# Science Infos
## Paralysie Cérébrale

N° 32 – JANVIER 2017


FONDATION PARALYSIE CÉRÉBRALE LA FONDATION MOTRICE

## *FOCUS*

### *Des nouvelles guidelines pour le diagnostic et la prise en charge de la paralysie cérébrale chez les jeunes de la naissance à 25 ans.*

Le ***NICE*** (National Institute for Heath and Care Excellence, UK) vient de publier des nouvelles guidelines sur le diagnostic et la prise en charge de la paralysie cérébrale chez les jeunes.

Une précédente recommandation publiée en juillet 2012 concernait la gestion de la spasticité, des problèmes moteurs concomitants et des complications musculo-squelettiques précoces chez les jeunes de moins de 19 ans atteints de troubles cérébraux non progressifs.
L'objectif était de réduire les disparités dans la pratique et d'aider les professionnels de santé à sélectionner et utiliser les traitements appropriés . En novembre 2016, cette recommandation a été modifiée pour mettre à jour les informations de l'ICF (World Health Organization's International Classification of Functioning, Disability and Health) et les domaines qu'elle couvre.

Cette nouvelle recommandation s'intéresse au diagnostic, à l'évaluation et à la prise en charge de la paralysie cérébrale chez le jeunes de la naissance à 25 ans
L'objectif est de s'assurer que ceux-ci reçoivent les soins et les traitements nécessaires pour gérer les comorbidités cliniques et anomalies du développement
Elle inclut des recommandations sur :

- Les facteurs de risque, les causes et la détection de la paralysie cérébrale
- La prise en charge multidisciplinaire
- L'apport d'information et le soutien
- La gestion des troubles de l'alimentation et de l'hypersialie
- Les aides pour l'élocution, le langage et la communication
- L'évaluation et la prise en charge de la douleur, l'inconfort, la détresse et les troubles du sommeil
- Des informations sur les comorbidités incluant les problèmes de santé mentale
- Le passage à l'âge adulte

Elle s'adresse

- aux Professionnels de santé,
- aux professionnels des services sociaux ,
- aux enfants et jeunes atteints de paralysie cérébrale ainsi qu'à leurs familles et aux accompagnants.

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# Manifestations et congrès

**Janvier 2017**

**27ème congrès de la Société Française de Neurologie Pédiatrique**
18-20 janvier 2017
Paris, France
http://www.sfneuroped.fr/nos-missions/congres-sfnp/

**Fevrier 2017**

**Journées d'études 2017 Polyhandicap et IMC**
Troubles du comportement : Repérer, comprendre, prévenir
pour mieux accompagner la personne polyhandicapée et IMC
27-28 Février 2017
Paris, France
http://www.cesap.asso.fr/images/CESAP_Formation/pdf/Programme%20JE%20POLY%20IMC%202017%20Troubles%20du%20comportement%202nd%20dition.pdf

**Mars 2017**

**45èmes Entretiens de Médecine Physique et de réadaptation**
15-17 mars 2017
Montpellier, France
http://www.empr.fr/EventPortal/Information/EMPR2017/ACCEUIL.aspx

**Mai 2017**

**29th Annual EACD Meeting,**
17-20 mai 2017
Amsterdam, pays bas
http://www.eacd2017.org/

**Juin 2017**

**Congrès Réseau Breizh - Sferhe – CDI**
**"La paralysie cérébrale au fil du temps »**
26-27 juin 2017
Saint Malo, France
http://www.tmsevents.fr/congres/2017/sferhe/

**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/

**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

**Children with motor impairment related to cerebral palsy: Prevalence, severity and concurrent impairments in China.**
He P, Chen G, Wang Z, Guo C, Zheng X
*J Paediatr Child Health. 2017 Jan 17. doi: 10.1111/jpc.13444. [Epub ahead of print]*

