An interview guide was used with topics: the child's functions before and after the treatment, the outcomes of the treatment and how they valued the BoNT-A treatment. Content analysis was used to analyse the interviews.

**RESULTS:** The analyses resulted in two themes: 'When softness comes and goes' and 'Both want and do not want'. The reduction of spasticity - softness - was described to promote motor functions, and facilitate the next step in motor development. The children were described as being more active out of their own initiative and having a happier mood. Spasticity, described as stiffness, was described to make walking more strenuous as well as interfering with activities. The BoNT-A injection procedure was perceived as troublesome and painful for the child, and sometimes traumatic for both children and parents.

**CONCLUSIONS:** Treatment with BoNT-A was described as facilitating motor development and activity. The children's and the parents' negative experiences of the injection procedure should be addressed.

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DOI: 10.1111/cch.12350

PMID: 27198886 [Indexed for MEDLINE]

## Chirurgie

### **A microcosting study of the surgical correction of upper extremity deformity in children with spastic cerebral palsy.**

Alewijnse JV , van Rooijen EM , Kreulen M , Smeulders MJ , Tan SS .

*Dev Neurorehabil.* 2017 Apr;20(3):173-178. doi: 10.3109/17518423.2016.1139010. Epub 2016 Apr 7.

**OBJECTIVE:** Determine healthcare costs of upper-extremity surgical correction in children with spastic cerebral palsy (CP).

**METHOD:** This cohort study included 39 children with spastic CP who had surgery for their upper extremity at a Dutch hospital. A retrospective cost analysis was performed including both hospital and rehabilitation costs. Hospital costs were determined using microcosting methodology. Rehabilitation costs were estimated using reference prices.

**RESULTS:** Hospital costs averaged €6813 per child. Labor (50%), overheads (29%), and medical aids (15%) were important cost drivers. Rehabilitation costs were estimated at €3599 per child.

**CONCLUSIONS:** Surgery of the upper extremity is an important contributor to the healthcare costs of children with CP. Our study shows that labor is the most important cost driver for hospital costs, owing to the multidisciplinary approach and patient-specific treatment plan. A remarkable finding was the substantial amount of rehabilitation costs.

DOI: 10.3109/17518423.2016.1139010

PMID: 27055081 [Indexed for MEDLINE]

### **A Systematic Review of the Effects of Single-Event Multilevel Surgery on Gait Parameters in Children with Spastic Cerebral Palsy.**

Lamberts RP , Burger M , du Toit J , Langerak NG .

*PLoS One.* 2016 Oct 18;11(10):e0164686. doi: 10.1371/journal.pone.0164686. eCollection 2016.

**BACKGROUND:** Three-dimensional gait analysis (3DGA) is commonly used to assess the effect of orthopedic single-event multilevel surgery (SEMLS) in children with spastic cerebral palsy (CP).

**PURPOSE:** The purpose of this systematic review is to provide an overview of different orthopedic SEMLS interventions and their effects on 3DGA parameters in children with spastic CP.

**METHODS:** A comprehensive literature search within six databases revealed 648 records, from which 89 articles were selected for the full-text review and 24 articles (50 studies) included for systematic review. The Oxford Centre for Evidence-Based Medicine Scale and the Methodological Index for Non-Randomized Studies (MINORS) were used to appraise and determine the quality of the studies.

**RESULTS:** Except for one level II study, all studies were graded as level III according to the Oxford Centre for Evidence-Based Medicine Scale. The MINORS score for comparative studies (n = 6) was on average 15.7/24, while non-comparative studies (n = 18) scored on average 9.8/16. Nineteen kinematic and temporal-distance gait parameters were selected, and a majority of studies reported improvements after SEMLS interventions. The largest improvements were seen in knee range of motion, knee flexion at initial contact and minimal knee flexion in stance phase, ankle dorsiflexion at initial contact, maximum dorsiflexion in stance and in swing phase, hip rotation and foot progression angles. However, changes in 3DGA parameters varied based on the focus of the SEMLS intervention.

**DISCUSSION:** The current article provides a novel overview of a variety of SEMLS interventions within different SEMLS focus areas and the post-operative changes in 3DGA parameters. This overview will assist clinicians and researchers as a potential theoretical framework to further improve SEMLS techniques within different SEMLS focus groups. In addition, it can also be used as a tool to enhance communication with parents, although the results of the studies can't be generalised and a holistic approach is needed when considering SEMLS in a child with spastic CP.

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DOI: 10.1371/journal.pone.0164686

PMCID: PMC5068714

PMID: 27755599 [Indexed for MEDLINE]

Conflict of interest statement: The authors have declared that no competing interests exist.

## **Comparison of Allograft and Bovine Xenograft in Calcaneal Lengthening Osteotomy for Flatfoot Deformity in Cerebral Palsy.**

Rhodes J , Mansour A, Frickman A, Pritchard B, Flynn K, Pan Z, Chang F, Miller N.

*J Pediatr Orthop.* 2017 Apr/May;37(3):e202-e208. doi: 10.1097/BPO.0000000000000822.

**BACKGROUND:** The Evan's calcaneal lengthening osteotomy is a treatment method for spastic flatfoot deformity in patients with cerebral palsy that fail nonoperative measures. Autograft and allograft have been reported as potential graft choices. Bovine xenograft has been introduced as an alternative, but limited human data exists supporting its efficacy. This study compares the long-term results of allograft versus xenograft in isolated Evan's procedure performed for correction of flexible spastic flatfoot deformity.

**METHODS:** This retrospective study accessed charts of 4- to 18-year-olds diagnosed with cerebral palsy who received an Evan's procedure. Preoperative and postoperative radiographic measurements (lateral calcaneal pitch, lateral talocalcaneal, lateral talo-first metatarsal, anteroposterior talonavicular coverage, anteroposterior talo-first metatarsal), graft incorporation, recurrence, secondary procedures, and complications were recorded and analyzed between graft types.

**RESULTS:** Sixty-three feet (34 allograft and 29 xenograft) in 36 patients (mean age 9.3 y) were included. Gross Motor Function Classification System between groups was significant ( $P=0.001$ ). Mean time for preoperative x-rays was 5.3 months before day of surgery (DOS) for allograft and 3.6 months for xenograft. Mean time of first and last postoperative x-ray for allograft was 3.6 and 39.5 months, respectively; for xenograft, 1.8 and 35.1 months, respectively. There was a significant difference in timing of preoperative x-ray to DOS and DOS to first postoperative x-ray ( $P=0.012$ ,  $0.006$ , respectively). Radiographically, xenograft retained postoperative improvement better than allograft, yet allograft had a higher grade 4 incorporation rate ( $P=0.036$ ). The allograft group experienced significantly more cast pressure ulcers ( $P=0.006$ ), but no other differences in complications between groups, and no infections were reported in either group. **CONCLUSIONS:** Allograft incorporated better than xenograft, likely with a greater potential to reach grade 5 incorporation, yet both groups retained postoperative improvement. Results indicate both grafts are appropriate; yet incorporation rate could affect correction maintenance, and should be considered during graft selection for Evan's procedure.

**LEVEL OF EVIDENCE:** This study presents clinical results using a novel bone graft material. Level III-retrospective comparative study.

DOI: 10.1097/BPO.0000000000000822

PMID: 27379788 [Indexed for MEDLINE]

## **Comparison of mid-term efficacy of spastic flatfoot in ambulant children with cerebral palsy by 2 different methods.**

Wen J , Liu H, Xiao S, Li X, Fang K, Zeng M, Tang Z, Cao S, Li F.

*Medicine (Baltimore).* 2017 Jun;96(22):e7044. doi: 10.1097/MD.0000000000007044.

To compare the treatment efficacy of spastic flatfoot surgery by 2 different surgical methods: nonfusion subtalar arthroereisis using subtalar joint stabilizer (SJS) and Dennyson-Fulford subtalar arthrodesis (D-FSA). A total of 26 cases of ambulant children with cerebral palsy diagnosed as spastic flatfoot were surgically treated from January 2011 to December 2014. Preoperative and postoperative American Orthopedic Foot and Ankle Society-Ankle and Hindfoot (AOFAS-AH) scores, anteroposterior-talocalcaneal angles (ATAs), and lateral talar-first metatarsal angles (Meary angles) of the affected foot were recorded. Among 12 children in the SJS group, the AOFAS-AH scores were median preoperative score of 61 (58-64) versus median postoperative score of 83 (75-92), with significant difference ( $P<.05$ ). Of the 20 feet treated, only 1 foot developed occasional pain. Postoperative ATA was decreased from preoperative  $35^\circ$  ( $20^\circ$ - $50^\circ$ ) to  $19^\circ$  ( $12^\circ$ - $25^\circ$ ); lateral X-ray films showed that the Meary angle was decreased from preoperative  $20^\circ$  ( $15^\circ$ - $40^\circ$ ) to postoperative  $0^\circ$  ( $0^\circ$ - $3^\circ$ ). The differences in both findings were statistically significant ( $P<.05$ ). Fourteen children (22 treated feet) formed the D-FSA group; all demonstrated fusion of the talocalcaneal joint; AOFAS-AH scores were median preoperative score of 61 (58-64) versus median postoperative score of 83 (75-92), with significant difference ( $P<.05$ ). Only 1 foot had occasional pain. Postoperative ATA was decreased from preoperative  $35^\circ$  ( $20^\circ$ - $45^\circ$ ) to  $16^\circ$  ( $12^\circ$ - $25^\circ$ ); lateral X-ray films showed that the Meary angle was decreased from preoperative  $19^\circ$  ( $10^\circ$ - $40^\circ$ ) to postoperative  $2^\circ$  ( $0^\circ$ - $5^\circ$ ); the differences in both findings were statistically significant ( $P<.05$ ). Both nonfusion subtalar arthroereisis using SJS and D-FSA were effective for the surgical treatment of spastic flatfoot, with similar clinical outcomes.

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DOI: 10.1097/MD.00000000000007044

PMCID: PMC5459726

PMID: 28562561

**Does Patella Lowering Improve Crouch Gait in Cerebral Palsy? Comparative Retrospective Study.**

Desailly E , Thévenin-Lemoine C , Khouri N .

*Orthop Traumatol Surg Res.* 2017 Jun 16. pii: S1877-0568(17)30168-8. doi: 10.1016/j.otsr.2017.03.028. [Epub ahead of print]

**BACKGROUND:** Patella lowering aims to improve quadriceps function as a means of correcting crouch gait in patients with cerebral palsy (PC). Few studies have assessed the effects of patella lowering as a component of multilevel surgery.

**HYPOTHESIS:** Including patella lowering into the components of multilevel surgery is beneficial in patients with crouch gait and patella alta.

**MATERIAL ET METHODS:** In 12 lower limbs with patella alta (Caton-Deschamps index >1.4) in 41 children with cerebral palsy, patella lowering was performed, without distal femoral extension osteotomy or hamstring release. Among limbs with similar surgical procedures (e.g., hamstring lengthening, rectus femoris transfer) except for patella lowering, controls were selected retrospectively by matching on a propensity score for patella lowering. The propensity score was computed based on preoperative knee flexion contracture, knee extension lag, and minimum knee flexion at mid-stance. Clinical and 3D kinematic data were compared between the two groups.

**RESULTS:** The improvement in minimum knee flexion at mid-stance was significantly greater in the group with patellar lowering (-24°±12° vs. -12°±7°). The Gait Deviation Index improved similarly in the two groups. Knee flexion contracture improved only in the group with patellar lowering. Extension lag did not improve in either group. Peak knee flexion during the swing phase remained unchanged in both groups.

**DISCUSSION:** Patellar lowering is effective in diminishing minimum knee flexion at mid-stance in patients with patella alta and crouch gait due to cerebral palsy. Patellar lowering has not adverse effects on gait. These findings cannot be assumed to apply to patients with normal patellar height.

**LEVEL OF EVIDENCE:** IV (retrospective study).

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DOI: 10.1016/j.otsr.2017.03.028

PMID: 28629941

**Effects of Soft Tissue Surgery on Pelvic and Hip Rotation in Patients with Spastic Diplegia: A Meta-Analysis.**

Jung HJ , Yoon JY , Oh MK , Kim YC , Kim JH , Eom TW , Park KB .

*Clin Orthop Surg.* 2016 Jun;8(2):187-93. doi: 10.4055/cios.2016.8.2.187. Epub 2016 May 10.

**BACKGROUND:** There are several different opinions regarding the improvements seen on the transverse plane after soft tissue surgery alone in independently ambulant patients with cerebral palsy. We performed a meta-analysis using data from previous studies to identify the effects of soft tissue surgery alone on pelvic and hip rotation in children with spastic diplegia.

**METHODS:** We conducted a pilot study to evaluate the improvement in pelvic and hip rotation after muscle-tendon lengthening surgery in children with spastic diplegia. We also searched EMBASE and PubMed and selected 2 previous studies using the same test conditions with kinematic data on the pelvis and hip joints. A meta-analysis of the results of these 3 studies, including this pilot study, was then performed.

**RESULTS:** The meta-analysis results showed an external rotation decrease ( $p = 0.005$ ) in the mean difference of pelvic rotation of -3.61 (95% confidence interval [CI], -6.13 to -1.09) and a mean difference in hip rotation of 6.60 (95% CI, 3.34 to 9.86), indicating a significant increase in the hip external rotation after surgery ( $p < 0.001$ ).

**CONCLUSIONS:** In independently community-ambulant pediatric patients with spastic diplegia, pelvic retraction and hip internal rotation could be improved after soft tissue surgery.

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DOI: 10.4055/cios.2016.8.2.187

PMCID: PMC4870323

PMID: 27247745 [Indexed for MEDLINE]

## **Functional Outcomes of Childhood Selective Dorsal Rhizotomy 20 to 28 Years Later.**

Park TS , Liu JL , Edwards C , Walter DM , Dobbs MB .

*Cureus. 2017 May 17;9(5):e1256. doi: 10.7759/cureus.1256.*

**BACKGROUND:** Selective dorsal rhizotomy (SDR) is a surgical method used to treat childhood spastic cerebral palsy (CP). However, the effects of early SDR on functional outcomes and quality of life decades later in adulthood remains to be elucidated.

**OBJECTIVES:** To evaluate the long-term outcomes in terms of satisfaction and mobility of adult patients who received childhood SDR. **METHODS:** Adult patients who received SDR in childhood were surveyed. The survey questionnaire asked about demographic information, quality of life, health outcomes, SDR surgical outcomes, ambulation, manual ability, pain, braces/orthotics, post-SDR treatment, living situation, education level, and work status.

**RESULTS:** Our study included 95 patients. The age that patients received SDR was between two and 18 years. The age at the time of survey was between 23 and 37 years (mean  $\pm$  S.D., 30.2  $\pm$  3.6 years). Post-SDR follow-up ranged from 20 to 28 years (mean  $\pm$  S.D., 24.3  $\pm$  2.2 years). Seventy-nine percent of patients had spastic diplegia, 20% had spastic quadriplegia, and one percent had spastic triplegia. Ninety-one percent of patients felt that SDR impacted positively the quality of life and two percent felt that the surgery impacted negatively the quality of life after SDR. Compared to pre-operative ambulatory function, 42% reported higher level of ambulation and 42% ambulated in the same level. Eighty-eight percent of patients would recommend the procedure to others and two percent would not. Thirty-eight percent reported pain, mostly in the back and lower limbs, with mean pain level 4.2  $\pm$  2.3 on the Numeric Pain Rating Scale (NPRS). Decreased sensation in patchy areas of the lower limbs that did not affect daily life was reported by eight percent of patients. Scoliosis was diagnosed in 31%. The severity of scoliosis is unknown. Only three percent of them underwent spinal fusion. Fifty-seven percent of patients required some orthopedic surgery after SDR. The soft-tissue tendon lengthening procedures included lengthening on hamstrings, Achilles tendons or adductors. Out of all bone procedures, 24% of patients had hip surgery, five percent had knee surgery, and 10% had derotational osteotomies. No late side effects of SDR surgery were reported in this survey.

**CONCLUSIONS:** In our 95 adult patients who received SDR in childhood, the surgery had positive effects on the quality of life and ambulation 20-28 years later. There were no late complications of SDR surgery.

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DOI: 10.7759/cureus.1256

PMCID: PMC5473717

PMID: 28649479

Conflict of interest statement: The authors have declared that no competing interests exist.

## **Gross motor function change after multilevel soft tissue release in children with cerebral palsy.**

Chang CH , Chen YY , Yeh KK , Chen CL .

*Biomed J. 2017 Jun;40(3):163-168. doi: 10.1016/j.bj.2016.12.003. Epub 2017 May 30.*

**BACKGROUND:** Improving motor function is a major goal of therapy for children with cerebral palsy (CP). However, changes in motor function after orthopedic surgery for gait disorders are seldom discussed. This study aimed to evaluate the postoperative changes in gross motor function and to investigate the prognostic factors for such changes.

**METHODS:** We prospectively studied 25 children with CP (4-12 years) who were gross motor function classification system (GMFCS) level II to IV and underwent bilateral multilevel soft-tissue release for knee flexion gait. Patients were evaluated preoperatively and at 6 weeks and 3 and 6 months postoperatively for Gross Motor Function Measure (GMFM-66), range of motion, spasticity, and selective motor control. The associations between change in GMFM-66 score and possible factors were analyzed.

**RESULTS:** 25 children with gross motor function level II to IV underwent surgery at a mean age of 8.6 years (range, 4-12 years). Mean GMFM-66 score decreased from 55.9 at baseline to 54.3 at 6-weeks postoperatively and increased to 57.5 at 6-months postoperatively ( $p < 0.05$ ). Regression analysis revealed better gross motor function level and greater surgical reduction of spasticity were predictors for decreased GMFM-66 score at 6-weeks postoperatively. Younger age was a predictor for increased GMFM-66 score at 6-months postoperatively.

**CONCLUSION:** Reduction of contracture and spasticity and improvement of selective motor control were noted after surgery in children with CP. However, a down-and-up course of GMFM-66 score was noted. It is emphasized that

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deterioration of motor function in children with ambulatory ability and the improvement in young children after orthopedic surgery for gait disorders. LEVEL OF EVIDENCE: case series, therapeutic study, level 4.

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DOI: 10.1016/j.bj.2016.12.003

PMID: 28651738

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

Dauter AK , Kratz AL , Hurvitz EA .

*Dev Med Child Neurol.* 2017 Jun 15. doi: 10.1111/dmcn.13481. [Epub ahead of print]

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

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

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

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

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DOI: 10.1111/dmcn.13481

PMID: 28617943

**Management of Severe Equinovalgus in Patients With Cerebral Palsy by Naviclectomy in Combination With Midfoot Arthrodesis.**

Dussa CU , Döderlein L , Forst R , Böhm H , Fujak A .

*Foot Ankle Int.* 2017 Jun 1:1071100717709577. doi: 10.1177/1071100717709577. [Epub ahead of print]

**BACKGROUND:** Equinovalgus deformity is the second most common deformity in cerebral palsy and may be flexible or rigid. Several operative methods from joint sparing to arthrodesis have been described with varying success rates. The aim of this study was to investigate the effectiveness of naviclectomy in combination with midfoot arthrodesis (talo-cuneiform and calcaneocuboid arthrodesis) in the correction of a rigid equinovalgus foot deformity in cerebral palsy.