AIM: Cerebral palsy (CP) is the most common cause of motor impairment in childhood. This study aimed to examine the prevalence, severity and concurrent impairments of CP-related motor impairment among Chinese children.
METHODS: Children with CP-related motor impairment aged 0-17 years were identified through a national population-based survey based on World Health Organization International Classification of Functioning, Disability and Health. Logistic regression models allowing for weights were used to examine individual and family factors in relation to CP-related motor impairment.
RESULTS: The weighted prevalence of CP-related motor impairment was 1.25 per 1000 children (95% confidence interval (CI): 1.16, 1.35) in China. Male children, children in multiples and in families where adults suffered from CP, were more likely to be affected by CP-related motor impairment. For mild, moderate, severe and extremely severe groups of motor impairment, weighted proportions of CP were 14.12% (95%CI: 11.70, 16.95), 20.35% (95%CI: 17.48, 23.56), 27.44% (95%CI: 24.25, 30.87) and 38.09% (95%CI: 34.55, 41.76), respectively; and weighted proportions of concurrent visual, hearing and cognitive impairment were 5.00% (95%CI: 3.59, 6.91), 6.98% (95%CI: 5.34, 9.08) and 71.06% (95%CI: 67.57, 74.31), respectively.
CONCLUSIONS: Gender, multiple births and family adults with CP were significantly associated with CP-related motor impairment in Chinese children. Proportions of CP and concurrent impairments that increased with severity of motor impairment were observed.

DOI: 10.1111/jpc.13444
PMID: 28094881 [PubMed - as supplied by publisher]

**Prevalence of cerebral palsy and intellectual disability among children identified in two U.S. National Surveys, 2011-2013.**
Maenner MJ, Blumberg SJ, Kogan MD, Christensen D, Yeargin-Allsopp M, Schieve LA.
*Ann Epidemiol. 2016 Mar;26(3):222-6. doi: 10.1016/j.annepidem.2016.01.001. Epub 2016 Jan 12.*

PURPOSE: Cerebral palsy (CP) and intellectual disability (ID) are developmental disabilities that result in considerable functional limitations. There are few recent and nationally representative prevalence estimates of CP and ID in the United States.
METHODS: We used two U.S. nationally representative surveys, the 2011-2012 National Survey of Children's Health (NSCH) and the 2011-2013 National Health Interview Survey (NHIS), to determine the prevalence of CP and ID based on parent report among children aged 2-17 years.
RESULTS: CP prevalence was 2.6 (95% confidence interval [CI]: 2.1-3.2) per 1000 in the NSCH and 2.9 (95% CI: 2.3-3.7) in the NHIS. ID prevalence was 12.2 (95% CI: 10.7-13.9) and 12.1 (95% CI: 10.8-13.7) in NSCH and NHIS,

respectively. For both conditions, the NSCH and NHIS prevalence estimates were similar to each other for nearly all sociodemographic subgroups examined.
CONCLUSIONS: Despite using different modes of data collection, the two surveys produced similar and plausible estimates of CP and ID and offer opportunities to better understand the needs and situations of children with these conditions.
Published by Elsevier Inc.
DOI: 10.1016/j.annepidem.2016.01.001
PMCID: PMC5144825 [Available on 2017-03-01]
PMID: 26851824 [PubMed - indexed for MEDLINE]

**Temporal trends in perinatal mortality and cerebral palsy: A regional population-based study in southern Japan.**
Kodama Y, Sameshima H, Ikenoue T
*Brain Dev. 2016 Apr;38(4):386-91. doi: 10.1016/j.braindev.2015.10.002. Epub 2015 Oct 21.*

AIM: The prevalence of cerebral palsy (CP) has not decreased in developed countries over the past 30 years. We examined gestational age-specific trends in the prevalence of CP.
METHODS: This unselected, population-based study was conducted in Miyazaki prefecture, Japan (10,000 deliveries annually), where 102,999 deliveries were registered between 2001 and 2010. Of these, 312 were stillbirths (⩾22 weeks of gestation), 126 were neonatal deaths (<28 days of birth), and 214 infants were determined to be at risk of CP at peer-review conferences. Survival and neurological damage were compared for two 5-year periods, 2001-2005 and 2006-2010, and infants were classified according to gestational ages.
RESULTS: Stillbirths and neonatal deaths decreased significantly during both periods. Likewise, the number of registered high-risk cases of CP decreased by 30.2%, from 126 to 88 cases. After excluding congenital anomalies, the corrected CP prevalence was 1.5 per 1000 (78/51,889) and 1.3 per 1000 (67/51,110), for the two periods, which was not a significant difference. The number of extremely preterm infants (22-25 weeks) did not change over the 10-year period, whereas that of moderately preterm infants (26-36 weeks) increased, and that of term infants significantly decreased ($p<0.01$). In term infants, asphyxia decreased from 18 to 7 cases ($p<0.05$).
CONCLUSIONS: Perinatal deaths and CP decreased in prevalence during both 5-year periods, and the CP prevalence was 2.1 per 1000 births. Furthermore, fewer term infants were at high risk for CP mainly because of the reduced prevalence of asphyxia.

DOI: 10.1016/j.braindev.2015.10.002
PMID: 26482600 [PubMed - indexed for MEDLINE]

## Facteurs de risque – Causes

**Anesthesia and Developing Brains - Implications of the FDA Warning.**
Andropoulos DB, Greene MF
*N Engl J Med. 2017 Feb 8. doi: 10.1056/NEJMp1700196. [Epub ahead of print]*
**Free article**
DOI: 10.1056/NEJMp1700196
PMID: 28177852 [PubMed - as supplied by publisher]

**Antecedents of cerebral palsy according to severity of motor impairment.**
Ahlin K, Himmelmann K, Nilsson S, Sengpiel V, Jacobsson B
*Acta Obstet Gynecol Scand. 2016 Jul;95(7):793-802. doi: 10.1111/aogs.12885. Epub 2016 Apr 4.*
*Comment on Dev Med Child Neurol. 1992 Jun;34(6):547-51.*

INTRODUCTION: The purpose of this study was to determine whether antecedents and neuroimaging patterns vary according to the severity of motor impairment in children with cerebral palsy.
MATERIAL AND METHODS: A population-based study in which all 309 term-born children with spastic and dyskinetic cerebral palsy born between 1983 and 1994 and 618 matched controls were studied. Antecedents were retrieved from obstetric records. Information on neuroimaging was retrieved from the cerebral palsy Register of Western Sweden. Cases were grouped by severity of motor impairment: mild (walks without aids), moderate (walks with aids)

or severe (dependent on wheelchair). Binary logistic regression, the Cochran-Armitage test for trends, interaction analyses and interrelationship analyses were performed.
RESULTS: Antecedents associated with mild motor impairment were antepartum (placental weight, maternal weight and antibiotic therapy) or intrapartum and postpartum adverse events (meconium-stained amniotic fluid, low Apgar score, admission to neonatal intensive care unit and neonatal encephalopathy). Antecedents associated with severe motor impairment were antepartum (congenital infection, small head circumference and brain maldevelopment) or intrapartum and postpartum (emergency cesarean section and maternal antibiotic therapy). Comparisons between mild and severe motor impairment revealed congenital infection, maldevelopment, neonatal encephalopathy and meconium aspiration syndrome significantly more often in the group with severe motor impairment ($p < 0.05$). White matter injury was the most common neuroimaging pattern in mild motor impairment, whereas maldevelopment and cortical/subcortical lesions were most common in the severe motor impairment group.
CONCLUSIONS: Our results suggest a variation in antecedents associated with cerebral palsy, related to severity of motor impairment. Timing of antecedents corresponded to neuroimaging patterns.

DOI: 10.1111/aogs.12885
PMID: 26910364 [PubMed - indexed for MEDLINE]

**Chronic Conditions and Health Care Needs of Adolescents Born at 23 to 25 Weeks' Gestation.**
Holsti A, Adamsson M, Hägglöf B, Farooqi A, Serenius F
*Pediatrics. 2017 Jan 20. pii: e20162215. doi: 10.1542/peds.2016-2215. [Epub ahead of print]*

OBJECTIVE: We examined chronic conditions, functional limitations, and special health care needs in extremely preterm children (EPT; 23-25 weeks' gestation) born between 1992 and 1998 at 2 Swedish tertiary care centers that offered regional and active perinatal care to all live-born EPT infants.
METHODS: Of 134 surviving EPT children, 132 (98%) were assessed at 10 to 15 years of age alongside 103 term-born controls. Identification of children with functional limitations and special health care needs was based on a questionnaire administered to parents. Categorization of medical diagnoses and developmental disabilities was based on child examinations, medical record reviews, and parent questionnaires.
RESULTS: In logistic regression analyses adjusting for social risk factors and sex, the EPT children had significantly more chronic conditions than the term-born controls, including functional limitations (64% vs 6%; odds ratio [OR], 15; 95% confidence interval [CI], 6.1-37.2; $P < .001$), compensatory dependency needs (60% vs 29%; OR, 3.8; 95% CI, 2.2-6.6; $P < .001$), and services above those routinely required by children (64% vs 25%; OR, 5.4; 95% CI, 3.0-9.6; $P < .001$). Specific diagnoses and disabilities for the EPT group versus controls included cerebral palsy (9.1% vs 0%; $P < .001$), asthma (21.2% vs 6.8%; P = 001), IQ > -2 SD (31.1% vs 4.9%; $P < .001$), poor motor skills without neurosensory impairment (21.9% vs 1.9%; $P < .001$), and psychiatric conditions (15.2% vs 1.9%; $P < .001$).
CONCLUSIONS: Adolescents born EPT have considerable long-term health and educational needs. Few had severe impairments that curtailed major activities of daily life.