**METHODS:** Forty-eight rigid equinovalgus feet were operated upon in 30 patients from 2008 to 2013. Of these, 44 feet in 26 patients with cerebral palsy (Gross Motor Function Classification System III, IV, or V) with follow-up of more than 2 years were included in the study. The mean age at surgery was 18.1 years. The outcomes were measured objectively using radiographic angles and subjectively using 5 questions to be answered by the caregiver. The feet were then graded into excellent, good, fair, and poor. The mean follow-up was  $5.0 \pm 1.7$  years.

**RESULTS:** Excellent to good results were obtained in 81% of the feet. Both objective and subjective outcomes improved significantly postoperatively ( $P < .001$ ). Three feet in 2 patients were graded as poor and underwent a revision operation for pain and recurrence.

**CONCLUSIONS:** Naviclectomy in combination with midfoot arthrodesis enabled a good 3-dimensional correction of the forefoot. However, the procedure did not necessarily correct the fixed subtalar joint deformity. Several additional bony and soft-tissue procedures were necessary to achieve a complete correction in these difficult feet. LEVEL OF EVIDENCE: Level IV, retrospective case series.

DOI: 10.1177/1071100717709577

PMID: 28587475

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## **Orthopedic surgery in cerebral palsy: Instructional course lecture.**

Sharan D .

*Indian J Orthop.* 2017 May-Jun;51(3):240-255. doi: 10.4103/ortho.IJOrtho\_197\_16.

Orthopedic surgery (OS) plays an important role in the management of cerebral palsy (CP). The objectives of OS are to optimize functions and prevent deformity. Newer developments in OS for CP include emphasis on hip surveillance, minimally invasive procedures, use of external fixators instead of plates and screws, better understanding of lever arm dysfunctions (that can only be corrected by bony OS), orthopedic selective spasticity-control surgery, and single-event multilevel lever arm restoration and anti spasticity surgery, which have led to significant improvements in gross motor function and ambulation, especially in spastic quadriplegia, athetosis, and dystonia. The results of OS can be dramatic and life altering for the person with CP and their caregivers if it is performed meticulously by a specialized surgical team, at the appropriate age, for the correct indications, employing sound biomechanical principles and is followed by physician-led, protocol based, intensive, multidisciplinary, institutional rehabilitation, and long term followup. However, OS can be a double-edged sword, and if performed less than optimally, and without the supporting multidisciplinary medical and rehabilitation team, expertise and infrastructure, it often leads to significant functional worsening of the person with CP, including irretrievable loss of previous ambulatory capacity. OS must be integrated into the long term management of the person with CP and should be anticipated and planned at the optimal time and not viewed as a "last resort" intervention or failure of rehabilitation. This instructional course lecture reviews the relevant contemporary principles and techniques of OS in CP.

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DOI: 10.4103/ortho.IJOrtho\_197\_16

PMCID: PMC5439309

PMID: 28566775

Conflict of interest statement: There are no conflicts of interest.

## **Outcomes after scoliosis surgery for children with cerebral palsy: a systematic review.**

Toovey R , Harvey A , Johnson M , Baker L , Williams K .

*Dev Med Child Neurol.* 2017 Jul;59(7):690-698. doi: 10.1111/dmcn.13412. Epub 2017 Mar 6.

**AIM:** This study aims (1) to evaluate and synthesize the evidence for the postoperative outcomes after scoliosis surgery for children with cerebral palsy (CP), and (2) to identify preoperative risk factors for adverse outcomes after surgery.

**METHOD:** Medline, EMBASE, CINAHL, and PubMed were searched for relevant literature. Included studies were assessed for risk of bias using the Cochrane Effective Practice and Organisation of Care tool. Quality of evidence for overall function, quality of life (QoL), gross motor function, caregiver outcomes, deformity correction, and postoperative complications were assessed using GRADE (Grades of Recommendation, Assessment, Development and Evaluation).

**RESULTS:** Fifty-one studies met inclusion criteria, including 35 case series designs. Risk of bias was high across all studies. On average good deformity correction was achieved, the trend appears positive for caregiver and QoL outcomes, but there was minimal to no change for gross motor or overall function. Inconsistent measurement limited synthesis. A mean overall complication rate of 38.1% (95% confidence interval 27.3-53.3) was found. The quality of evidence was very low across all functional outcomes.

**INTERPRETATION:** Limited high-quality evidence exists for outcomes after scoliosis surgery in children with CP, a procedure associated with a moderately high complication rate. The intervention appears indicated for deformity correction, but currently there is insufficient evidence to make recommendations for this surgery as a way to also improve functional outcomes, caregiver outcomes, and quality of life.

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DOI: 10.1111/dmcn.13412

PMID: 28262923 [Indexed for MEDLINE]

## **Post-operative Hypertension following Correction of Flexion Deformity of the Knees in a Spastic Diplegic Child: A Case Report.**

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*Malays Orthop J. 2016 Nov;10(3):46-48. doi: 10.5704/MOJ.1611.006.*

Vipin M , Sujendra DM , Imthiaz VK , Hitesh-Shah .

An adolescent boy with spastic diplegic cerebral palsy presented with crouch gait. He had bilateral severe flexion deformities of knees and hips. He was treated with single event multilevel surgery for the correction of deformities. Surgical procedures included bilateral adductor release, iliopsoas lengthening, bilateral femoral shortening and patella plication. Persistent hypertension was noted in the post-operative period. All causes of secondary hypertension were ruled out. Having persistent hypertension following the femoral shortening procedure is unusual. Antihypertensive medication controlled his blood pressure 15 months after surgery. Hypertension following correction of knee flexion deformity and limb lengthening is well known. Hypertension has not been described with the shortening osteotomy of the femur. Hypertension is a rare complication following the corrective surgery for the treatment of crouch gait. Blood pressure should be monitored during the post-operative period to detect such a rare complication.

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DOI: 10.5704/MOJ.1611.006

PMCID: PMC5333685

PMID: 28553449

### **Pre-operative walking activity in youth with cerebral palsy.**

Nicholson K , Lennon N , Hulbert R , Church C , Miller F .

*Res Dev Disabil. 2017 Jan;60:77-82. doi: 10.1016/j.ridd.2016.11.011. Epub 2016 Nov 29.*

**BACKGROUND:** No data are available regarding level of walking activity for youth with cerebral palsy (CP) before undergoing orthopaedic surgery. The goals of this study were to quantify pre-operative walking activity, and determine whether pre-operative values are different from previously defined levels of walking activity in youth with CP.

**PROCEDURES:** This study retrospectively evaluated pre-operative walking activity in youth with spastic CP, GMFCS levels I-IV. Walking activity was monitored using the StepWatch™. Outcome variables included mean daily strides, percent of day active, and percent of active time at high activity. Differences between GMFCS levels were examined and comparisons were made to published data.

**RESULTS:** Pre-operative walking activity data from 126 youth with CP were included. All variables demonstrated higher walking activity in youth at GMFCS levels I/II compared to those at GMFCS levels III/IV. When compared to previously defined walking activity levels, pre-operative walking activity was lower.

**CONCLUSIONS:** Walking activity among pre-operative youth with CP is significantly lower than published data for ambulatory youth with CP. Results suggest that youth with CP who are surgical candidates have less walking activity than youth with CP without surgical needs. Therefore this study should encourage the effort to collect and analyze individual pre-operative data for comparison and evaluation of post-operative functional recovery. Copyright © 2016 Elsevier Ltd. All rights reserved.

DOI: 10.1016/j.ridd.2016.11.011

PMID: 27912105 [Indexed for MEDLINE]

### **Presurgical Concerns of Primary Family Caregivers of Children With Cerebral Palsy.**

Yu LC , Chen LC, Lin HC, Lin YE, Chang CH, Chen SC.

*Orthop Nurs. 2017 Mar/Apr;363:140-146. doi: 10.1097/NOR.0000000000000328.*

**BACKGROUND:** Primary family caregivers (PFCs) of children with cerebral palsy have many worries and concerns when their children face orthopedic surgery. Levels of PFC stress about the upcoming surgery is related to the child's level of gross motor function as well as the support they receive from medical professionals. **PURPOSE:** The purposes of the present study were to explore the levels of concern about orthopedic surgery; and (2) explore the predictive factors associated with concerns about orthopedic surgery among PFCs of children with cerebral palsy during the preoperative period.

**METHODS:** A cross-sectional, correlational study was conducted. Primary family caregivers were assessed preoperatively using the Single-event Multilevel Surgery Scale, Social Support Scale, Gross Motor Function Classification System-Expanded and Revised, and background information form. Primary family caregivers were

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recruited from the outpatient department of orthopedic surgery and pediatric rehabilitation of a medical center in northern Taiwan. Data were analyzed by descriptive analysis, Pearson product-moment correlation, and multiple regression analysis.

**RESULTS:** A total of 63 eligible subjects were enrolled in this study. Primary family caregivers had moderate levels of concern and mild-to-moderate levels of social support. The higher severity of motor function impairment in children with cerebral palsy, prior caregiving by PFCs for another family member, and PFCs' lower level of social support from healthcare providers were associated with higher levels of PFC concern.

**CONCLUSIONS:** Concerns about orthopedic surgery is an overlooked issue that needs more attention from healthcare providers. This study determined that PFCs who perceived a lack of social support from their healthcare providers and those with children who had limited gross motor function were more concerned and anxious about their children's upcoming orthopedic surgery. Health professionals should provide adequate health education and counseling to help PFCs of children with cerebral palsy in the decision-making process prior to orthopedic surgery.

DOI: 10.1097/NOR.0000000000000328

PMID: 28358778 [Indexed for MEDLINE]

### **Surgical Outcomes of Posterior Spinal Fusion Alone Using Cervical Pedicle Screw Constructs for Cervical Disorders Associated With Athetoid Cerebral Palsy.**

Watanabe K , Hirano T, Katsumi K, Ohashi M, Shoji H, Yamazaki A, Izumi T, Hasegawa K, Ito T, Endo N.

*Spine (Phila Pa 1976)*. 2017 Jun 1. doi: 10.1097/BRS.0000000000002257. [Epub ahead of print]

**STUDY DESIGN:** Retrospective case series.

**OBJECTIVE:** To investigate clinical outcomes after posterior spinal fusion (PSF) using cervical pedicle screw (CPS) constructs for cervical disorders associated with athetoid cerebral palsy (CP).

**SUMMARY OF BACKGROUND DATA:** Traditionally, most patients with cervical myelopathy associated with CP have required combined anterior and posterior fusion to achieve solid stability against severe involuntary movement.

**METHODS:** Thirty-one CP patients with cervical disorders who underwent PSF alone with a minimum 2-year follow-up (mean 58 months) were analyzed. All patients were treated with PSF using CPS constructs with or without decompression procedures. The average number of fused segments was 5.1 (range, 1 to 10 segments), and a halo jacket was applied in 16 patients for at least 2 months after surgery. Clinical outcomes using the Japanese Orthopaedic Association scoring system (JOA score) and walking ability, radiographic sagittal alignment, fusion status, surgery-related complications were evaluated.

**RESULTS:** The JOA score improved from 8.3 points preoperatively to 10.9 points at the final follow-up ( $p < 0.05$ ). While no patients experienced deterioration in their walking ability postoperatively, 10 patients were unable to walk at the final follow-up. Sagittal alignment, including C0-2 angle, C2-7 angle, and local alignment in fused segments, was maintained postoperatively. Twenty-five patients achieved fusion at the final follow-up (fusion rate: 81%), and 5 patients with non-union required additional surgery. With regard to complications, 5 patients encountered postoperative upper extremity palsy.

**CONCLUSIONS:** The CPS construct is amenable to achieve a relatively high fusion rate without correction loss, and good clinical outcomes can be achieved with a posterior single approach for CP patients. In the future, efforts should be made to make appropriate decisions regarding the fusion area, take preventative measures against postoperative upper extremity palsy, and simplify external orthoses after surgery, especially with the use of a halo jacket.

**LEVEL OF EVIDENCE:** 4.

DOI: 10.1097/BRS.0000000000002257

PMID: 28574882

### **The Effects of a Home-Based Connective Tissue Targeting Therapy on Hip Development in Children With Cerebral Palsy: Six Case Reports.**

Drewes E , Driscoll M , Blyum L , Vincentz D .

*Explore (NY)*. 2016 Jul-Aug;12(4):268-76. doi: 10.1016/j.explore.2016.04.004. Epub 2016 Apr 19.

Hip subluxation in children with Cerebral Palsy (CP) has an incidence of 10-30 %, and children with severe CP having the highest incidence. The condition deteriorates if left untreated. Surgery is the most common method used in managing hip subluxation because standard conservative therapies do not improve it. Surgery may have to be  
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repeated and comes at a biological cost to the child. A new home-based CAM, Advanced Biomechanical Rehabilitation (ABR), has shown encouraging results leading to improved spinal stability and stability in sitting in children with severe CP. This case report examines hip development over time in six children with severe CP in the ABR Program. Changes in their clinical picture and pelvic X-Rays are reported. ABR appeared to help stabilize and improve hip subluxation, resulting in these children not requiring further surgical intervention. These findings warrant further investigation of ABR as a noninvasive therapy for hip subluxation.

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DOI: 10.1016/j.explore.2016.04.004

PMID: 27198038 [Indexed for MEDLINE]

### **What's New in the Orthopaedic Treatment of Cerebral Palsy.**

Aversano MW , Sheikh Taha AM, Mundluru S, Otsuka NY.

*J Pediatr Orthop.* 2017 Apr/May;37(3):210-216. doi: 10.1097/BPO.0000000000000675.

**BACKGROUND:** The orthopaedic treatment of the patient with cerebral palsy (CP) is complex and must take into account the heterogeneity and natural history of the condition. Although the goals of management are for the most part universal, the specific interventions and outcome measures used to reach these goals are wide ranging. This update serves to summarize some of the recent publications in the field of pediatric orthopaedics that have made important contributions to our understanding and care of the patient with CP.

**METHODS:** We searched the PubMed database using the following terms: "cerebral palsy" AND "orthopedic." The results were then filtered to include only review papers or clinical trials published in English from 2010 to 2014. The obtained list of references was then reviewed for publications in the fields of lower extremity muscle imbalance, foot and ankle deformities, hip and acetabular dysplasia, and advances in orthopaedic-related technology.

**RESULTS:** Updates in the field of pediatric orthopaedics are constant and the current level of evidence for the effectiveness of specific treatment modalities in patients with CP was reviewed. The search method yielded 153 publications, of which 31 papers were identified as having contributed important new findings. **CONCLUSIONS:** Our understanding of orthopaedic treatments for children with CP continues to grow and expand. The studies reviewed illustrate just some of the strides we have taken in utilizing evidence-based surgical decision making in practice. Nevertheless, there remains a paucity of randomized controlled trials and higher evidence research, which may contribute to the variability in current practices among providers. By elucidating these gaps we can more purposefully delegate our time and resources into targeted areas of research.

**LEVEL OF EVIDENCE:** Level 4-literature review.

DOI: 10.1097/BPO.0000000000000675

PMID: 26523699 [Indexed for MEDLINE]

### **Réadaptation fonctionnelle**

#### **A home-based body weight supported treadmill training program for children with cerebral palsy: A case series.**

Kenyon LK Pt Dpt PhD Pcs , Westman M Pt Dpt , Hefferan A Pt Dpt , McCrary P Pt Dpt , Baker BJ Pt PhD Ncs .

*Physiother Theory Pract.* 2017 Jul;33(7):576-585. doi: 10.1080/09593985.2017.1325956. Epub 2017 May 30.

**BACKGROUND AND PURPOSE:** Contemporary approaches to the treatment of cerebral palsy (CP) advocate a task-specific approach that emphasizes repetition and practice of specific tasks. Recent studies suggest that body-weight-supported treadmill training (BWSTT) programs may be beneficial in clinical settings. The purposes of this case series were to explore the outcomes and feasibility of a home-based BWSTT program for three children with CP.

**CASE DESCRIPTION:** Three children with CP at Gross Motor Function Classification System (GMFCS) Levels III or IV participated in this case series. Examination included the Functional Assessment Questionnaire (FAQ), the 10-meter walk test, the Gross Motor Function Measure (GMFM-66), and the Pediatric Evaluation of Disability Inventory-Computer Adaptive Test (PEDI-CAT). A harness system was used to conduct the BWSTT program over an 8-12 week period.

**OUTCOMES:** All of the families reported enjoying the BWSTT program and found the harness easy to use. Participant 2 increased from a 2 to a 4 on the FAQ, while Participant 3 increased from a 6 to a 7.

DISCUSSION: Two of the participants demonstrated post-intervention improvements in functional mobility. In addition to mobility outcomes, future research should explore the potential health benefits of a home-based BWSTT program.

DOI: 10.1080/09593985.2017.1325956

PMID: 28557625

### **A Progressive Running Program for an Adolescent With Cerebral Palsy.**

Lewis J .

*Pediatr Phys Ther. 2017 Jul;29(3):E12-E16. doi: 10.1097/PEP.0000000000000429.*

PURPOSE: To describe the physical therapy intervention and outcomes for a 20-week progressive running program.

SUMMARY OF KEY POINTS: A 12-year-old boy with spastic diplegic cerebral palsy, Gross Motor Function Classification System level II, participated in a 20-week running program. The 6-minute walk test and the 88-item and 66-item versions of the Gross Motor Function Measure (GMFM) were administered at baseline and program completion. After completion of the program, the participant exceeded thresholds for minimally clinically important differences on the GMFM-66 total score and GMFM-88 Dimension D and E scores. He improved gait speed and distance walked during the 6-minute walk test.

CONCLUSIONS AND RECOMMENDATIONS FOR CLINICAL PRACTICE: Participation in a progressive running program is a feasible intervention to promote improvements in walking speed and gross motor function in some adolescents with spastic diplegic cerebral palsy in Gross Motor Function Classification System level II.

DOI: 10.1097/PEP.0000000000000429

PMID: 28654506

### **Achilles tendon moment arm length is smaller in children with cerebral palsy than in typically developing children.**

Kalkman BM , Bar-On L , Cenni F , Maganaris CN , Bass A , Holmes G , Desloovere K , Barton GJ , O'Brien TD .

*J Biomech. 2017 May 3;56:48-54. doi: 10.1016/j.jbiomech.2017.02.027. Epub 2017 Mar 3.*

When studying muscle and whole-body function in children with cerebral palsy (CP), knowledge about both internal and external moment arms is essential since they determine the mechanical advantage of a muscle over an external force. Here we asked if Achilles tendon moment arm (MAAT) length is different in children with CP and age-matched typically developing (TD) children, and if MAAT can be predicted from anthropometric measurements. Sixteen children with CP (age: 10y 7m±3y, 7 hemiplegia, 12 diplegia, GMFCS level: I (11) and II (8)) and twenty TD children (age: 10y 6m±3y) participated in this case-control study. MAAT was calculated at 20° plantarflexion by differentiating calcaneus displacement with respect to ankle angle. Seven anthropometric variables were measured and related to MAAT. We found normalized MAAT to be 15% (~7mm) smaller in children with CP compared to TD children (p=0.003). MAAT could be predicted by all anthropometric measurements with tibia length explaining 79% and 72% of variance in children with CP and TD children, respectively. Our findings have important implications for clinical decision making since MAAT influences the mechanical advantage about the ankle, which contributes to movement function and is manipulated surgically.