DOI: 10.1542/peds.2016-2215
PMID: 28108580 [PubMed - as supplied by publisher]

**Immunoglobulins in Neonates with Rhesus Hemolytic Disease of the Fetus and Newborn: Long-Term Outcome in a Randomized Trial.**
van Klink JM, van Veen SJ, Smits-Wintjens VE, Lindenburg IT, Rijken M, Oepkes D, Lopriore E.
*Fetal Diagn Ther. 2016;39(3):209-13. doi: 10.1159/000434718. Epub 2015 Jul 3.*

OBJECTIVE: Prophylactic intravenous immunoglobulin (IVIg) does neither reduce the need for exchange transfusion nor the rates of other adverse neonatal outcomes in neonates with rhesus hemolytic disease of the fetus and newborn (rhesus HDFN) according to our randomized controlled trial analysis. Our objective was to assess the long-term neurodevelopmental outcome in the children included in the trial and treated with either IVIg or placebo.
METHODS: All families of the children included in the trial were asked to participate in this follow-up study. The long-term neurodevelopmental outcome in children at least 2 years of age was assessed using standardized tests. The primary outcome was the incidence of neurodevelopmental impairment defined as at least one of the following: cerebral palsy, severe cognitive and/or motor developmental delay (with a test score of less than -2 SD), bilateral deafness or blindness.

RESULTS: Sixty-six of the 80 children (82.5%) who had been recruited to the initial randomized controlled trial participated in the follow-up study. The children were assessed at a median age of 4 years (range 2-7). The median cognitive score was 96 (range 68-118) in the IVIg group and 97 (range 66-118) in the placebo group (p = 0.79). There was no difference in the rate of neurodevelopmental impairment between the IVIg and the placebo group [3% (1/34) vs. 3% (1/32); p = 1.00].
CONCLUSIONS: The long-term neurodevelopmental outcome in children treated with IVIg was not different from that in children treated with placebo. Standardized long-term follow-up studies with large enough case series and sufficient power are needed to replicate these findings.

**Free Article**
DOI: 10.1159/000434718
PMID: 26159803 [PubMed - indexed for MEDLINE]

**MR angiography findings in infants with neonatal arterial ischemic stroke in the middle cerebral artery territory: A prospective study using circle of Willis MR angiography.**
Husson B, Hertz-Pannier L, Adamsbaum C, Renaud C, Presles E, Dinomais M, Kossorotoff M, Landrieu P, Chabrier S
*Eur J Radiol. 2016 Jul;85(7):1329-35. doi: 10.1016/j.ejrad.2016.05.002. Epub 2016 May 6.*

AIM: Neonatal arterial ischemic stroke (NAIS) results from a focal disruption of the blood flow in a cerebral artery by a not well understood mechanism. Our objective is to describe the acute MRangiography (MRA) findings in infants with an NAIS in the middle cerebral artery (MCA) territory and correlate them with early parenchymal infarcts and motor outcome.
METHODS: Among one hundred prospectively followed neonates with NAIS, we studied thirty-seven patients with an MCA infarct explored with circle of Willis MRA. MCA flow characteristics were documented, along with infarct location/extent and motor outcome at age 7 years.
RESULTS: Twenty-three (62%) of the children showed arterial changes, all ipsilateral to the NAIS, with occlusion in six, thrombus-type flow defect in nine, and unilateral increased flow in enlarged insular arteries in the remaining eight. There was a statistically significant correlation between parenchymal and arterial MR findings (p=0.0002). A normal MRA had a negative predictive value of 100% (95% CI: 76.8-100) in ruling out a main branch infarct. Patients with abnormal MRA tended to be at increased risk for cerebral palsy (OR=3.1). Occlusion was associated with a worse outcome (p=0.04).
INTERPRETATION: MRangiography shows arterial abnormalities suggesting that embolism is a frequent cause of NAIS.