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DOI: 10.1016/j.jbiomech.2017.02.027

PMID: 28318605 [Indexed for MEDLINE]

### **Can new technologies improve upper limb performance in grown-up diplegic children?**

Turconi AC , Biffi E, Maghini C, Peri E, Servodio Iammarone F, Gagliardi C.

*Eur J Phys Rehabil Med. 2016 Oct;52(5):672-681. Epub 2015 Nov 10.*

BACKGROUND: Few systematic studies describe rehabilitation trainings for upper limb in diplegic children with cerebral palsy (CP), who - especially once grown up - are often not considered as a target for rehabilitation interventions.

AIM: In this pilot study, we describe the details and the effectiveness of an intensive, technology assisted intervention for upper limb.

SETTING: The treatment combines the utilization of Armeo® Spring with a training focused on hand/finger fluency and dexterity in a pre-post treatment experimental design.

**POPULATION:** Participants were ten school-aged children (mean age 11.2) with bilateral CP and diplegia, attending mainstream schools.

**METHODS:** Participants underwent 40 therapy sessions in four weeks. Armeo® Spring measures, standardized motor and perceptual outcome indexes, as well as everyday life indicators were utilized to assess the effect of the intervention.

**RESULTS:** Upper limb coordination, fluency and quality of movements mainly of hands and fingers significantly improved, with a good transferability to everyday life also in areas not specifically trained, such as self-care abilities and mobility. Probably due to the visual feedback provided by the virtual reality setting (which was all in one the context, the incentive and the product of activities), perceptual abilities significantly improved, too.

**CONCLUSIONS:** Our study suggests the importance of intervention on upper limb even in milder CP diplegic forms and in relatively grown-up children. The possibility of modification at least partially relies on learning processes that are active all along development and benefit from stimulation.

**CLINICAL REHABILITATION IMPACT:** Though further studies with control groups and follow-up perspective are needed to confirm, new technologies offer interesting possibilities to be integrated into new evidence-based rehabilitation models.

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PMID: 26554345 [Indexed for MEDLINE]

### **Can we prevent hip dislocation in children with cerebral palsy? Effects of postural management.**

Picciolini O, LE Métayer M, Consonni D, Cozzaglio M, Porro M, Gasparroni V, Panou A, Mosca F, Portinaro NM.

*Eur J Phys Rehabil Med.* 2016 Oct;52(5):682-690. Epub 2016 May 6.

**BACKGROUND:** Hip dislocation is common in children with cerebral palsy (CP). At birth they do not have musculoskeletal deformities but they develop over time due to the combined effects of the movement disorder and impaired gross motor function. Early detection and treatment of a hip at risk is needed to modify the natural of hip development in CP.

**AIM:** The aim of this study was to determine the effect of postural management treatment on hip displacement's progression in children CP.

**DESIGN:** Prospective comparative non-randomized study.

**SETTING:** Rehabilitative outpatient unit.

**POPULATION:** Fifty-one children with CP were studied; the treated group (N.=30) was compared to a control group (N.=21).

**METHODS:** The treated group followed a two year's long combined treatment program consisting a neurodevelopment treatment (NDT) two times a week and a 5 hours daily siège moulé postural program. The control group underwent only NDT twice a week for two years. Hip radiographs were measured with the migration percentage (MP) method at baseline, at 1 and 2 years of follow-up.

**RESULTS:** A significant difference has been observed in the MP (%) trend (P<0.001) between treatment and control groups. At 2 years, there was a marked worsening (MP from 23.0 to 37.7) in the control group, compared to the stability (from 28.8 to 26.8) in the treatment group.

**CONCLUSIONS:** This study supports the evidence that conservative postural management of hip deformity is useful to prevent the natural progression of hip dislocation.

**CLINICAL REHABILITATION IMPACT:** Hip radiographic follow up program together with NDT and postural management program is useful to modify the natural progression of hip dislocation in children with CP.

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PMID: 27153480 [Indexed for MEDLINE]

### **Changes in Mobility and Muscle Function of Children with Cerebral Palsy after Gait Training: A Pilot Study.**

Hegarty AK, Kurz MJ, Stuberger W, Silverman AK.

*J Appl Biomech.* 2016 Oct;32(5):469-86. doi: 10.1123/jab.2015-0311. Epub 2016 Aug 19.

The goal of this pilot study was to characterize the effects of gait training on the capacity of muscles to produce body accelerations and relate these changes to mobility improvements seen in children with cerebral palsy (CP). Five children (14 years ± 3 y; GMFCS I-II) with spastic diplegic CP participated in a 6-week gait training program. Changes in 10-m fast-as-possible walking speed and 6-minute walking endurance were used to assess changes in

mobility. In addition, musculoskeletal modeling was used to determine the potential of lower-limb muscles to accelerate the body's center of mass vertically and forward during stance. The mobility changes after the training were mixed, with some children demonstrating vast improvements, while others appeared to be minimal. However, the musculoskeletal results revealed unique responses for each child. The most common changes occurred in the capacity for the hip and knee extensors to produce body support and the hip flexors to produce body propulsion. These results cannot yet be generalized to the broad population of children with CP, but demonstrate that therapy protocols may be enhanced by modeling analyses. The pilot study results provide motivation for gait training emphasizing upright leg posture, mediolateral balance, and ankle push-off.

DOI: 10.1123/jab.2015-0311

PMID: 27348240 [Indexed for MEDLINE]

### **Coupling Timing of Interventions With Dose to Optimize Plasticity and Participation in Pediatric Neurologic Populations.**

Gannotti ME .

*Pediatr Phys Ther. 2017 Jul;29 Suppl 3 Supplement, IV Step 2016 Conference Proceedings Supplement:S37-S47. doi: 10.1097/PEP.0000000000000383.*

**PURPOSE:** The purpose of this article is to propose that coupling of timing of interventions with dosing of interventions optimizes plasticity and participation in pediatric neurologic conditions, specifically cerebral palsy. Dosing includes frequency, intensity, time per session, and type of intervention. Interventions focus on body structures and function and activity and participation, and both are explored. Known parameters for promoting bone, muscle, and brain plasticity and evidence supporting critical periods of growth during development are reviewed. Although parameters for dosing participation are not yet established, emerging evidence suggests that participation at high intensities has the potential for change. Participation interventions may provide an additional avenue to promote change through the life span. Recommendations for research and clinical practice are presented to stimulate discussions and innovations in research and practice.

DOI: 10.1097/PEP.0000000000000383

PMID: 28654476

### **Effect of neurodevelopmental treatment-based physical therapy on the change of muscle strength, spasticity, and gross motor function in children with spastic cerebral palsy.**

Park EY , Kim WH .

*J Phys Ther Sci. 2017 Jun;29(6):966-969. doi: 10.1589/jpts.29.966. Epub 2017 Jun 7.*

[Purpose] This study aimed to investigate the effectiveness of neurodevelopmental treatment-based physical therapy on muscle tone, strength, and gross motor function in children with spastic cerebral palsy. [Subjects and Methods] One-hundred-seventy-five children with spastic cerebral palsy (88 diplegia; 78 quadriplegia) received neurodevelopmental treatment-based physical therapy for 35 minutes per day, 2-3 times per week for 1 year. Spasticity, muscle strength, and gross motor function were measured before and after treatment with the Modified Ashworth Scale, Manual Muscle Testing, and Gross Motor Function Measure, respectively.

[Results] Spasticity was significantly reduced after 1 year of treatment. The Gross Motor Functional Classification System levels I-II group showed a significant increase in muscle strength compared with the Gross Motor Functional Classification System levels III-V, and the latter showed a significant decrease in spasticity compared with the former.

[Conclusion] Neurodevelopmental treatment-based physical therapy in children with cerebral palsy seems to be effective in reducing spasticity, but does not improve gross motor function. Therefore, other interventional approaches are needed to improve gross motor function in children with cerebral palsy.

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DOI: 10.1589/jpts.29.966

PMCID: PMC5468216

PMID: 28626301

### **Effects of an Off-Axis Pivoting Elliptical Training Program on Gait Function in Persons With Spastic Cerebral Palsy: A Preliminary Study.**

Tsai LC , Ren Y, Gaebler-Spira DJ, Revivo GA, Zhang LQ.

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

This preliminary study examined the effects of off-axis elliptical training on reducing transverse-plane gait deviations and improving gait function in 8 individuals with cerebral palsy (CP) (15.5 ± 4.1 years) who completed an training program using a custom-made elliptical trainer that allows transverse-plane pivoting of the footplates during exercise. Lower-extremity off-axis control during elliptical exercise was evaluated by quantifying the root-mean-square and maximal angular displacement of the footplate pivoting angle. Lower-extremity pivoting strength was assessed. Gait function and balance were evaluated using 10-m walk test, 6-minute-walk test, and Pediatric Balance Scale. Toe-in angles during gait were quantified. Participants with CP demonstrated a significant decrease in the pivoting angle (root mean square and maximal angular displacement; effect size, 1.00-2.00) and increase in the lower-extremity pivoting strength (effect size = 0.91-1.09) after training. Reduced 10-m walk test time (11.9 ± 3.7 seconds vs. 10.8 ± 3.0 seconds; P = 0.004; effect size = 1.46), increased Pediatric Balance Scale score (43.6 ± 12.9 vs. 45.6 ± 10.8; P = 0.042; effect size = 0.79), and decreased toe-in angle (3.7 ± 10.5 degrees vs. 0.7 ± 11.7 degrees; P = 0.011; effect size = 1.22) were observed after training. We present an intervention to challenge lower-extremity off-axis control during a weight-bearing and functional activity for individuals with CP. Our preliminary findings suggest that this intervention was effective in enhancing off-axis control, gait function, and balance and reducing in-toeing gait in persons with CP. DOI: 10.1097/PHM.0000000000000632  
PMID: 28628539

### **Effect of body-weight suspension training versus treadmill training on gross motor abilities of children with spastic diplegic cerebral palsy.**

Emara HA , El-Gohary TM, Al-Johany AA.

*Eur J Phys Rehabil Med.* 2016 Jun;52(3):356-63. Epub 2016 Feb 4.

**BACKGROUND:** Suspension training and treadmill training are commonly used for promoting functional gross motor skills in children with cerebral palsy.

**AIM:** The aim of this study was to compare the effect of body-weight suspension training versus treadmill training on gross motor functional skills.

**DESIGN:** Assessor-blinded, randomized, controlled intervention study.

**SETTING:** Outpatient rehabilitation facility.

**POPULATION:** Twenty children with spastic diplegia (7 boys and 13 girls) in the age ranged from 6 to 8 years old were randomly allocated into two equal groups. All children were assessed at baseline, after 18-session and after 36-session.

**METHODS:** During the twelve-week outpatient rehabilitation program, both groups received traditional therapeutic exercises. Additionally, one group received locomotor training using the treadmill while the other group received locomotor training using body-weight suspension through the dynamic spider cage. Assessment included dimensions "D" standing and "E" walking of the gross motor function measure, in addition to the 10-m Walking Test and the five times sit to stand test. Training was applied three times per week for twelve consecutive weeks. **RESULTS:** No significant difference was found in standing or walking ability for measurements taken at baseline or after 18-session of therapy. Measurements taken at 36-session showed that suspension training achieved significantly (P<0.05) higher average score than treadmill training for dimension D as well as for dimension E. No significant difference was found between suspension training and treadmill training regarding walking speed or sit to stand transitional skills. **CONCLUSIONS:** Body-weight suspension training is effective in improving walking and locomotor capabilities in children with spastic diplegia. After three month suspension training was superior to treadmill training.

**CLINICAL REHABILITATION IMPACT:** Body-weight suspension training promotes adequate postural stability, good balance control, and less exertion which facilitates efficient and safe gait.

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PMID: 26845668 [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 Jun 21. doi: 10.1097/PHM.0000000000000776. [Epub ahead of print]

**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 activity for a maximum of 1.5 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

PMID: 28644244

### **Interactive wearable systems for upper body rehabilitation: a systematic review.**

Wang Q, Markopoulos P, Yu B, Chen W, Timmermans A.

*J Neuroeng Rehabil.* 2017 Mar 11;14(1):20. doi: 10.1186/s12984-017-0229-y.

**BACKGROUND:** The development of interactive rehabilitation technologies which rely on wearable-sensing for upper body rehabilitation is attracting increasing research interest. This paper reviews related research with the aim: 1) To inventory and classify interactive wearable systems for movement and posture monitoring during upper body rehabilitation, regarding the sensing technology, system measurements and feedback conditions; 2) To gauge the wearability of the wearable systems; 3) To inventory the availability of clinical evidence supporting the effectiveness of related technologies.

**METHOD:** A systematic literature search was conducted in the following search engines: PubMed, ACM, Scopus and IEEE (January 2010-April 2016).

**RESULTS:** Forty-five papers were included and discussed in a new cuboid taxonomy which consists of 3 dimensions: sensing technology, feedback modalities and system measurements. Wearable sensor systems were developed for persons in: 1) Neuro-rehabilitation: stroke ( $n = 21$ ), spinal cord injury ( $n = 1$ ), cerebral palsy ( $n = 2$ ), Alzheimer ( $n = 1$ ); 2) Musculoskeletal impairment: ligament rehabilitation ( $n = 1$ ), arthritis ( $n = 1$ ), frozen shoulder ( $n = 1$ ), bones trauma ( $n = 1$ ); 3) Others: chronic pulmonary obstructive disease ( $n = 1$ ), chronic pain rehabilitation ( $n = 1$ ) and other general rehabilitation ( $n = 14$ ). Accelerometers and inertial measurement units (IMU) are the most frequently used technologies (84% of the papers). They are mostly used in multiple sensor configurations to measure upper limb kinematics and/or trunk posture. Sensors are placed mostly on the trunk, upper arm, the forearm, the wrist, and the finger. Typically sensors are attachable rather than embedded in wearable devices and garments; although studies that embed and integrate sensors are increasing in the last 4 years. 16 studies applied knowledge of result (KR) feedback, 14 studies applied knowledge of performance (KP) feedback and 15 studies applied both in various modalities. 16 studies have conducted their evaluation with patients and reported usability tests, while only three of them conducted clinical trials including one randomized clinical trial.

**CONCLUSIONS:** This review has shown that wearable systems are used mostly for the monitoring and provision of feedback on posture and upper extremity movements in stroke rehabilitation. The results indicated that



accelerometers and IMUs are the most frequently used sensors, in most cases attached to the body through ad hoc contraptions for the purpose of improving range of motion and movement performance during upper body rehabilitation. Systems featuring sensors embedded in wearable appliances or garments are only beginning to emerge. Similarly, clinical evaluations are scarce and are further needed to provide evidence on effectiveness and pave the path towards implementation in clinical settings.

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DOI: 10.1186/s12984-017-0229-y

PMCID: PMC5346195

PMID: 28284228 [Indexed for MEDLINE]

**Immediate effects of quick trunk movement exercise on sit-to-stand movement in children with spastic cerebral palsy: a pilot study.**

Abdolrahmani A , Sakita H , Yonetsu R , Iwata A .

*J Phys Ther Sci.* 2017 May;29(5):905-909. doi: 10.1589/jpts.29.905. Epub 2017 May 16.

[Purpose] This pilot study examined the immediate effects of quick-seated trunk exercise on sit-to-stand movement in children with cerebral palsy. [Subjects and

Methods] Five children with spastic cerebral palsy (hemiplegia, 3; diplegia, 2; age 6-17 years) performed five sessions of natural-seated trunk exercise at a self-selected speed (control). Following a 50-min rest period, five sessions of the quick-seated trunk exercise were conducted (experimental intervention) for each child. Each seated trunk exercise included 10 repetitions in the anterior-posterior and lateral directions. Sit-to-stand was assessed before and after each intervention using a motion analysis system. The total sit-to-stand task duration and sagittal, angular movements of the trunk, hip, knee, and ankle were calculated. [Results] There was a significant difference in the total duration of the sit-to-stand movement before and after natural-seated trunk exercise ( $2.40 \pm 0.67$  s vs.  $2.24 \pm 0.44$  s) as well as quick seated trunk exercise ( $2.41 \pm 0.54$  s vs.  $2.06 \pm 0.45$  s). However, the sit-to-stand duration increased after natural-seated trunk exercise in one participant while that after quick-seated trunk exercise decreased in all participants.

[Conclusion] Performing a trunk exercise in a seated position resulted in immediate improvement of the temporal sit-to-stand parameters in children with spastic cerebral palsy.

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DOI: 10.1589/jpts.29.905

PMCID: PMC5462696

PMID: 28603369

**Markerless motion capture systems as training device in neurological rehabilitation: a systematic review of their use, application, target population and efficacy.**

Knippenberg E , Verbrugge J , Lamers I , Palmaers S , Timmermans A , Spooren A .

*J Neuroeng Rehabil.* 2017 Jun 24;14(1):61. doi: 10.1186/s12984-017-0270-x.

BACKGROUND: Client-centred task-oriented training is important in neurological rehabilitation but is time consuming and costly in clinical practice. The use of technology, especially motion capture systems (MCS) which are low cost and easy to apply in clinical practice, may be used to support this kind of training, but knowledge and evidence of their use for training is scarce. The present review aims to investigate 1) which motion capture systems are used as training devices in neurological rehabilitation, 2) how they are applied, 3) in which target population, 4) what the content of the training and 5) efficacy of training with MCS is.

METHODS: A computerised systematic literature review was conducted in four databases (PubMed, Cinahl, Cochrane Database and IEEE). The following MeSH terms and key words were used: Motion, Movement, Detection, Capture, Kinect, Rehabilitation, Nervous System Diseases, Multiple Sclerosis, Stroke, Spinal Cord, Parkinson Disease, Cerebral Palsy and Traumatic Brain Injury. The Van Tulder's Quality assessment was used to score the methodological quality of the selected studies. The descriptive analysis is reported by MCS, target population, training parameters and training efficacy.

RESULTS: Eighteen studies were selected (mean Van Tulder score =  $8.06 \pm 3.67$ ). Based on methodological quality, six studies were selected for analysis of training efficacy. Most commonly used MCS was Microsoft Kinect, training was mostly conducted in upper limb stroke rehabilitation. Training programs varied in intensity, frequency and content.

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None of the studies reported an individualised training program based on client-centred approach. **CONCLUSION:** Motion capture systems are training devices with potential in neurological rehabilitation to increase the motivation during training and may assist improvement on one or more International Classification of Functioning, Disability and Health (ICF) levels. Although client-centred task-oriented training is important in neurological rehabilitation, the client-centred approach was not included. Future technological developments should take up the challenge to combine MCS with the principles of a client-centred task-oriented approach and prove efficacy using randomised controlled trials with long-term follow-up.

TRIAL REGISTRATION: Prospero registration number 42016035582 .

[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5482943/pdf/12984\\_2017\\_Article\\_270.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5482943/pdf/12984_2017_Article_270.pdf)

DOI: 10.1186/s12984-017-0270-x

PMID: 28646914

### **The effects of dosage time and frequency on motor outcomes in children with cerebral palsy: A systematic review.**

Cope S , Mohn-Johnsen S .

*Dev Neurorehabil.* 2017 Feb 16:1-12. doi: 10.1080/17518423.2017.1282053. [Epub ahead of print]

**PURPOSE:** Provide an updated review regarding treatment dosage for children with cerebral palsy (CP) by examining the variables of type, time, frequency, and intensity.

**METHODS:** A systematic review was performed with 30 articles meeting the inclusion criteria. Two authors independently extracted data including information about risk of bias. Ten articles were included in the review.

**RESULTS:** Eight studies manipulated time, two studies manipulated frequency, and three studies manipulated both variables. No studies investigated intensity. Findings suggest that manipulating time and/or frequency may result in better motor function for higher total dosing; however, benefits were not consistent across studies and few showed clinically significant improvements.

**CONCLUSION:** This most current evidence regarding the effect of dosage on motor function for children with CP suggests that there is insufficient evidence to support implementing high-dosage therapy. Further research is needed to clarify the relationship between dosage variables on motor function for children with CP.

DOI: 10.1080/17518423.2017.1282053

PMID: 28632463

### **Structured skill practice during intensive bimanual training leads to better trunk and arm control than unstructured practice in children with unilateral spastic cerebral palsy.**

Hung YC , Brandão MB , Gordon AM .

*Res Dev Disabil.* 2017 Jan;60:65-76. doi: 10.1016/j.ridd.2016.11.012. Epub 2016 Nov 29.

**BACKGROUND:** Recently, intensive practice showed good efficacy in improving upper extremity function for children with unilateral spastic cerebral palsy (USCP). However, little is known about the significance of skill progression frequently used during intensive practice.

**AIMS:** We evaluate the importance of skill progression during intensive bimanual practice on movement coordination.

**METHODS AND PROCEDURES:** Twenty children with USCP (average age: 8.5; MACS levels: I-III) participated in the study. Ten children were randomly allocated to a structured practice group (SPG) with skill progression, and the other 10 children randomized to an unstructured practice group (UPG) without skill progression. Both groups practiced bimanual activities 6h a day for 15days. Children were asked to perform a bimanual drawer-opening task before and after intensive practice using 3-D kinematic analyses.

**OUTCOMES AND RESULTS:** Both groups showed improved temporal bimanual coordination with increased normalized movement overlap of the two hands ( $p=0.005$ ) and decreased goal synchronization time ( $p=0.002$ ). However, only the SPG showed decreased trunk involvement ( $p=0.01$ ) and increased elbow joint excursion ( $p=0.017$ ) with decreased variability ( $p=0.015$  and  $0.048$  respectively).

**CONCLUSIONS AND IMPLICATIONS:** The results highlighted the importance of skill progression for intensive practice to improve upper extremity and trunk movement control and consistency for children with USCP.

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DOI: 10.1016/j.ridd.2016.11.012

PMID: 27912104 [Indexed for MEDLINE]

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## Using the electronic medical record to study the association of child and environmental characteristics on the type of physical therapy services delivered to individuals with cerebral palsy.

Bailes AF , Gannotti M , Fenchel M .

*Physiother Theory Pract.* 2017 Jun 7:1-9. doi: 10.1080/09593985.2017.1328717. [Epub ahead of print]

**OBJECTIVE:** The purpose of this study was to characterize the intervention type delivered to individuals with cerebral palsy (CP) in a pediatric outpatient medical setting and to identify factors associated with the total amount of service within each type.

**SUBJECTS:** Four hundred and twenty-five individuals with CP (1-33 years) Gross Motor Function Classification System (GMFCS): Level I (n = 152); II (n = 63); III (n = 55); IV (n = 80); and V (n = 75).

**METHODS:** Billing code data was extracted retrospectively from 2008 medical records and categorized to reflect four types: body structures and function (BSF), activity (ACT), environment (ENV), and examination (EXAM). Age at first visit, type of insurance at first visit and GMFCS level was also collected.

**RESULTS:** The majority (47%) of the PT delivered was categorized as activity based units, 25% as body structure and function, 21% as environment, and 7% as examination. Significant differences were found in: total BSF therapy units among GMFCS ( $p = 0.008$ ) and insurance type ( $p < 0.001$ ), ACT units among GMFCS ( $p < 0.001$ ), age groups ( $p < 0.001$ ), and insurance type ( $p = 0.008$ ), and ENV units among GMFCS ( $p = 0.04$ ). The amount of variability ( $R(2)$ ) explained by the model for each category BSF, ACT, and ENV was 0.09 ( $p < 0.0001$ ), 0.15 ( $p < 0.0001$ ) and 0.02 ( $p = 0.04$ ), respectively.

**CONCLUSION:** Variations in amount of services received among types of intervention are associated with child and environmental characteristics. Low  $R(2)$  values indicate the need to collect information on other factors that influence service delivery. Data that are standardized and reliably collected should be validated and compared across institutions to support larger studies of service delivery patterns.

DOI: 10.1080/09593985.2017.1328717

PMID: 28590797

## Robots – Exosquelette

### Locomotor training through a novel robotic platform for gait rehabilitation in pediatric population: short report.

Bayón C , Lerma S , Ramírez O , Serrano JI , Del Castillo MD , Raya R , Belda-Lois JM , Martínez I , Rocon E .

*J Neuroeng Rehabil.* 2016 Nov 14;13(1):98.

**BACKGROUND:** Cerebral Palsy (CP) is a disorder of posture and movement due to a defect in the immature brain. The use of robotic devices as alternative treatment to improve the gait function in patients with CP has increased. Nevertheless, current gait trainers are focused on controlling complete joint trajectories, avoiding postural control and the adaptation of the therapy to a specific patient. This paper presents the applicability of a new robotic platform called CPWalker in children with spastic diplegia.

**FINDINGS:** CPWalker consists of a smart walker with body weight and autonomous locomotion support and an exoskeleton for joint motion support. Likewise, CPWalker enables strategies to improve postural control during walking. The integrated robotic platform provides means for testing novel gait rehabilitation therapies in subjects with CP and similar motor disorders. Patient-tailored therapies were programmed in the device for its evaluation in three children with spastic diplegia for 5 weeks. After ten sessions of personalized training with CPWalker, the children improved the mean velocity ( $51.94 \pm 41.97$  %), cadence ( $29.19 \pm 33.36$  %) and step length ( $26.49 \pm 19.58$  %) in each leg. Post-3D gait assessments provided kinematic outcomes closer to normal values than Pre-3D assessments.

**CONCLUSIONS:** The results show the potential of the novel robotic platform to serve as a rehabilitation tool. The autonomous locomotion and impedance control enhanced the children's participation during therapies. Moreover, participants' postural control was substantially improved, which indicates the usefulness of the approach based on promoting the patient's trunk control while the locomotion therapy is executed. Although results are promising, further studies with bigger sample size are required.

[Free PMC Article](#)

DOI: 10.1186/s12984-016-0206-x

PMCID: PMC5109815

PMID: 27842562 [Indexed for MEDLINE]

**Robotic resistance treadmill training improves locomotor function in children with cerebral palsy: a randomized controlled pilot study.**

Wu M , Kim J , Gaebler-Spira DJ , Schmit BD , Arora P .

*Arch Phys Med Rehabil.* 2017 May 30. pii: S0003-9993(17)30367-2. doi:10.1016/j.apmr.2017.04.022. [Epub ahead of print]

**OBJECTIVE:** To determine whether applying controlled resistance forces to the legs during the swing phase of gait may improve the efficacy of treadmill training compared to applying controlled assistance forces in children with cerebral palsy (CP).

**DESIGN:** Randomized controlled study.

**SETTING:** Research unit of rehabilitation hospital.

**PARTICIPANTS:** Children with spastic CP (n = 23, average age 10.6 years old, ranged from 6-14, GMFCS levels: I to IV).

**INTERVENTIONS:** Participants were randomly assigned to receive controlled assistance (n=11) or resistance (n=12) loads applied to the legs at the ankle. Participants underwent robotic treadmill training 3 times a week for 6 weeks (18 sessions). A controlled swing assistance/resistance load was applied to both legs starting from toe-off to mid-swing phase of gait during training.

**MAIN OUTCOME MEASURES:** Outcome measures consisted of overground walking speed, 6 minute walking distance, and GMFM scores, and were assessed pre, post 6 weeks of training, and 8 weeks after the end of training.

**RESULTS:** Following 6 weeks of treadmill training for participants from the resistance training group, fast walking speed and 6 minute walking distance significantly improved (18% and 30% increases, respectively), and 6 minute walking distance was still significantly greater than baseline (35% increase) 8 weeks after the end of training. In contrast, overground gait speed and 6 minute walking distance had no significant changes after robotic assistance training.

**CONCLUSION:** Results from the current study indicated that robotic resistance treadmill training is more effective than assistance training in improving locomotor function in children with CP.

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DOI: 10.1016/j.apmr.2017.04.022

PMID: 28576629

**The effectiveness of robotic-assisted gait training for paediatric gait disorders: systematic review.**

Lefmann S , Russo R , Hillier S .

*J Neuroeng Rehabil.* 2017 Jan 5;14(1):1. doi: 10.1186/s12984-016-0214-x.

**BACKGROUND:** Robotic-assisted gait training (RAGT) affords an opportunity to increase walking practice with mechanical assistance from robotic devices, rather than therapists, where the child may not be able to generate a sufficient or correct motion with enough repetitions to promote improvement. However, the devices are expensive and clinicians and families need to understand if the approach is worthwhile for their children, and how it may be best delivered.

**METHODS:** The objective of this review was to identify and appraise the existing evidence for the effectiveness of RAGT for paediatric gait disorders, including modes of delivery and potential benefit. Six databases were searched from 1980 to October 2016, using relevant search terms. Any clinical trial that evaluated a clinical aspect of RAGT for children/adolescents with altered gait was selected for inclusion. Data were extracted following the PRISMA approach. Seventeen trials were identified, assessed for level of evidence and risk of bias, and appropriate data extracted for reporting.

**RESULTS:** Three randomized controlled trials were identified, with the remainder of lower level design. Most individual trials reported some positive benefits for RAGT with children with cerebral palsy (CP), on activity parameters such as standing ability, walking speed and distance. However, a meta-analysis of the two eligible RCTs did not confirm this finding ( $p = 0.72$ ). Training schedules were highly variable in duration and frequency and adverse events were either not reported or were minimal. There was a paucity of evidence for diagnoses other than CP.

**CONCLUSION:** There is weak and inconsistent evidence regarding the use of RAGT for children with gait disorders. If clinicians (and their clients) choose to use RAGT, they should monitor individual progress closely with appropriate outcome measures including monitoring of adverse events. Further research is required using higher level trial design,

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increased numbers, in specific populations and with relevant outcome measures to both confirm effectiveness and clarify training schedules.

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DOI: 10.1186/s12984-016-0214-x

PMCID: PMC5217646

PMID: 28057016 [Indexed for MEDLINE]

### **Stimulation transcrânienne – Neuroprothèses**

#### **A Stepwise Approach: Decreasing Infection in Deep Brain Stimulation for Childhood Dystonic Cerebral Palsy.**

Johans SJ , Swong KN , Hofler RC , Anderson DE .

*J Child Neurol.* 2017 Jan 1;883073817713900. doi: 10.1177/0883073817713900. [Epub ahead of print]

Dystonia is a movement disorder characterized by involuntary muscle contractions, which cause twisting movements or abnormal postures. Deep brain stimulation has been used to improve the quality of life for secondary dystonia caused by cerebral palsy. Despite being a viable treatment option for childhood dystonic cerebral palsy, deep brain stimulation is associated with a high rate of infection in children. The authors present a small series of patients with dystonic cerebral palsy who underwent a stepwise approach for bilateral globus pallidus interna deep brain stimulation placement in order to decrease the rate of infection. Four children with dystonic cerebral palsy who underwent a total of 13 surgical procedures (electrode and battery placement) were identified via a retrospective review. There were zero postoperative infections. Using a multistaged surgical plan for pediatric patients with dystonic cerebral palsy undergoing deep brain stimulation may help to reduce the risk of infection.

DOI: 10.1177/0883073817713900

PMID: 28604158

#### **Cerebellar transcranial direct current stimulation in children with ataxic cerebral palsy: A sham-controlled, crossover, pilot study.**

Grecco LA , Oliveira CS , Duarte NA , Lima VL , Zanon N , Fregni F .

*Dev Neurorehabil.* 2017 Apr;20(3):142-148. doi: 10.3109/17518423.2016.1139639. Epub 2016 Mar 22.

**OBJECTIVE:** The aim of the present study was to analyze the use of anodal tDCS of the cerebellar region combined with treadmill training to improve balance and functional performance in children with ataxic cerebral palsy.

**DESIGN:** Single-blind, sham-controlled, crossover, pilot study.

**SETTING:** Rehabilitation center and research motion analysis laboratory.

**PARTICIPANTS:** Children (N = 6) with ataxic cerebral palsy and balance deficit.

**MAIN OUTCOME MEASURES:** Static balance (oscillations of the center of pressure), functional balance (Pediatric Balance Scale) and functional performance (Pediatric Evaluation of Disability Inventory) were evaluated. **RESULTS:** Significant reductions occurred in oscillations of the center of pressure with eyes closed after active anodal tDCS only. The effects of treadmill training on functional balance and functional performance in mobility were maintained in the active tDCS group only. **CONCLUSION:** These preliminary data support the notion that anodal tDCS of the cerebellar region combined with treadmill training improves balance in children with ataxic cerebral palsy.

DOI: 10.3109/17518423.2016.1139639

PMID: 27003795 [Indexed for MEDLINE]

#### **Effects of a single session of transcranial direct current stimulation on upper limb movements in children with cerebral palsy: A randomized, sham-controlled study.**

Moura RCF , Santos C , Collange Grecco L , Albertini G , Cimolin V , Galli M , Oliveira C .

*Dev Neurorehabil.* 2017 Feb 25;1-8. doi: 10.1080/17518423.2017.1282050. [Epub ahead of print]

**INTRODUCTION:** Motor impairment in children with spastic hemiparetic cerebral palsy (CP) is generally more prominent in the affected upper limb, leading to limitations in hand function stemming from deficiencies in motor coordination and selective motor control as well as muscle weakness, slower execution of movements and deficient integration of sensory-motor information.

**OBJECTIVE:** Determine the effect of a single session of anodal transcranial directcurrent stimulation (tDCS) combined with functional training on the spatiotemporal variables of upper arm movements in children with spastic hemiparesis.

**METHOD:** A randomized, sham-controlled trial with a blinded evaluator was conducted involving 20 children with CP between 6 and 12 years of age. The spatiotemporal variables of the upper limbs were analyzed by comparing the results of Evaluation 1 (before stimulation) and Evaluation 2 (immediately after stimulation). The protocol consisted of a 20-minute session of functional training of the paretic upper limb combined with tDCS administered over the primary motor cortex of the hemisphere contralateral to the motor impairment at an intensity of 1 mA. The participants were randomly allocated to two groups: experimental group (anodal tDCS) and control group (sham tDCS).

**RESULTS:** Statistically significant ( $p < 0.05$ ) reductions in total movement duration and returning movement duration were found in both the paretic and non-paretic limbs in the group submitted to active tDCS. No significant differences were found in the control group for any of the variables analyzed.

**CONCLUSION:** A single session of anodal tDCS over the primary motor cortex of the hemisphere ipsilateral to the brain lesion led to momentary motor improvements in both upper limbs of the children with spastic hemiparetic CP analyzed in the present study.

DOI: 10.1080/17518423.2017.1282050

PMID: 28632467

### **Participation and community-based walking activity after neuroprosthesis use in children with hemiplegic cerebral palsy: A pilot study<sup>1</sup>.**

Bailes AF , Caldwell C , Clay M , Tremper M , Dunning K , Long J .

*J Pediatr Rehabil Med.* 2017 May 17;10(2):71-79. doi: 10.3233/PRM-170434.

**PURPOSE:** To explore the effects of neuroprosthesis use on participation, level of community-based walking activity, safety and satisfaction in children with hemiplegic CP.

**METHODS:** Eleven children (mean 9 years 11 months) with hemiplegic CP Gross Motor Function Classification System (GMFCS) Level I and II participated in a 16-week intervention using the Ness L300 neuroprosthesis. Outcome measures included satisfaction and performance with self-selected participation goals (Canadian Occupational Performance Measure (COPM)), level of community-based walking activity (Step Watch Activity Monitor (SAM)), trip and fall frequency (caregiver report) and a satisfaction questionnaire.

**RESULTS:** Significant ( $p < 0.001$ ) improvements in performance and satisfaction with self-selected participation goals (COPM) were demonstrated. No significant changes were noted in SAM values. A significant ( $p = 0.01$ ) decrease in trips was demonstrated from baseline to post. Satisfaction with the device was high.

**CONCLUSION:** Results indicate that daily neuroprosthesis use may improve performance and satisfaction with participation goals and reduce trips. No changes in community-based walking activity were noted. Further study is needed to examine response based on GMFCS levels, across geographical regions and between FES neuroprosthesis and a control group.

DOI: 10.3233/PRM-170434

PMID: 28582881

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

### **A pilot single-blind multicentre randomized controlled trial to evaluate the potential benefits of computer-assisted arm rehabilitation gaming technology on the arm function of children with spastic cerebral palsy.**

Preston N , Weightman A , Gallagher J , Levesley M , Mon-Williams M , Clarke M , O'Connor RJ .

*Clin Rehabil.* 2016 Oct;30(10):1004-1015. Epub 2015 Sep 13.

**OBJECTIVE:** To evaluate the potential benefits of computer-assisted arm rehabilitation gaming technology on arm function of children with spastic cerebral palsy.

**DESIGN:** A single-blind randomized controlled trial design. Power calculations indicated that 58 children would be required to demonstrate a clinically important difference.

**SETTING:** Intervention was home-based; recruitment took place in regional spasticity clinics.

**PARTICIPANTS:** A total of 15 children with cerebral palsy aged five to 12 years were recruited; eight to the device group.

**INTERVENTIONS:** Both study groups received 'usual follow-up treatment' following spasticity treatment with botulinum toxin; the intervention group also received a rehabilitation gaming device.

**MAIN MEASURES:** ABILHAND-kids and Canadian Occupational Performance Measure were performed by blinded assessors at baseline, six and 12 weeks. **RESULTS:** An analysis of covariance showed no group differences in mean ABILHAND-kids scores between time points. A non-parametric analysis of variance on Canadian Occupational Performance Measure scores showed a statistically significant improvement across time points ( $\chi^2(2,15) = 6.778$ ,  $p = 0.031$ ), but this improvement did not reach minimal clinically important difference. Mean daily device use was seven minutes. Recruitment did not reach target owing to unanticipated staff shortages in clinical services. Feedback from children and their families indicated that the games were not sufficiently engaging to promote sufficient use that was likely to result in functional benefits.

**CONCLUSION:** This study suggests that computer-assisted arm rehabilitation gaming does not benefit arm function, but a Type II error cannot be ruled out.