DOI: 10.1016/j.ejrad.2016.05.002
PMID: 27235881 [PubMed - indexed for MEDLINE]

**Neuroinflammation in intrauterine growth restriction.**
Wixey JA, Chand KK, Colditz PB, Bjorkman ST
*Placenta. 2016 Nov 25. pii: S0143-4004(16)30642-7. doi: 10.1016/j.placenta.2016.11.012. [Epub ahead of print]*

Disruption to the maternal environment during pregnancy from events such as hypoxia, stress, toxins, inflammation, and reduced placental blood flow can affect fetal development. Intrauterine growth restriction (IUGR) is commonly caused by chronic placental insufficiency, interrupting supply of oxygen and nutrients to the fetus resulting in abnormal fetal growth. IUGR is a major cause of perinatal morbidity and mortality, occurring in approximately 5-10% of pregnancies. The fetal brain is particularly vulnerable in IUGR and there is an increased risk of long-term neurological disorders including cerebral palsy, epilepsy, learning difficulties, behavioural difficulties and psychiatric diagnoses. Few studies have focused on how growth restriction interferes with normal brain development in the IUGR neonate but recent studies in growth restricted animal models demonstrate increased neuroinflammation. This review describes the role of neuroinflammation in the progression of brain injury in growth restricted neonates. Identifying the mediators responsible for alterations in brain development in the IUGR infant is key to prevention and treatment of brain injury in these infants.

DOI: 10.1016/j.placenta.2016.11.012
PMID: 27916232 [PubMed - as supplied by publisher]

**Outcome of hemiplegic cerebral palsy born at term depends on its etiology.**
Kitai Y, Haginoya K, Hirai S, Ohmura K, Ogura K, Inui T, Endo W, Okubo Y, Anzai M, Takezawa Y, Arai H
*Brain Dev. 2016 Mar;38(3):267-73. doi: 10.1016/j.braindev.2015.09.007. Epub 2015 Oct 1.*

OBJECTIVES: To elucidate the etiology and its relationship to the outcomes of hemiplegic cerebral palsy (HCP).
PARTICIPANTS AND METHODS: MR images and outcomes of 156 children with HCP born at term and older than three years were investigated in two major centers for cerebral palsy in Japan. Etiologies were classified into perinatal ischemic stroke (PIS), cerebral dysgenesis (CD), and others. PIS was divided into periventricular venous infarction (PVI) and two types of arterial infarction; middle cerebral artery infarction (MCAI) and deep gray matter infarction (DGMI). Initial signs and the time of presentation were investigated among the three types of PIS. As functional outcomes, laterality of paresis, age at initial walk, affected hand's function, intellectual development, and occurrence of epilepsy were compared among all the four types.
RESULTS:
ETIOLOGY: PIS was found in 106 children (68%), while CD accounted for 28 (18%). Among PIS, venous infarction was more common than arterial infarction (62:44).
OUTCOMES: PVI revealed later presentation of motor asymmetry and more involvement of lower extremity as the initial sign among PIS groups. Only MCAI showed right-side predominance in laterality of paresis. DGMI related to better intellectual development and PVI showed lower occurrence of epilepsy, while there was no significant difference in affected hand's function among the four groups. PIS groups showed significantly earlier attainment of independent walk, better intellectual development, and lower occurrence of epilepsy than CD.
CONCLUSIONS: PVI was the most common cause of HCP born at term, and the etiology closely related to the initial signs of hemiplegia and overall outcomes.