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DOI: 10.1177/0269215515604699

PMID: 26370148 [Indexed for MEDLINE]

### **Do active video games benefit the motor skill development of non-typically developing children and adolescents: A systematic review. Je l'aurais mis dans une la rubrique Réalité virtuelle Jeux vidéos**

Page ZE , Barrington S , Edwards J , Barnett LM .

*J Sci Med Sport. 2017 May 18. pii: S1440-2440(17)30411-5. doi:10.1016/j.jsams.2017.05.001. [Epub ahead of print]*

**OBJECTIVES:** The use of interactive video gaming, known as 'exergames' or 'active video games (AVG)' may provide an opportunity for motor skill development. Youth with non-typical patterns of development may have deficits in gross motor skill capacities and are therefore an intervention target. The aim was to determine the effectiveness of AVG use on motor skill development in non-typically developing children and adolescents.

**DESIGN:** Review article. **METHODS:** The PRISMA protocol was used to conduct a systematic review of EBSCOhost, Embase, Gale Cengage, Informit, Ovid, ProQuest, PubMed, Scopus and Web of Science databases. A total of 19 articles met inclusion criteria (non-typically developing participants such as those with a learning or developmental delay aged 3-18, use of an AVG console, assessed one or more gross motor skills). Studies were excluded if gross motor skill outcomes encompassed fine motor skills or reflected mobility related to daily living.

**RESULTS:** Interventions included children and adolescents with eight different conditions. The Nintendo Wii was the most utilised gaming platform (14/19 studies). Studies examined a combination of skills, with most examining balance (15/19), five studies examining ball skills, and other gross motor skills such as coordination (3 studies), running (3 studies) and jumping (3 studies). There was strong evidence that AVG's improved balance. AVG's also appeared to benefit participants with Cerebral Palsy.

**CONCLUSIONS:** AVG's could be a valuable tool to improve gross motor skills of non-typically developing children. There is scope for further exploration, particularly of ball, coordination and locomotor skills and varying platforms to draw more conclusive evaluations.

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DOI: 10.1016/j.jsams.2017.05.001

PMID: 28600111

### **Home-based Nintendo Wii training to improve upper-limb function in children ages 7 to 12 with spastic hemiplegic cerebral palsy.**

Kassee C , Hunt C , Holmes MWR , Lloyd M .

*J Pediatr Rehabil Med. 2017 May 17;10(2):145-154. doi: 10.3233/PRM-170439.*

This pilot study compared a Nintendo Wii intervention to single-joint resistance training for the upper limb in children ages 7 to 12 with spastic hemiplegic cerebral palsy (CP). Children were randomized to Wii training (n= 3), or resistance training (n= 3) and trained at home for 6 weeks. Pre, post and 4-week follow-up measures were collected. Outcome measures were the Melbourne Assessment (MA2), and ABILHAND-Kids, and grip strength. Compliance, motivation and feasibility of each intervention was explored using daily logbook responses and questionnaires.

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Descriptive statistics were used. Three children improved in the MA2, two of which were in the Wii training group. Improvements in the ABILHAND-Kids were minimal for all participants. Grip strength improvements were observed in 3 participants, two of which were in the resistance training group. The Wii training group reported higher compliance and more consistently positive responses to motivation and feasibility questions. Therefore, Wii training may be an effective home-based rehabilitation strategy, and is worth exploring in a larger trial. Implications of Wii training in the context of motivation theory are discussed.

DOI: 10.3233/PRM-170439

PMID: 28582885

### **Quantifying selective elbow movements during an exergame in children with neurological disorders: a pilot study.**

van Hedel HJ , Häfliger N , Gerber CN .

*J Neuroeng Rehabil.* 2016 Oct 21;13(1):93.

**BACKGROUND:** It is difficult to distinguish between restorative and compensatory mechanisms underlying (pediatric) neurorehabilitation, as objective measures assessing selective voluntary motor control (SVMC) are scarce.

**METHODS:** We aimed to quantify SVMC of elbow movements in children with brain lesions. Children played an airplane game with the glove-based YouGrabber system. Participants were instructed to steer an airplane on a screen through a cloud-free path by correctly applying bilateral elbow flexion and extension movements. Game performance measures were (i) % time on the correct path and (ii) similarity between the ideal flight path and the actually flown path. SVMC was quantified by calculating a correlation coefficient between the derivative of the ideal path and elbow movements. A therapist scored whether the child had used compensatory movements.

**RESULTS:** Thirty-three children with brain lesions (11 girls; 12.6 ± 3.6 years) participated. Clinical motor and cognitive scores correlated moderately with SVMC (0.50-0.74). Receiver Operating Characteristics analyses showed that SVMC could differentiate well and better than clinical and game performance measures between compensatory and physiological movements.

**CONCLUSIONS:** We conclude that a simple measure assessed while playing a game appears promising in quantifying SVMC. We propose how to improve the methodology, and how this approach can be easily extended to other joints.

[Free PMC Article](#)

DOI: 10.1186/s12984-016-0200-3

PMCID: PMC5073824

PMID: 27769301 [Indexed for MEDLINE]

### **The cost-effectiveness of a web-based multimodal therapy for unilateral cerebral palsy: the Mitii randomized controlled trial.**

Comans T , Mihala G , Sakzewski L , Boyd RN , Scuffham P .

*Dev Med Child Neurol.* 2017 Jul;59(7):756-761. doi: 10.1111/dmcn.13414. Epub 2017 Mar 1.

**AIM:** To estimate the cost-effectiveness of the Mitii training system for improvements in upper limb function for children with unilateral cerebral palsy (CP). Mitii is a web-based programme delivered at home with set-up and monitoring by therapists.

**METHOD:** A randomized controlled trial was conducted comparing the Mitii training programme to usual care. The Assessment of Motor and Process Skills (AMPS) and Canadian Occupational Performance Measure (COPM) were collected for each child at baseline and 20 weeks. Responders to training were characterized as those who met a minimally important difference on either the AMPS (0.3 logits) or COPM (2 points). Costs of the intervention were calculated by quantifying the equipment and staff cost. A cost per responder was calculated for each of the outcome measures.

**RESULTS:** A total of 102 participants (52 males, 50 females) were included in the analysis. There were significantly more responders in the training group on both the AMPS motor and process scales and the COPM performance and satisfaction scales. The cost per responder for the Mitii programme ranged from AU\$3078 to AU\$4191 depending on the scale used.

**INTERPRETATION:** The cost of delivering the Mitii training system is modest relative to the improvements in function.

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DOI: 10.1111/dmcn.13414

PMID: 28247406 [Indexed for MEDLINE]

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## Thérapies cellulaires

### **Administration of Autologous Bone Marrow-Derived Stem Cells for Treatment of Cerebral Palsy Patients: A Proof of Concept.**

Bansal H , Singh L , Verma P , Agrawal A , Leon J , Sundell IB , Koka PS .  
*J Stem Cells*. 2016;11(1):37-49.

**Background:** Stem cell therapy is a promising treatment for cerebral palsy, which refers to a category of brain diseases that are associated with chronic motor disability in children. Autologous bone marrow stem cells may be a better cell source and have been studied for the treatment of cerebral palsy because of their functions in tissue repair and the regulation of immunological processes.

**Methods:** To assess autologous marrow stem cells as a novel treatment for patients with moderate-to-severe cerebral palsy, a total of 10 cerebral palsy patients were enrolled in this clinical study with 24 months follow-up. A total of 10 cerebral palsy patients received autologous bone marrow cells transplantation ( $4.5 \times 10^8$ ) mononuclear cells; 90% viability) into the subarachnoid cavity and rehabilitation.

**Results:** We recorded the gross motor function measurement scores, manual ability function measurement score, and adverse events up to 24 months post-treatment. The gross motor function measurement scores were significantly higher at month 6 post-treatment compared with the baseline scores and were stable up to 24 months follow-up. The increase in manual ability and communication function measurement scores at 6 months were not significant when compared to the baseline score. All the 10 patients survived and none of the patients experienced any serious adverse events or complications.

**Conclusion:** Our results indicated that bone marrow derived MNCs are safe and effective for the treatment of motor deficits related to cerebral palsy. Further randomized clinical trials are necessary to establish the efficacy of this procedure.

PMID: 28296863 [Indexed for MEDLINE]

### **Cell-Based Therapy Using Umbilical Cord Blood for Novel Indications in Regenerative Therapy and Immune Modulation: an Updated Systematic Scoping Review of the Literature.**

Rizk M , Aziz J , Shorr R , Allan DS .

*Biol Blood Marrow Transplant*. 2017 Jun 5. pii: S1083-8791(17)30498-6. doi: 10.1016/j.bbmt.2017.05.032. [Epub ahead of print]

**BACKGROUND:** Cell-based therapy using umbilical cord blood is used increasingly for novel applications. To balance heightened public expectations and ensure appropriateness of emerging cell-based treatment choices, regular evidence-based assessment of novel cord blood-derived therapies is needed.

**METHODS AND RESULTS:** We performed a systematic search of the literature and identified 57 studies (814 patients) for analysis. 16 studies (353 patients) included control groups for comparison. The most commonly reported novel indication for therapy was neurological diseases (25 studies, 476 patients), including studies of cerebral palsy (12 studies, 276 patients). Other indications included diabetes mellitus (9 studies, 149 patients), cardiac and vascular diseases (7 studies, 24 patients) and hepatic diseases (4 studies, 106 patients). Most studies administered total nucleated cells, mononuclear cells or CD34-selected cells (31 studies, 513 patients) while 20 studies described the use of cord blood-derived mesenchymal stromal cells. The majority of reports (46 studies, 627 patients) described cellular products obtained from allogeneic sources while 11 studies (187 patients) used autologous products. We identified 3 indications where multiple prospective controlled studies have been published (4/4 reported clinical benefit in cerebral palsy, 1/3 studies reported benefit for cirrhosis, and 1/3 studies reported biochemical response in type 1 diabetes), although heterogeneity between studies precluded meaningful pooled analysis of results.

**CONCLUSIONS:** We anticipate a more clear understanding of the clinical benefit for specific indications once more controlled studies are reported. Patients should continue to be enrolled on registered clinical trials for novel therapies. Blood establishments, transplant centres, and regulatory bodies need to prepare for greater clinical demand.

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DOI: 10.1016/j.bbmt.2017.05.032

PMID: 28602892

### **Transplantation of allogeneic adipose-derived mesenchymal stem cells in a cerebral palsy patient.**

Kantake M , Hirano A , Sano M , Urushihata N , Tanemura H , Oki K , Suzaki E .  
*Regen Med.* 2017 Jun 2. doi: 10.2217/rme-2017-0043. [Epub ahead of print]

We studied the safety and efficacy of allogeneic human adipose-derived mesenchymal cell (hAMSC) transplantation in a patient with cerebral palsy (CP). The patient received six infusions of allogeneic hAMSCs intravenously, without or with intramuscular or local injections and was followed up for 12 months. Changes in quality of life were assessed using the Short Form 8 health survey questionnaire incorporating physical and mental component summary scores. Clinical manifestations improved remarkably, with significant improvements in the quality of life physical and mental scores. No serious adverse effect or toxicity was observed. The patient maintained his recovery very well at 12 months follow-up. This case study suggests that allogeneic hAMSCs can be administered safely and feasibly in a pediatric patient with CP. Whether the results can be generalized to other pediatric patients with CP warrants further investigation.

DOI: 10.2217/rme-2017-0043

PMID: 28573917

### **Méthodes alternatives - Autres**

### **Horseback riding therapy in addition to conventional rehabilitation program decreases spasticity in children with cerebral palsy: A small sample study.**

Alemdaroğlu E , Yanıkoğlu İ , Öken Ö , Uçan H , Ersöz M , Köseoğlu BF , Kapıcıoğlu Mİ .

*Complement Ther Clin Pract.* 2016 May;23:26-9. doi: 10.1016/j.ctcp.2016.02.002. Epub 2016 Feb 13.

**OBJECTIVE:** To evaluate the short-term effects of horseback riding therapy in addition to a conventional rehabilitation program in children with cerebral palsy.

**METHODS:** Nine children receiving horseback riding therapy in addition to conventional rehabilitation (Group 1) and seven children receiving conventional rehabilitation alone (Group 2) were assessed at baseline and 5 weeks later. Assessed were: modified functional reach test (MFRT), hip abduction angle, the Ashworth Scale for hip adductor muscle spasticity, knee distance test, and the Gross Motor Function Classification System (GMFCS).

**RESULTS:** The percentage change in hip adductor spasticity on the Ashworth Scale was 22% in Group 1 and 0% in Group 2 (significant difference;  $p = 0.016$ ). Comparison of changes on the MFRT, GMFCS, knee distance test and hip abduction angle showed that the differences between Groups 1 and 2 were not significant.

**CONCLUSIONS:** In these children, horseback riding therapy in addition to conventional rehabilitation resulted in significant improvement in adductor spasticity on short-term follow-up.

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DOI: 10.1016/j.ctcp.2016.02.002

PMID: 27157954 [Indexed for MEDLINE]

### **To be active through indoor-climbing: an exploratory feasibility study in a group of children with cerebral palsy and typically developing children. Je l'aurais mis dans traitements alternatifs comme hippothérapie**

Schram Christensen M , Jensen T , Voigt CB , Nielsen JB , Lorentzen J .

*BMC Neurol.* 2017 Jun 15;17(1):112. doi: 10.1186/s12883-017-0889-z.

**BACKGROUND:** Cerebral Palsy (CP) is the most common cause of motor disabilities in children and young adults and it is also often associated with cognitive and physiological challenges. Climbing requires a multifaceted repertoire of movements, participants at all levels of expertise may be challenged functionally and cognitively, making climbing of great potential interest in (re)habilitation settings. However, until now only few research projects have investigated the feasibility of climbing as a potential activity for heightening physical activity in children with CP and the possible beneficial effects of climbing activities in populations with functional and/or cognitive challenges. The aim of this study was therefore to test the feasibility of an intensive 3 weeks indoor-climbing training program in children with CP and typically developing (TD) peers. In addition we evaluated possible functional and cognitive benefits of 3 weeks of intensive climbing training in 11 children with cerebral palsy (CP) aged 11-13 years and six of their TD peers. **METHOD:** The study was designed as a feasibility and interventional study. We evaluated the amount of time spent being physically active during the 9 indoor-climbing training sessions, and climbing abilities were measured. The

participants were tested in a series of physiological, psychological and cognitive tests: two times prior to and one time following the training in order to explore possible effects of the intervention.

**RESULTS:** The children accomplished the training goal of a total of nine sessions within the 3-week training period. The time of physical activity during a 2:30 h climbing session, was comparably high in the group of children with CP and the TD children. The children with CP were physically active on average for almost 16 h in total during the 3 weeks. Both groups of participants improved their climbing abilities, the children with CP managed to climb a larger proportion of the tested climbing route at the end of training and the TD group climbed faster. For the children with CP this was accompanied by significant improvements in the Sit-to-stand test ( $p < 0.01$ ), increased rate of force development in the least affected hand during an explosive pinch test and increased muscular-muscular coherence during a pinch precision test ( $p < 0.05$ ). We found no improvements in maximal hand or finger strength and no changes in cognitive abilities or psychological well-being in any of the groups.

**CONCLUSIONS:** These findings show that it is possible to use climbing as means to make children with CP physically active. The improved motor abilities obtained through the training is likely reflected by increased synchronization between cortex and muscles, which results in a more efficient motor unit recruitment that may be transferred to daily functional abilities.

**TRIAL REGISTRATION:** ISRCTN18006574; day of registration: 09/05/2017; the trial is registered retrospectively.

DOI: 10.1186/s12883-017-0889-z

PMCID: PMC5472985

PMID: 28619011

## **Douleur**

### **Assessing and treating pain associated with stroke, multiple sclerosis, cerebral palsy, spinal cord injury and spasticity. Evidence and recommendations from the Italian Consensus Conference on Pain in Neurorehabilitation.**

Paolucci S , Martinuzzi A , Scivoletto G , Smania N , Solaro C , Aprile I , Armando M , Bergamaschi R , Berra E , Berto G , Carraro E , Cella M , Gandolfi M , Masciullo M , Molinari M , Pagliano E , Pecchioli C , Roncari L , Torre M , Trabucco E , Vallies G , Zerbini P , Tamburini S ; Italian Consensus Conference on Pain in Neurorehabilitation (ICCPN).

*Eur J Phys Rehabil Med.* 2016 Dec;52(6):827-840. Epub 2016 Aug 31.

Pain is a common and disabling symptom in patients with stroke, multiple sclerosis (MS), cerebral palsy (CP), spinal cord injury (SCI) and other conditions associated with spasticity, but data on its prevalence, and natural history, as well as guidelines on its assessment and treatment in the field of neurorehabilitation, are largely lacking. The Italian Consensus Conference on Pain in Neurorehabilitation (ICCPN) searched and evaluated current evidence on the frequency, evolution, predictors, assessment, and pharmacological and non-pharmacological treatment of pain in patients with stroke, MS, CP, SCI and other conditions associated with spasticity. Patients with stroke, MS, CP, and SCI may suffer from pain related to spasticity, as well as nociceptive and neuropathic pain (NP), whose prevalence, natural history, impact on functional outcome, and predictors are only partially known. Diagnosis and assessment of the different types of pain in these patients is important, because their treatment may differ. Botulinum neurotoxin is the first choice treatment for spasticity, while some antidepressant and antiepileptic drugs may be effective on NP, but pharmacological treatment varies according to the underlying disease. In most cases, a single therapy is not sufficient to treat pain, and a multidisciplinary approach, which include pharmacological and non-pharmacological treatments is needed. Further studies, and in particular randomized controlled trials, are needed on these topics.

#### **Free Article**

PMID: 27579581 [Indexed for MEDLINE]

### **Pain in cerebral palsy: a neglected comorbidity.**

Fehlings D .

*Dev Med Child Neurol.* 2017 May 29. doi: 10.1111/dmcn.13477. [Epub ahead of print]

DOI: 10.1111/dmcn.13477

PMID: 28555892

## **Pain report and musculoskeletal impairment in young people with severe forms of cerebral palsy: A population-based series.**

McDowell BC , Duffy C , Lundy C .

*Res Dev Disabil.* 2017 Jan;60:277-284. doi: 10.1016/j.ridd.2016.10.006. Epub 2016 Oct 25.

**BACKGROUND:** While pain is reportedly more prevalent in more functionally impaired children with cerebral palsy, information is scant in those with poor communication skills.

**METHODS:** Young people (4-27 years) with severe forms of cerebral palsy were recruited from a population-based register. The Child Health Questionnaire (CHQ) provided information on general health and bodily pain; the Paediatric Pain Profile (PPP) was used for participants with limited communication; and the Spinal Alignment and Range of Motion Measure (SAROMM) described musculoskeletal impairment.

**RESULTS:** 123 young people (GMFCS IV=55 and V=68) and their families/carers participated. Fourteen percent of CHQ responses (n=123) reported severe/very severe pain in recent weeks, whilst 7% reported pain every/almost every day. CHQ pain report was significantly higher for young people in GMFCS level V and correlated significantly with both global health and musculoskeletal impairment. High levels of pain were recorded on the PPP for non-communicating children but only a weak correlation between PPP and CHQ scores was detected.

**CONCLUSION:** Managing pain in young people with severe musculoskeletal and cognitive impairment presents a huge challenge to carers and professionals. The PPP may represent a useful adjunct in those young people with severe communication difficulties.

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DOI: 10.1016/j.ridd.2016.10.006

PMID: 27793550 [Indexed for MEDLINE]

## **Language -Communication**

### **Acoustic and Perceptual Consequences of Speech Cues for Children With Dysarthria.**

Levy ES , Chang YM , Ancelle JA , McAuliffe MJ .

*J Speech Lang Hear Res.* 2017 Jun 22;60(6S):1766-1779. doi: 10.1044/2017\_JSLHR-S-16-0274.

**Purpose:** Reductions in articulatory working space and vocal intensity have been linked to intelligibility deficits in children with dysarthria due to cerebral palsy. However, few studies have examined the outcomes of behavioral treatments aimed at these underlying impairments or investigated which treatment cues might best facilitate improved intelligibility. This study assessed the effects of cues targeting clear speech (i.e., "Speak with your big mouth") and greater vocal intensity (i.e., "Speak with your strong voice") on acoustic measures of speech production and intelligibility.

**Method:** Eight children with spastic dysarthria due to cerebral palsy repeated sentence- and word-level stimuli across habitual, big mouth, and strong voice conditions. Acoustic analyses were conducted, and 48 listeners completed orthographic transcription and scaled intelligibility ratings.

**Results:** Both cues resulted in significant changes to vocal intensity and speech rate although the degree of change varied by condition. In a similar manner, perceptual analysis revealed significant improvements to intelligibility with both cues; however, at the single-word level, big mouth outperformed strong voice.

**Conclusion:** Children with dysarthria are capable of changing their speech styles differentially in response to cueing. Both the big mouth and strong voice cues hold promise as intervention strategies to improve intelligibility in this population. Supplemental Material: <https://doi.org/10.23641/asha.5116843>.

DOI: 10.1044/2017\_JSLHR-S-16-0274

PMID: 28655046

### **Changes in brain activity following intensive voice treatment in children with cerebral palsy.**

Bakhtiari R , Cummine J , Reed A , Fox CM , Chouinard B , Cribben I , Boliek CA .

*Hum Brain Mapp.* 2017 Jun 5. doi: 10.1002/hbm.23669. [Epub ahead of print]

Eight children (3 females; 8-16 years) with motor speech disorders secondary to cerebral palsy underwent 4 weeks of an intensive neuroplasticity-principled voice treatment protocol, LSVT LOUD(®), followed by a structured 12-week

maintenance program. Children were asked to overtly produce phonation (ah) at conversational loudness, cued-phonation at perceived twice-conversational loudness, a series of single words, and a prosodic imitation task while being scanned using fMRI, immediately pre- and post-treatment and 12 weeks following a maintenance program. Eight age- and sex-matched controls were scanned at each of the same three time points. Based on the speech and language literature, 16 bilateral regions of interest were selected a priori to detect potential neural changes following treatment. Reduced neural activity in the motor areas (decreased motor system effort) before and immediately after treatment, and increased activity in the anterior cingulate gyrus after treatment (increased contribution of decision making processes) were observed in the group with cerebral palsy compared to the control group. Using graphical models, post-treatment changes in connectivity were observed between the left supramarginal gyrus and the right supramarginal gyrus and the left precentral gyrus for the children with cerebral palsy, suggesting LSVT LOUD enhanced contributions of the feedback system in the speech production network instead of high reliance on feedforward control system and the somatosensory target map for regulating vocal effort. Network pruning indicates greater processing efficiency and the recruitment of the auditory and somatosensory feedback control systems following intensive treatment.

Hum Brain Mapp, 2017. © 2017 Wiley Periodicals, Inc.

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DOI: 10.1002/hbm.23669

PMID: 28580693

### **Initial Observations of Lingual Movement Characteristics of Children With Cerebral Palsy.**

Nip ISB , Arias CR , Morita K , Richardson H .

*J Speech Lang Hear Res.* 2017 Jun 22;60(6S):1780-1790. doi: 10.1044/2017\_JSLHR-S-16-0239.

**Purpose:** This preliminary study compared the speech motor control of the tongue and jaw between children with cerebral palsy (CP) and their typically developing (TD) peers.

**Method:** Tongue tip and jaw movements of 4 boys with spastic CP and 4 age- and sex-matched TD peers were recorded using an electromagnetic articulograph during 10 repetitions of "Dad told stories today." The duration, path distance, average speed, and speech movement stability of the movements were calculated for each repetition.

**Results:** The children with CP had longer durations than their TD peers. Children with CP had longer path distances and faster average speed as compared with their TD peers for both articulators. The TD group but not the CP group had longer path distances and faster average speeds for the tongue than the jaw. The CP group had reduced speech movement stability for the tongue as compared with their TD peers, but both groups had similar speech movement stability for the jaw.

**Conclusions:** Children with CP had impaired speech motor control of the tongue and jaw as compared with their TD peers, and these speech motor control deficits were more pronounced in the tongue tip than the jaw.

DOI: 10.1044/2017\_JSLHR-S-16-0239

PMID: 28655047

### **Range and Precision of Formant Movement in Pediatric Dysarthria.**

Allison KM , Annear L , Policcicio M , Hustad KC .

*J Speech Lang Hear Res.* 2017 Jun 28;1-13. doi: 10.1044/2017\_JSLHR-S-15-0438. [Epub ahead of print]

**Purpose:** This study aimed to improve understanding of speech characteristics associated with dysarthria in children with cerebral palsy by analyzing segmental and global formant measures in single-word and sentence contexts.

**Method:** Ten 5-year-old children with cerebral palsy and dysarthria and 10 age-matched, typically developing children participated in this study. Vowel space area and second formant interquartile range were measured from children's elicited productions of single words and sentences.

**Results:** Results showed that the children with dysarthria had significantly smaller vowel space areas than typically developing children in both word and sentence contexts; however, overall ranges of second formant movement did not differ between groups in word or sentence contexts. Additional analysis of single words revealed that, compared to typical children, children with dysarthria had smaller second formant interquartile ranges in single words with phonetic contexts requiring large changes in vocal tract configuration, but not in single words with monophthongs.

**Conclusions:** Results of this study suggest that children with dysarthria may not have globally reduced ranges of

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articulatory movement compared to typically developing peers; however, they do exhibit reduced precision in producing phonetic targets.

DOI: 10.1044/2017\_JSLHR-S-15-0438

PMID: 28655064

## Autres Troubles / Troubles concomitants

### + Troubles respiratoires

#### **An Autopsy Case of Respiratory Failure Induced by Repetitive Cervical Spinal Cord Damage due to Abnormal Movement of the Neck in Athetoid Cerebral Palsy.**

Takei YI , Koshihara H , Oguchi K , Oyanagi K , Ohara S .

*Intern Med.* 2017;56(11):1425-1430. doi: 10.2169/internalmedicine.56.7411. Epub 2017 Jun 1.

We herein report the clinical and autopsy findings of a 48-year-old right-handed man with athetoid cerebral palsy who suffered from cervical myelopathy due to abnormal neck movement, and who died of respiratory failure. Pathologically, the external appearance of the ventral surface of the cervical spinal cord revealed a linear indentation running obliquely at the level between the C4 and C5 segments. In the most severely compressed lesion, the gray matter was predominantly affected and severely atrophic. Microscopically, clusters of oligodendrocytes associated with thinly myelinated axons were also observed in the lateral funiculus. The latter findings are unique, and could be interpreted as regenerative and/or restorative phenomena of the central nervous system following chronic repetitive spinal cord compression.

#### [Free Article](#)

DOI: 10.2169/internalmedicine.56.7411

PMID: 28566610

### + Troubles musculosquelettiques, des tissus conjonctifs et osseux

#### **Effectiveness of vitamin K2 on osteoporosis in adults with cerebral palsy.**

Kodama Y , Okamoto Y , Kubota T , Hiroyama Y , Fukami H , Matsushita K , Kawano Y .

*Brain Dev.* 2017 Jun 14. pii: S0387-7604(17)30152-3. doi: 10.1016/j.braindev.2017.05.012. [Epub ahead of print]

**BACKGROUND:** Osteoporosis can lead to spontaneous fractures in adults with cerebral palsy (CP). Undercarboxylated osteocalcin (ucOC) is a useful marker for vitamin K insufficiency in osteoporosis. The primary objective of this study was to determine the effect of vitamin K2 on bone mineral density (BMD) in adults with CP and vitamin K insufficiency.

**METHODS:** Sixteen adults, median age of 56 years, with CP and osteoporosis in whom the serum ucOC concentration exceeded 4.5 ng/mL were included. All patients received 45 mg of vitamin K2 per day. BMD was measured and presented as a percentage of the young adult mean (%YAM). Serum levels of ucOC and BMD were measured at baseline and after 6 and 12 months.

**RESULTS:** Serum levels of ucOC decreased from 7.8 ng/mL (range, 4.9-32) at baseline to 3.9 ng/mL (range, 1.9-6.8) after 6 months ( $P=0.001$ ). BMD increased from 59%YAM (range, 45-67) at baseline to 68%YAM (range, 50-79) after 12 months ( $P=0.003$ ).

**CONCLUSIONS:** Vitamin K2 had a positive effect on BMD in osteoporotic adults with CP and high serum concentrations of ucOC, and might be useful as a first line treatment for osteoporotic adults with CP and vitamin K insufficiency.

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DOI: 10.1016/j.braindev.2017.05.012

PMID: 28624135

#### **Heterogeneity of muscle sizes in the lower limbs of children with cerebral palsy.**

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Handsfield GG , Meyer CH , Abel MF , Blemker SS .  
*Muscle Nerve*. 2016 Jun;53(6):933-45. doi: 10.1002/mus.24972. Epub 2016 Feb 26.

**INTRODUCTION:** Cerebral palsy (CP) is associated with reduced muscle volumes, but previous studies have reported deficits in only a small number of muscles. The extent of volume deficits across lower limb muscles is not known. This study presents an imaging-based assessment of muscle volume and length deficits in 35 lower limb muscles.

**METHODS:** We imaged and segmented 35 muscles in 10 subjects with CP and 8 typically developing (TD) controls using MRI. Muscle volumes were normalized, and Z-scores were computed using TD data. Volume Z-scores and percent deficits in volume, length, and cross-sectional area are reported.

**RESULTS:** Muscle volumes are 20% lower, on average, for subjects with CP. Volume deficits differ significantly between muscles (12%-43%) and display significant heterogeneity across subjects. Distal muscles, especially the soleus, are commonly and severely small.

**CONCLUSIONS:** Heterogeneity across muscles and across subjects reinforces the subject specificity of CP and the need for individualized treatment planning. *Muscle Nerve* 53: 933-945, 2016.

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DOI: 10.1002/mus.24972

PMID: 26565390 [Indexed for MEDLINE]

## ⚡ Métabolisme -Composition corporelle

### **Body composition, diet, and physical activity: a longitudinal cohort study in preschoolers with cerebral palsy.**

Oftedal S , Davies PS , Boyd RN , Stevenson RD , Ware RS , Keawutan P (6), Benfer KA , Bell KL .

*Am J Clin Nutr*. 2017 Feb;105(2):369-378. doi: 10.3945/ajcn.116.137810. Epub 2017 Jan 11.

**BACKGROUND:** Altered body composition in children with cerebral palsy (CP) could be due to differences in energy intake, habitual physical activity (HPA), and sedentary time.

**OBJECTIVE:** We investigated the longitudinal relation between the weight-for-age z score (WZ), fat-free mass (FFM), percentage of body fat (%BF), and modifiable lifestyle factors for all Gross Motor Function Classification System (GMFCS) levels (I-V).

**DESIGN:** The study was a longitudinal population-based cohort study of children with CP who were aged 18-60 mo (364 assessments in 161 children; boys: 61%; mean  $\pm$  SD recruitment age: 2.8  $\pm$  0.9 y; GMFCS: I, 48%; II, 11%; III, 15%; IV, 11%; and V, 15%). A deuterium dilution technique or bioelectrical impedance analysis was used to estimate FFM, and the %BF was calculated. Energy intake, HPA, and sedentary time were measured with the use of a 3-d weighed food diary and accelerometer wear. Data were analyzed with the use of a mixed-model analysis.

**RESULTS:** Children in GMFCS group I did not differ from age- and sex-specific reference children with typical development for weight. Children in GMFCS group IV were lighter-for-age, and children in GMFCS group V had a lower FFM-for-height than those in GMFCS group I. Children in GMFCS groups II-V had a higher %BF than that of children in GMFCS group I, with the exception of orally fed children in GMFCS group V. The mean %BF of children with CP classified them as overfat or obese. There was a positive association between energy intake and FFM and also between HPA level and FFM for children in GMFCS group I.

**CONCLUSIONS:** Altered body composition was evident in preschool-age children with CP across functional capacities. Gross motor function, feeding method, energy intake, and HPA level in GMFCS I individuals are the strongest predictors of body composition in children with CP between the ages of 18 and 60 mo.

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DOI: 10.3945/ajcn.116.137810

PMID: 28077375 [Indexed for MEDLINE]

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

### **Dental health of children with cerebral palsy.**

*Neurosciences (Riyadh)*. 2016 Oct;21(4):314-318. doi: 10.17712/nsj.2016.4.20150729.

Jan BM , Jan MM.

Cerebral palsy (CP) is a common chronic motor disorder with associated cognitive, communicative, and seizure disorders. Children with CP have a higher risk of dental problems creating significant morbidity that can further  
[Science Infos Paralysie Cérébrale, Juin 2017, FONDATION PARALYSIE CEREBRALE 67 rue Vergniaud 71 75013 Paris - tel +33 1 45 54 03 03 contact: Christine Doumergue cdoumergue@lafondationmotrice.org](#)

affect their wellbeing and negatively impact their quality of life. Screening for dental disease should be part of the initial assessment of any child with CP. The objective of this article is to present an updated overview of dental health issues in children with CP and outline important preventative and practical strategies to the management of this common comorbidity. Providing adequate oral care requires adaptation of special dental skills to help families manage the ongoing health issues that may arise. As oral health is increasingly recognized as a foundation for general wellbeing, caregivers for CP patients should be considered an important component of the oral health team and must become knowledgeable and competent in home oral health practices.

[Free PMC Article](#)

PMCID: PMC5224428

PMID: 27744459 [Indexed for MEDLINE]

### **Dental trauma in Brazilian children and adolescents with cerebral palsy.**

Cardoso AM , Silva CR , Gomes LN , Gomes Mda N , Padilha WW , Cavalcanti AL .

*Dent Traumatol.* 2015 Dec;31(6):471-6. doi: 10.1111/edt.12184. Epub 2015 Jun 1.

**BACKGROUND:** Assessing the frequency and factors associated with dental trauma in pediatric populations with cerebral palsy is important for the planning and implementation of prevention and health promotion programs. The aim of this study was to determine the prevalence and factors associated with dental trauma in children and adolescents with cerebral palsy.

**MATERIAL AND METHODS:** Cross-sectional study with a non-probabilistic sample of 80 patients aged 2-18 years was treated in a rehabilitation institution in northeastern Brazil. Caregivers completed a socioeconomic questionnaire, while oral exams were performed by a calibrated investigator ( $K = 0.75-1.00$ ), with record of the Dental Trauma Index, DMFT and dmft, and Dental Aesthetics and malocclusion indices. Bivariate and multivariate Poisson regression analyses ( $\alpha = 0.05$ ) were performed with the Statistical Package for Social Sciences, version 17.

**RESULTS:** The prevalence of dental trauma was 36.3%, enamel fracture was the most common trauma (89.1%), and the upper central incisors were the most affected dental elements (63.0%). Patients with dental trauma were male, aged 7-18 years, with family income more than one minimum wage, caregiver's education over 4 years, increased overjet, lip hypotonia, quadriplegia, epilepsy, oral breathing, and severe communication skills. The presence of dental trauma was not associated with socioeconomic characteristics (gender, age, family income, and caregiver's educational level), oral health perception, and systemic and oral conditions (dental caries, malocclusion, and lip hypotonia) were evaluated ( $P > 0.05$ ).

**CONCLUSION:** The prevalence of dental trauma was high, but not associated with clinical variables and evaluated socioeconomic indicators.

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DOI: 10.1111/edt.12184

PMID: 26033710 [Indexed for MEDLINE]

### **The Eating and Drinking Ability Classification System in a population-based sample of preschool children with cerebral palsy. Je l'aurais mis avec sphère bucco dentaire**

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

*Dev Med Child Neurol.* 2017 Jun;59(6):647-654. doi: 10.1111/dmcn.13403. Epub 2017 Mar 9.

**AIM:** To determine (1) the reproducibility of the Eating and Drinking Ability Classification System (EDACS); (2) EDACS classification distribution in a population-based cohort with cerebral palsy (CP); and (3) the relationships between the EDACS and clinical mealtime assessment, other classifications, and health outcomes.

**METHOD:** This was a cross-sectional population-based cohort study of 170 children with CP at 3 years to 5 years (mean 57.6mo, standard deviation [SD] 8.3mo; 105 males, n=65 females). Functional abilities were representative of a population sample (Gross Motor Function Classification System level I=74, II=34, III=21, IV=18, V=23). The EDACS was the primary classification of mealtime function. The Dysphagia Disorders Survey was the clinical mealtime assessment. Gross motor function was classified using the Gross Motor Function Classification System.

**RESULTS:** EDACS classification had 88.3% intrarater agreement ( $\kappa=0.84$ , intraclass correlation coefficient=0.95;  $p<0.001$ ) and 51.7% interrater agreement ( $\kappa=0.36$ , intraclass correlation coefficient=0.79;  $p<0.001$ ). In total, 56.5% of children were classified as EDACS level I. There was a strong stepwise relationship between the Dysphagia Disorders



Survey and EDACS ( $r=0.96$ ,  $p<0.001$ ). Parental stress (odds ratio=1.3,  $p=0.05$ ) and feeding tubes (odds ratio=6.4,  $p<0.001$ ) were significantly related to more limited function on the EDACS.

INTERPRETATION: The EDACS presents a viable adjunct to clinical assessment of feeding skills in children with CP for use in surveillance trials and clinical practice. A rating addendum would be a useful contribution to the tool to enhance reproducibility.

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DOI: 10.1111/dmnc.13403

PMID: 28276586 [Indexed for MEDLINE]

### **Treatment of drooling with sublingual atropine sulfate in children and adolescents with cerebral palsy.**

Dias BLS , Fernandes AR , Maia HS Filho .

*Arq Neuropsiquiatr.* 2017 May;75(5):282-287. doi: 10.1590/0004-282X20170033.

Objective: To report the effect of sublingual atropine sulfate to treat drooling in children with cerebral palsy by comparing the results of the Drooling Impact Scale in a non-controlled open clinical trial.

Results: Twenty-five children were assessed. The difference in the mean scores of the pre- and post-treatment scales reached statistical significance. There was a low frequency of side effects compared to studies with other anticholinergics.

Conclusion: The use of sublingual atropine sulfate seems to be safe and there is a reduction in the Drooling Impact Scale score, which suggests efficacy in the treatment of drooling in children and adolescents with cerebral palsy. Our results should be replicated in randomized, placebo-controlled studies with large numbers of participants.

DOI: 10.1590/0004-282X20170033

PMID: 28591387 [Indexed for MEDLINE]

### **Posture-Dependent Dysphagia After Botulinum Toxin Type A Injection at Sternocleidomastoid in a Patient With Athetoid Cerebral Palsy.**

Chang WK , Kim K, Seo HG, Leigh JH, Bang MS.

*Am J Phys Med Rehabil.* 2017 Jun 9. doi: 10.1097/PHM.0000000000000763. [Epub ahead of print]

Cervical dystonia is a common issue in patients with athetoid cerebral palsy. Botulinum toxin injection to dystonic cervical muscles is a well-recognized treatment option, but it is known to be associated with dysphagia. Previously reported cases of dysphagia after botulinum toxin injection to the sternocleidomastoid muscle were related to the regional spread of toxin to the pharyngeal muscles. We report a unique case of posture-dependent dysphagia due to preactivation of the suprahyoid and infrahyoid muscles to compensate for impaired head stabilization by the weakened sternocleidomastoid muscle while swallowing. This case suggests a possible mechanism of dysphagia in patients with athetoid cerebral palsy.

DOI: 10.1097/PHM.0000000000000763

PMID: 28604409

### **The Role of the Corpus Callosum in Pediatric Dysphagia: Preliminary Findings from a Diffusion Tensor Imaging Study in Children with Unilateral Spastic Cerebral Palsy.**

Mourão LF , Friel KM , Sheppard JJ , Kuo HC , Luchesi KF , Gordon AM , Malandraki GA .

*Dysphagia.* 2017 Jun 8. doi: 10.1007/s00455-017-9816-0. [Epub ahead of print]

The purpose of this study is to determine the relationship between the structural integrity of the corpus callosum (CC) and clinical feeding/swallowing performance in children with unilateral spastic cerebral palsy (USCP). Twenty children with USCP, (11 males, 5.11-17.6 yoa) were assessed via the Dysphagia Disorder Survey (DDS) and diffusion tensor imaging. Children were grouped into left hemisphere lesion (LHL;  $n = 13$ ) and right hemisphere lesion (RHL;  $n = 7$ ) groups. DTI variables analyzed for three CC regions (anterior, middle, posterior) were: fractional anisotropy (FA), radial diffusivity (RD), mean diffusivity (MD), and fibers count. Children with RHL presented with higher clinical dysphagia severity ( $p = 0.03$ ). Six of seven children with RHL had lesions affecting periventricular/subcortical areas, and 8/13 children with LHL had lesions affecting the sensorimotor cortex. In the LHL group, as FA and fiber count of the anterior CC decreased and RD increased (all indicating reduced CC structural integrity), signs of dysphagia

increased ( $r = -0.667$ ,  $p = 0.013$ ;  $r = -0.829$ ,  $p \leq 0.001$ ;  $r = 0.594$ ,  $p = 0.032$ , respectively). Reduced fiber count in the middle and posterior CC was also significantly associated with increased DDS scores ( $r = -0.762$ ,  $p = 0.002$ ;  $r = -0.739$ ,  $p = 0.004$ , respectively). For the RHL group no significant correlations were observed. We provide preliminary evidence that corpus callosum integrity correlates with feeding/swallowing performance in children with USCP, especially when cortical sensorimotor areas of the left hemisphere are impacted. In this sample, CC integrity appeared to enable interhemispheric cortical plasticity for swallowing, but was not as critical when intrahemispheric connections were disrupted, as seen in the RHL group.

DOI: 10.1007/s00455-017-9816-0

PMID: 28597327

## Troubles du transit

### **Role Of Stretching Exercises In The Management Of Constipation In Spastic Cerebral Palsy.**

Awan WA , Masood T .

*J Ayub Med Coll Abbottabad. 2016 Oct-Dec;28(4):798-801.*

**BACKGROUND:** Constipation is considered as one of the most common non-motor manifestations in cerebral palsy (CP). Along with other reasons, spasticity also contributes in developing constipation in CP, by decreasing mobility of trunk and lower extremities and abdominal viscera. Stretching exercises of upper extremities, trunk and lower extremities are routine management of spasticity in CP children. The objective of the study was to determine the role of stretching exercises in improving constipation symptoms in children with spastic cerebral palsy and to explore the association between spasticity and constipation among cerebral palsy children.

**METHODS:** Single-group Pretest-Posttest Design (Quasi Experimental Study Design). The study was conducted at Physiotherapy Department of National Institute of Rehabilitation Medicine (NIRM) Islamabad. Thirty spastic CP children - both male and female - with complaints of constipation were recruited through non-probability, convenience sampling. The mean age of the children was  $7.55 \pm 1.33$  years. Each child was assessed for defecation frequency (DF), constipation severity by constipation assessment scale (CAS) and level of spasticity by modified ashworth scale for spasticity (MASS) at baseline. Stretching exercises were performed for 30 seconds with five repetitions and at least once a day for six week, followed by positioning of patients in reflex inhibiting posture. Final data was collected using the same tools as done at the baseline. Paired samples t-test was used to analyse the rehabilitation-induced changes after 6 weeks. To determine association between spasticity and constipation Pearson product-moment correlation coefficient was used. The data was analysed through SPSS 20.

**RESULTS:** Significant changes, compared to the baseline scores, were observed after 6 weeks of stretching exercises in MASS ( $2.53 \pm 0.62$  Vs  $1.53 \pm 0.77$ ), DF ( $2.43 \pm 0.67$  Vs  $3.70 \pm 1.02$ ) and CAS ( $7.23 \pm 1.50$  Vs  $5.43 \pm 1.73$ ) with  $p \leq 0.05$ . The results also showed significant correlation between changes in levels of spasticity and severity of constipation ( $r = 0.37$ ;  $p = 0.04$ ). Finally, significant correlation was present between improvement in spasticity and defecation frequency ( $r = -0.39$ ;  $p = 0.02$ ).

**CONCLUSIONS:** Stretching exercises administered for the management of spasticity in CP can significantly improve the symptoms of constipation in such children. The results of the study showed that constipation is strongly associated with level of spasticity in CP children.

[Free Article](#)

PMID: 28586619

## Troubles de la vision

### **Gross motor function in children with spastic Cerebral Palsy and Cerebral Visual Impairment: A comparison between outcomes of the original and the Cerebral Visual Impairment adapted Gross Motor Function Measure-88 (GMFM-88-CVI).**

Salavati M , Rameckers EA , Waninge A , Krijnen WP , Steenbergen B , van der Schans CP .

*Res Dev Disabil. 2017 Jan;60:269-276. doi: 10.1016/j.ridd.2016.10.007. Epub 2016 Oct 19.*

**PURPOSE:** To investigate whether the adapted version of the Gross Motor Function Measure-88 (GMFM-88) for children with Cerebral Palsy (CP) and Cerebral Visual Impairment (CVI) results in higher scores. This is most likely to

be a reflection of their gross motor function, however it may be the result of a better comprehension of the instruction of the adapted version.

**METHOD:** The scores of the original and adapted GMFM-88 were compared in the same group of children (n=21 boys and n=16 girls), mean (SD) age 113 (30) months with CP and CVI, within a time span of two weeks. A paediatric physical therapist familiar with the child assessed both tests in random order. The GMFCS level, mental development and age at testing were also collected. The Wilcoxon signed-rank test was used to compare two different measurements (the original and adapted GMFM-88) on a single sample, (the same child with CP and CVI;  $p < 0.05$ ). **RESULTS:** The comparison between scores on the original and adapted GMFM-88 in all children with CP and CVI showed a positive difference in percentage score on at least one of the five dimensions and positive percentage scores for the two versions differed on all five dimensions for fourteen children. For six children a difference was seen in four dimensions and in 10 children difference was present in three dimensions (GMFM dimension A, B & C or C, D & E) ( $p < 0.001$ ). **CONCLUSION:** The adapted GMFM-88 provides a better estimate of gross motor function per se in children with CP and CVI that is not adversely impacted by their visual problems. On the basis of these findings, we recommend using the adapted GMFM-88 to measure gross motor functioning in children with CP and CVI.

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DOI: 10.1016/j.ridd.2016.10.007

PMID: 27771178 [Indexed for MEDLINE]



### **Longitudinal Growth, Diet, and Physical Activity in Young Children With Cerebral Palsy.**

Oftedal S , Davies PS , Boyd RN , Stevenson RD , Ware RS , Keawutan P , Benfer KA , Bell KL .

*Pediatrics*. 2016 Oct;138(4). pii: e20161321. Epub 2016 Sep 7.

**OBJECTIVES:** To describe the longitudinal relationship between height-for-age z score (HZ), growth velocity z score, energy intake, habitual physical activity (HPA), and sedentary time across Gross Motor Function Classification System (GMFCS) levels I to V in preschoolers with cerebral palsy (CP).

**METHODS:** Children with CP (n = 175 [109 (62.2%) boys]; mean recruitment age 2 years, 10 months [SD 11 months]; GMFCS I = 83 [47.2%], II = 21 [11.9%], III = 28 [15.9%], IV = 19 [10.8%], V = 25 [14.2%]) were assessed 440 times between the age of 18 months and 5 years. Height/length ratio was measured or estimated via knee height. Population-based standards were used to calculate HZ and growth velocity z-score by age and sex categories. Feeding method (oral or tube) and gestational age at birth (GA) were collected from parents. Three-day ActiGraph and food diary data were used to measure HPA/sedentary time ratio and energy intake, respectively. Oropharyngeal dysphagia was rated with the Dysphagia Disorder Survey (part 2, Pediatric). Analysis was undertaken with mixed-effects regression models.

**RESULTS:** For GMFCS level I, height and growth velocity did not differ from population-level growth standards. Children in levels II to V were significantly shorter, and those in levels III to V grew significantly more slowly than those in level I. There was a significant positive association between HZ and GA at all GMFCS levels. Energy intake, HPA, sedentary time, Dysphagia Disorder Survey score, and feeding method were not significantly associated with either height or growth velocity once GMFCS level was accounted for.

**CONCLUSIONS:** Functional status and GA should be considered when assessing the growth of a child with CP. Research into interventions aimed at increasing active movement in GMFCS levels III to V and their efficacy in improving growth and health outcomes is warranted.

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DOI: 10.1542/peds.2016-1321

PMID: 27604185 [Indexed for MEDLINE]

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

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

*Dev Med Child Neurol*. 2017 Jun 28. doi: 10.1111/dmcn.13495. [Epub ahead of print]

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

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

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

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

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

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DOI: 10.1111/dmnc.13495

PMID: 28656704

## Troubles du spectre autistique

### **Prevalence and characteristics of autism spectrum disorders in children with cerebral palsy.**

Delobel-Ayoub M, Klapouszczak D, van Bakel MME, Horridge K, Sigurdardottir S, Himmelmann K, Arnaud C  
*Dev Med Child Neurol.* 2017 Jul;59(7):738-742. doi: 10.1111/dmnc.13436. Epub 2017 Apr 25.

**AIM:** To evaluate the prevalence of co-occurring autism spectrum disorders (ASDs) among children with cerebral palsy (CP), and to describe their characteristics.

**METHOD:** The data of 1225 CP cases from four population-based registers (Iceland, Sweden, and two in France) and one population-based surveillance programme (North East England, UK) participating in the Surveillance of Cerebral Palsy in Europe Network (SCPE) were analysed. The ASD diagnoses were systematically recorded using category F84 of the International Classification of Diseases, 10th Revision. The registers provided data on children born between 1995 and 2006, while the cross-sectional survey in the UK concerned children aged 0 to 19 years, registered in 2010.

**RESULTS:** Among the children with CP, 107 had an associated diagnosis of ASD - i.e., 8.7% of the study population (95% confidence interval 7.2-10.5). This proportion varied across centres from 4.0% to 16.7% but was independent of CP prevalence. Male sex, co-occurring epilepsy, intellectual disability, and better walking ability were associated with the coexistence of ASD.

**INTERPRETATION:** Our findings support the need for a multidisciplinary approach to management of children with CP to adequately identify and address all facets of presentation, including ASD.

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DOI: 10.1111/dmnc.13436

PMID: 28439889 [Indexed for MEDLINE]

## Neuropsychologie

### **Neuropsychological profiles of children with cerebral palsy.**

Stadskleiv K, Jahnsen R, Andersen GL, von Tetzchner S.

*Dev Neurorehabil.* 2017 Feb 21:1-13. doi: 10.1080/17518423.2017.1282054. [Epub ahead of print]

**PURPOSE:** To explore factors contributing to variability in cognitive functioning in children with cerebral palsy (CP).

**METHOD:** A geographical cohort of 70 children with CP was assessed with tests of language comprehension, visual-spatial reasoning, attention, working memory, memory, and executive functioning. Mean age was 9;9 years (range 5;1-17;7), 54.3% were girls, and 50.0% had hemiplegic, 25.7% diplegic, 12.9% quadriplegic, and 11.4% dyskinetic CP. For the participants with severe motor impairments, assessments were adapted for gaze pointing. A cognitive quotient (CQ) was computed.

**RESULTS:** Mean CQ was 78.5 (range 19-123). Gross motor functioning, epilepsy, and type of brain injury explained 35.5% of the variance in CQ ( $F = 10.643$ ,  $p = .000$ ).

CONCLUSION: Twenty-four percent had an intellectual disability, most of them were children with quadriplegic CP. Verbal comprehension and perceptual reasoning scores did only differ for the 21% with an uneven profile, of whom two-thirds had challenges with perceptual reasoning.

DOI: 10.1080/17518423.2017.1282054

PMID: 28632466

## Qualité de vie et rapport au monde

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

#### **Course of employment in adults with cerebral palsy over a 14-year period.**

Benner JL , Hilberink SR , Veenis T , van der Slot WMA , Roebroek ME .

*Dev Med Child Neurol.* 2017 Jul;59(7):762-768. doi: 10.1111/dmcn.13423. Epub 2017 Mar 17.

AIM: To explore the course of employment in adults with cerebral palsy (CP) over 14 years, and to identify subgroups at risk for unemployment. METHOD: Sixty-five adults with CP (33 males, 32 females; baseline age 25y 8mo, standard deviation [SD] 3y 2mo; intellectual impairment 25%; bilateral CP 65%) participated in a prospective cohort study. Self-reports of employment and work hours per week in 1996, 2000, and 2010 were documented. The course of employment (including sheltered work) and work hours per week were analysed, using generalized estimating equations (GEE).

RESULTS: Overall, employment rate was stable over time (38-45%,  $p=0.413$ ), but lower than in the general population (75-86%,  $p<0.001$ ). Employment rates were specifically low in adults with intellectual impairment, bilateral CP, and in adults with Gross Motor Function Classification System (GMFCS) levels IV and V. Work hours per week declined (35.0 [SD 7.9] to 31.2 [SD 10.3],  $p=0.033$ ), especially among females (32.3 [SD 6.4] to 23.4 [SD 7.4],  $p<0.001$ ). Similar to the general population, females often worked part-time.

INTERPRETATION: Employment was low compared with the general population, but remained stable in the long term; however, work hours per week decreased. Adults with intellectual impairment, bilateral CP, and GMFCS levels IV and V are subgroups at risk for unemployment.

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DOI: 10.1111/dmcn.13423

PMID: 28304081 [Indexed for MEDLINE]

#### **Gaze-based assistive technology in daily activities in children with severe physical impairments-An intervention study.**

Borgestig M , Sandqvist J , Ahlsten G , Falkmer T , Hemmingsson H .

*Dev Neurorehabil.* 2017 Apr;20 :129-141. doi: 10.3109/17518423.2015.1132281. Epub 2016 Mar 1.

OBJECTIVE: To establish the impact of a gaze-based assistive technology (AT) intervention on activity repertoire, autonomous use, and goal attainment in children with severe physical impairments, and to examine parents' satisfaction with the gaze-based AT and with services related to the gaze-based AT intervention.

METHODS: Non-experimental multiple case study with before, after, and follow-up design. Ten children with severe physical impairments without speaking ability (aged 1-15 years) participated in gaze-based AT intervention for 9-10 months, during which period the gaze-based AT was implemented in daily activities.

RESULTS: Repertoire of computer activities increased for seven children. All children had sustained usage of gaze-based AT in daily activities at follow-up, all had attained goals, and parents' satisfaction with the AT and with services was high. DISCUSSION: The gaze-based AT intervention was effective in guiding parents and teachers to continue supporting the children to perform activities with the AT after the intervention program.

DOI: 10.3109/17518423.2015.1132281

PMID: 26930111 [Indexed for MEDLINE]

#### **How children with cerebral palsy master bimanual activities from a parental perspective.**

Lidman G , Himmelman K , Gosman-Hedström G , Peny-Dahlstrand M .  
*Scand J Occup Ther. 2017 Jun 9:1-8. doi: 10.1080/11038128.2017.1337807. [Epub ahead of print]*

**BACKGROUND:** During childhood, children learn the daily life activities they want and need to do. Children with unilateral spastic cerebral palsy often have difficulties performing activities requiring two hands. **AIM:** To describe parental reasoning on how children with unilateral spastic cerebral palsy learn to master the performance of bimanual activities in everyday life.

**MATERIAL AND METHODS:** Sixteen parents participated in focus groups, a qualitative research approach with its own methodological criteria and research methods. **RESULTS:** One overall theme emerged from the analysis: 'Finding harmony between pleasure and effort is the key to learning'. This overall theme arose as a synthesis of four themes: 'awakening of the inner drive', 'trying on one's own', 'enabling things to work' and 'it must be worth the effort'. The parents described when an activity woke their children's inner drive to perform. Their children also strived to develop their own way to perform an activity, sometimes with the support of others, still, some activities were not possible to learn.

**CONCLUSIONS:** Occupational therapists and others in the children's environment have an important mission to support the children to find their own harmony between pleasure and effort and their individual key to success in learning bimanual everyday activities.

DOI: 10.1080/11038128.2017.1337807

PMID: 28599586

### **Mastery Motivation and Executive Functions as Predictors of Adaptive Behavior in Adolescents and Young Adults With Cerebral Palsy or Myelomeningocele.**

Warschausky S, Kaufman JN, Evitts M, Schutt W, Hurvitz EA.

*Rehabil Psychol. 2017 Jun 1. doi: 10.1037/rep0000151. [Epub ahead of print]*

**PURPOSE/OBJECTIVE:** To examine mastery motivation and executive functions or behaviors as predictors of adaptive behavior in adolescents and young adults with congenital neurodevelopmental conditions.

**METHOD:** Participants were 2 groups of adolescents and young adults, ages 13-29, including 43 with cerebral palsy and 36 with myelomeningocele living with a parent or caregiver. Participants completed measures of mastery motivation, executive functions or behaviors, and a measure of adaptive behavior.

**RESULTS:** Group differences in mastery motivation, executive functions and executive behaviors, and adaptive behavior profiles were not significant. Mastery motivation, executive functions, and executive behaviors explained a significant portion of variance in adaptive behavior.

**CONCLUSIONS:** Findings highlight the importance of assessing and addressing motivational and executive needs in developing interventions to promote independence. Findings also suggest the need for more comprehensive assessment of adaptive behaviors that include the ability to self-direct others in the completion of tasks necessary for successful daily functioning. (PsycINFO Database Record (c) 2017 APA, all rights reserved).

DOI: 10.1037/rep0000151

PMID: 28569523

### **Moderating effect of the environment in the relationship between mobility and school participation in children and adolescents with cerebral palsy.**

Furtado SR , Sampaio RF , Kirkwood RN , Vaz DV , Mancini MC .

*Braz J Phys Ther. 2015 Jul-Aug;19(4):311-9. doi: 10.1590/bjpt-rbf.2014.0127. Epub 2015 Sep 1.*

**BACKGROUND:** The literature demonstrates that the social participation of children with disabilities is influenced by both their functional skills repertoire and environmental factors. However, it is not yet known whether the effect of functional limitations on social participation is minimized or enhanced by the environmental facilitators and barriers. This study aimed to test this hypothesis.

**OBJECTIVE:** To investigate the moderating effect of environmental factors in the relationship between mobility and school participation of children and adolescents with cerebral palsy (CP).

**METHOD:** Participants were 102 elementary school children and adolescents with CP, aged 6 to 17 years, classified as levels I, II, and III according to the Gross Motor Classification System, along with their parents or caregivers and

teachers. School participation and parents' perceptions of barriers were evaluated using the School Function Assessment and the Craig Hospital Inventory of Environmental Factors (CHIEF), respectively.

**RESULTS:** The regression model failed to reveal a moderating effect of environmental factors in the relationship between mobility and school participation. While mobility was a strong predictor of participation, environmental factors demonstrated a weak predictive effect on the latter. The CHIEF subscale school/work showed the factors which were greatest barrier to children's participation, while the subscale attitude/support had the least impact.

**CONCLUSION:** The absence of moderation on the tested relationship suggests that, when investigated under the negative perspective of environmental barriers, the contextual factors do not modify the relationship between mobility and school participation. Factors specific to the school environment might add to the present study's results regarding the effect of school participation in this population.

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PMID: 26443979 [Indexed for MEDLINE]

### **myTREEHOUSE Self-Concept Assessment: preliminary psychometric analysis of a new self-concept assessment for children with cerebral palsy.**

Cheong SK , Lang CP , Hemphill SA , Johnston LM .

*Dev Med Child Neurol.* 2017 Jun;59(6):655-660. doi: 10.1111/dmcn.13392. Epub 2017 Jan 19.

**AIM:** To evaluate the preliminary validity and reliability of the myTREEHOUSE Self-Concept Assessment for children with cerebral palsy (CP) aged 8 to 12 years.

**METHOD:** The myTREEHOUSE Self-Concept Assessment includes 26 items divided into eight domains, assessed across three Performance Perspectives (Personal, Social, and Perceived) and an additional Importance Rating. Face and content validity was assessed by semi-structured interviews with seven expert professionals regarding the assessment construct, content, and clinical utility. Reliability was assessed with 50 children aged 8 to 12 years with CP (29 males, 21 females; mean age 10y 2mo; Gross Motor Function Classification System [GMFCS] level I=35, II=8, III=5, IV=1; mean Wechsler Intelligence Scale for Children - Fourth Edition [WISC-IV]=104), whose data was used to calculate internal consistency of the scale, and a subset of 35 children (20 males, 15 females; mean age 10y 5mo; GMFCS level I=26, II=4, III=4, IV=1; mean WISC-IV=103) who participated in test-retest reliability within 14 to 28 days.

**RESULTS:** Face and content validity was supported by positive expert feedback, with only minor adjustments suggested to clarify the wording of some items. After these amendments, strong internal consistency (Cronbach's  $\alpha$  0.84-0.91) and moderate to good test-retest reliability (intraclass correlation coefficient 0.64-0.75) was found for each component.

**INTERPRETATION:** The myTREEHOUSE Self-Concept Assessment is a valid and reliable assessment of self-concept for children with CP aged 8 to 12 years.

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### **Social dominance in children with cerebral palsy during a problem-solving task with peers.**

Voyer AP , Nadeau L , Tessier R .

*Disabil Rehabil.* 2017 Jun 6:1-5. doi: 10.1080/09638288.2017.1334237. [Epub ahead of print]

**PURPOSE:** Children with cerebral palsy tend to have poorer social competence outcomes than their peers without a disability in mainstream school settings. To understand their social competence, this study compared children with cerebral palsy with paired children without cerebral palsy with respect to their ability to access resources, defined here as "social dominance", in a problem-solving situation.

**METHOD:** Children with cerebral palsy were randomly paired to a peer (teammate) and put in a competitive context where each team of two children was instructed to solve an impossible problem. To control for social status, a sociometric measure was administered previously in the classroom (Social Preference score). Behaviors related to social dominance (prosocial and coercive behaviors) were coded using an observation scale validated for this study.

**RESULTS:** The results showed that regardless of social status, children with cerebral palsy were less socially dominant than controls without cerebral palsy. Furthermore, their teams seemed to be less dominant than teams composed of two controls.

**CONCLUSIONS:** The lower social competence in children with cerebral palsy could be partly explained by their reduced social dominance behavior in activities requiring speed and fluidity as an expression of executive functions. This might be viewed as a marker for social risks in the integration process at school. Implications for rehabilitation Gross Motor Function Classification System level I or II cerebral palsy is a condition that affects not only motor abilities but also social competence in children. Lower social competence in children with cerebral palsy could be partly explained by reduced social dominance behavior in activities such as problem solving with peers. To improve social competence, rehabilitation interventions should include social participation opportunities in which children with cerebral palsy are encouraged to take an active role in the activity.

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PMID: 28585442

## **Activité physique -Sport**

### **Effects of Participation in Sports Programs on Walking Ability and Endurance Over Time in Children With Cerebral Palsy.**

Ross SA , Yount M, Ankarstad S, Bock S, Orso B, Perry K, Miros J, Brunstrom-Hernandez JE.

*Am J Phys Med Rehabil.* 2017 Jun 21. doi: 10.1097/PHM.0000000000000767. [Epub ahead of print]

**OBJECTIVE:** Children with cerebral palsy may benefit from maintaining a high level of physical fitness similar to typically developing children especially in terms of long-term physical performance, although in practice this is often difficult. The purpose of this study was to determine the effect of participation in sports programs on walking ability and endurance over time.

**DESIGN:** A retrospective cohort study included participants with cerebral palsy, aged 6 to 20 yrs, who attended a summer sports program from 2004 to 2012. There were 256 participant sessions with pre/post data recorded. The participants consisted of a total of 97 children (mean age [SD] = 11.4 [3.1] yrs), many of whom attended multiple programs throughout the years. Programs were held 6 hrs/d, 5 d/wk for up to 4 wks. Outcome measures included the Timed Up and Go, modified 6-min walk, and 25-ft walk/run.

**RESULTS:** The results showed significant improvements in the Timed Up and Go, modified 6-min walk distance and 25-ft walk/run over time. Children in Gross Motor Classification System level III made the largest gains.

**CONCLUSIONS:** Walking ability and endurance seem to improve after participation in an intensive summer sports programs. Higher frequency of program attendance resulted in significant improvements in the Timed Up and Go.

**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 Gross Motor Function Classification System level I, II, and III after 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 activity for a maximum of 1.5 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.0000000000000767

PMID: 28644242

### **Evaluation Of The Official Match External Load In Soccer Players With Cerebral Palsy.**

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

*J Strength Cond Res.* 2017 Jun 22. doi: 10.1519/JSC.0000000000002085. [Epub ahead of print]



The aims of this study were to analyze the official match external loads (i.e. total distance [TD], distance covered at different speeds, accelerations, decelerations, player load [PL], peak metabolic power [PMP] and changes of direction [CODs]) of football players with cerebral palsy (CP), and to determine the external loads according to playing time (i.e. < 20 min, 20-40 min and > 40 min). The external load of thirty-one international football players with CP (23.0 ± 6.6 years; 69.1 ± 9.0 kg; 174.8 ± 7.3 cm) was analyzed during a World Championship Qualification Tournament (n = 8 matches, 58 individual observations). Results showed that the football players with CP, covered less distance at high intensity running and sprinting, performing a smaller number of moderate and high intensity accelerations and decelerations, had a lower PL and made fewer CODs in official matches compared to conventional football players as reported in other studies. The number of minutes played by the players (i.e. < 20 min, 20-40 min and > 40 min) could significantly influence the players' match external load (ES = 0.3-5.5, small to extremely large). The impairments presented by football players with CP affect players' match external loads, especially in short-term high-intensity neuromuscular actions.

DOI: 10.1519/JSC.0000000000002085

PMID: 28658075

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

### **Availability, spatial accessibility, utilisation and the role of telehealth for multi-disciplinary paediatric cerebral palsy services in Queensland.**

Edirippulige S , Reyno J , Armfield NR , Bambling M , Lloyd O , McNevin E .

*J Telemed Telecare. 2016 Oct;22(7):391-6. doi: 10.1177/1357633X15610720. Epub 2015 Oct 29.*

**AIMS:** The purpose of this study was to understand the methods of current delivery of health care services to cerebral palsy (CP) patients in Queensland, Australia. The study also examines the current use of telehealth by clinicians and their perceptions about telehealth use.

**METHODS:** Patient records during July 2013-July 2014 were accessed from the Queensland Paediatric Rehabilitation Service (QPRS) to collect information relating to the service delivery for CP patients. Analysis was carried out to examine the patient locations and travel distances using ArcMap geoprocessing software. In addition, 13 face-to-face semi structured interviews were conducted with clinicians from the QPRS and the Cerebral Palsy Health Service (CPHS) to understand the perceptions of clinicians relating to the current level of health care delivery. We also examined the clinicians' current use of telehealth and their opinions about this method.

**RESULTS:** Records of 329 paediatric CP patients were accessed and reviewed. The majority of patients (96%, n = 307) who attended the clinics at the Royal Children's Hospital (RCH), Brisbane, were from remote, rural or regional areas of Queensland. Only 4% of patients (n = 13) were from major cities. During 12 months, patients had attended nine outreach programmes that were conducted by the QPRS and CPHS. The study found that non-local patients were required to travel an average distance of 836 km to access QPRS and CPHS services in Brisbane. The average distance for receiving a consultation at an outreach clinic was 173 km. Clinicians perceived that access to health care services to CP patients in Queensland is inadequate. Nearly all clinicians interviewed had some experience in using telehealth. They had high satisfaction levels with the method.

**CONCLUSIONS:** Traditional methods of delivering services to CP patients do not meet their needs. Clinicians have found telehealth is a feasible and satisfactory delivery method. However, the use of telehealth is still limited.

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PMID: 26519377 [Indexed for MEDLINE]

### **Does an educational workshop have an impact on caregivers' levels of knowledge about cerebral palsy? A comparative, descriptive cross-sectional survey of Zimbabwean caregivers.**

Dambi JM , Mandizvidza C , Chiwaridzo M , Nhunzvi C , Tadyanemhandu C .

*Malawi Med J. 2016 Dec;28(4):167-173.*

**BACKGROUND:** The diagnosis of a child with a life-long disability, such as cerebral palsy (CP), can be catastrophic to parents. It is often accompanied by feelings of despair, anxiety, hopelessness, and the fear of the unknown.

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Knowledge about CP is thus essential for caregiver adjustment and preparation for the caregiving role. However, there is a paucity of empirical evidence regarding the best method for educating caregivers. The aim of this study was therefore to evaluate the impact of an educational intervention on caregivers' knowledge about cerebral palsy. METHODS: This cross-sectional survey included 49 caregivers of children with cerebral palsy. Convenience sampling was used to select participants from two central hospitals in Harare, Zimbabwe. The caregivers were divided into two groups based on whether or not they had attended an educational workshop. The knowledge of cerebral palsy questionnaire (KCPQ) was administered once to assess the caregivers' CP knowledge.

RESULTS: The caregivers were comparable in terms of sociodemographic characteristics. The mean KCPQ scores for caregivers who attended workshops was 17.4 (SD 1.5), versus 13.8 (SD 2.5) for those without exposure to workshops. The differences between the two groups was statistically significant ( $U = 77.0$ ,  $Z = -4.45$ , and  $P < 0.001$ ).

CONCLUSIONS: Our findings suggest that educational workshops may lead to improved CP knowledge among caregivers. This may better equip parents and guardians to meet the extra caregiving demands associated with CP, leading to improved health outcomes for children with CP and their caregivers.

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PMCID: PMC5348609

PMID: 28321280 [Indexed for MEDLINE]

### **Invisible work of using and monitoring knowledge by parents (end-users) of children with chronic conditions.**

Lagosky S , Bartlett D , Shaw L .

*Work.* 2016;55 :727-736. doi: 10.3233/WOR-162456.

BACKGROUND: Parents who care for young children with chronic conditions are knowledge users. Their efforts, time, and energy to source, consider and monitor information add to the 'invisible' work of parents in making decisions about care, school transitions, and interventions. Little is known or understood about the work of parents as knowledge users.

OBJECTIVE: To understand the knowledge use patterns and how these patterns may be monitored in parents caring for their young children with cerebral palsy (CP).

METHODS: An embedded case study methodology was used. In-depth qualitative interviews and visual mapping were employed to collect and analyze data based on the experiences of three mothers of young children with CP.

RESULTS: Knowledge use in parents caring for their young children with CP is multi-factorial, complex and temporal. Findings resulted in a provisional model elaborating on the ways knowledge is used by parents and how it may be monitored.

CONCLUSIONS: The visual mapping of pathways and actions of parents as end users makes the processes of knowledge use more visible and open to be valued as well as appreciated by others. The provisional model has implications for knowledge mobilization as a strategy in childhood rehabilitation and the facilitation of knowledge use in the lives of families with children with chronic health conditions.

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PMID: 28059821 [Indexed for MEDLINE]

### **Parents' perceptions of the services provided to children with cerebral palsy in the transition from preschool rehabilitation to school-based services.**

Alsem MW , Verhoef M , Gorter JW , Langezaal LC , Visser-Meily JM , Ketelaar M .

*Child Care Health Dev.* 2016 Jul;42 :455-63. doi: 10.1111/cch.12341. Epub 2016 Apr 26

AIM: To describe the course of parents' perceptions of the family centredness of rehabilitation services provided to their children with cerebral palsy (CP) before and after the transition from preschool to school-based services.

BACKGROUND: Parents of 59 children with CP aged 2.5 to 4.5 years filled in the 56-item Measure of Processes of Care (MPOC-56) on three occasions pre (2) and post (1) transition to school-based services. Friedman tests were used to describe changes in parents' perceptions over time. Mann-Whitney U tests were used to describe differences in course of parents' perceptions between regular school and special school or day care.

RESULTS: Parents' perceptions of preschool services were stable between the ages of 2.5 and 3.5 years, with a decline after transition on four of the five domains of the MPOC ( $P < 0.05$ ). The domain providing general information was scored lowest (median at baseline 3.56, IQR 2.39) compared with the four other MPOC domains, but remained stable over time. No differences in course of parental perceptions were found for school type.

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CONCLUSION: The transition from preschool to school-based services for children with CP is associated with a decrease in parents' perception of family centredness independent of the type of school. The transition in services has a negative impact on perceived family-centred practices.

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PMID: 27117085 [Indexed for MEDLINE]

### **The Effect of a Comprehensive Care Transition Model on Cost and Utilization for Medically Complex Children With Cerebral Palsy.**

Howard SW, Zhang Z, Buchanan P, Armbrecht E, Williams C, Wilson G, Hutchinson J, Pearson L, Ellsworth S, Byler CM, Loux T, Wang J, Bernell S, Holekamp N.

*J Pediatr Health Care.* 2017 Jun 13. pii: S0891-5245(17)30240-7. doi: 10.1016/j.pedhc.2017.04.017. [Epub ahead of print]

INTRODUCTION: Our aim was to evaluate cost and acute care utilization related to an organized approach to care coordination and transitional care after major acute care hospitalization for children with medical complexities, including cerebral palsy.

METHODS: A retrospective cohort of 32 patients from Ranken Jordan Pediatric Bridge Hospital (RJPBH) who received the Care Beyond the Bedside model was compared with 151 patients receiving standard care elsewhere across Missouri. Claims data (2007-2012) were obtained from MoHealthNet, Missouri's Medicaid program, for all children with moderate to severe cerebral palsy (defined using approximated Gross Motor Function Classification System levels) who had at least one hospital visit during the study period (N = 183). Risk-adjusted linear and Poisson regression models were used to analyze per-member-per-month costs and three indicators of acute care utilization (emergency department visits, readmissions, and inpatient days).

RESULTS: RJPBH patients were associated with statistically significant reductions in per-member-per-month costs (-21%), hospital readmissions (-66%), and inpatient days (-57%).

DISCUSSION: RJPBH's enhanced interprofessional medical home-like model, including intense care coordination, psychosocial therapy, family and caregiver empowerment, and transitional care, may be keys to reducing cost and unnecessary hospital use for children with medical complexities with cerebral palsy who receive Medicaid.

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PMID: 28622983

### **What housing features should inform the development of housing solutions for adults with neurological disability?: A systematic review of the literature.**

Wright CJ, Zeeman H, Kendall E, Whitty JA.

*Health Place.* 2017 Jun 21;46:234-248. doi: 10.1016/j.healthplace.2017.06.001. [Epub ahead of print]

Despite the recent emphasis in Australian political, academic, and legislative narratives to more actively promote real housing choice for people with high healthcare and support needs, there is a lack of understanding regarding the specific housing features that might constitute better housing solutions for this population. Inclusive housing provision in Australia rightly emphasises safety and accessibility issues but often fails to incorporate factors related to broader psychosocial elements of housing such as dwelling location, neighbourhood quality, and overall design. While the importance of these broader elements appears obvious, it is not yet clear what specific housing features relate to these elements and how they might contribute to housing solutions for people with high healthcare and support needs. For individuals with complex neurological conditions such as brain injury or cerebral palsy, who require maximum support on a daily basis yet want to live independently and away from a primary care hospital or health facility, a more detailed understanding of the housing features that might influence design and development is needed. Thus, in order to clarify the broader factors related to housing solutions for this population, a systematic review was conducted to identify and synthesise the current research evidence (post-2003) and guide future housing design and development opportunities. From the included studies (n=26), 198 unique housing features were identified. From the 198 features, 142 related to housing design (i.e., internal or external characteristics of the dwelling and its land), 12 related to the dwelling's location (i.e., its proximity to available resources), and 54 related to the nature of the surrounding neighbourhood (i.e., the physical, social, and economic conditions of the area). The *Science Infos Paralyse Cérébrale*, Juin 2017, **FONDATION PARALYSIE CEREBRALE** 67 rue Vergniaud 83 75013 Paris - tel +33 1 45 54 03 03 contact: Christine Doumergue [cdoumergue@lafondationmotrice.org](mailto:cdoumergue@lafondationmotrice.org)

findings of this review contribute significantly to the literature by reporting a broader scope of relevant housing features for people with neurological disability, presenting preliminary guiding principles for housing design and development for this population, and identifying opportunities for future research.

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