DOI: 10.1016/j.braindev.2015.09.007
PMID: 26428444 [PubMed - indexed for MEDLINE]

**Perinatal Regionalization and Implications for Long-Term Health Outcomes in Cerebral Palsy.**
Bolbocean C, Wintermark P, Shevell MI, Oskoui M
*Can J Neurol Sci. 2016 Mar;43(2):248-53. doi: 10.1017/cjn.2015.322. Epub 2016 Jan 21.*

BACKGROUND: Perinatal regionalization is linked to improved neonatal outcomes; however, the effects on long-term outcomes in cerebral palsy (CP) are not known. We estimate the effect of highest levels of neonatal care available at delivery on the risk of developing a nonambulatory CP status.
METHODS: Children with CP born in Quebec from the Canadian CP Registry excluding postneonatal causes were included (N=360). We estimate the effect of level of care available at delivery on risk of nonambulatory status among children with CP using propensity score matching and instrumental variables methods to adjust for differences in case mix among the three groups of hospitals. The outcome variable is an indicator for CP nonambulation assigned according to Gross Motor Function Classification System (levels IV and V). This study used data that predated therapeutic hypothermia in Quebec.
RESULTS: Propensity score estimates of change in the adjusted risk of having a nonambulatory CP status because of birth at level II versus level I is -0.081, 95% confidence interval (CI; -0.2182 to 0.0562); level III versus level I is -0.072 95% CI (-0.225 to 0.08), and level III versus level II is 0.157 95% CI (0.027 to 0.286).
CONCLUSIONS: Differences in levels of neonatal care available at hospital where the delivery was carried out are not associated with the risk of a nonambulatory CP phenotype. This suggests that level of care and associated medical technology within the Quebec regionalized neonatal-perinatal system is used efficiently because it does not offer any further marginal benefit in the reduction of severe CP outcomes. The system works well as it is, which is supportive of the perinatal regionalization. The success of the neonatal resuscitation program and referral of high-risk births to regional hospitals with sufficient obstetric and perinatal competence and resources may contribute to this lack of variability.
DOI: 10.1017/cjn.2015.322
PMID: 26790470 [PubMed - indexed for MEDLINE]

**Preterm birth: Inflammation, fetal injury and treatment strategies.**
Boyle AK, Rinaldi SF, Norman JE, Stock SJ

*J Reprod Immunol. 2016 Dec 2. pii: S0165-0378(16)30390-4. doi: 10.1016/j.jri.2016.11.008. [Epub ahead of print]*

Preterm birth (PTB) is the leading cause of childhood mortality in children under 5 and accounts for approximately 11% of births worldwide. Premature babies are at risk of a number of health complications, notably cerebral palsy, but also respiratory and gastrointestinal disorders. Preterm deliveries can be medically indicated/elective procedures or they can occur spontaneously. Spontaneous PTB is commonly associated with intrauterine infection/inflammation. The presence of inflammatory mediators in utero has been associated with fetal injury, particularly affecting the fetal lungs and brain. This review will outline (i) the role of inflammation in term and PTB, (ii) the effect infection/inflammation has on fetal development and (iii) recent strategies to target PTB. Further research is urgently required to develop effective methods for the prevention and treatment of PTB and above all, to reduce fetal injury.

DOI: 10.1016/j.jri.2016.11.008
PMID: 28122664 [PubMed - as supplied by publisher]

**Risk factors for cerebral palsy in premature infants identified during the pre and perinatal periods: a case- control study.**
Andrade E, Araujo Júnior E, Rolo LC, Costa Fda S.
*Minerva Ginecol. 2016 Feb;68(1):29-36. Epub 2014 Nov 21.*

BACKGROUND: The aim of this paper was to assess the pre and perinatal risk factors for cerebral palsy in premature infants, comparing them with full-term infants.
METHODS: This was a prospective cross-sectional cohort study on 48 infants between four and eight months of life, of whom 20 were born prematurely (<37 weeks of gestational age) and 28 at full term (37 to 42 weeks). A questionnaire was used, which investigated maternal reproductive, obstetric and neonatal factors, along with an evaluation scale for neurosensory-motor development of infants at risk of neuromotor alterations. For the statistical analysis, the Student's t, chi-square, Fisher's exact and Cramer's V tests were used.
RESULTS: All the newborns that were small for their gestational age (35%) were in the premature group (P=0.001). Hyperbilirubinemia (P=0.000), anemia (P=0.009), respiratory distress syndrome (P=0.000) and periventricular hemorrhage (P=0.025) were more frequent in the premature newborn group. Phototherapy and blood transfusion were more frequent among the premature infants: 70.0% vs. 25.0% (P=0.002) and 20.0% vs. 0.0% (P=0.025), respectively. Among the premature infants, 50.0% presented neuromotor development alterations, against only 14.3% of the full-term infants.
CONCLUSIONS: Prematurity is an important risk factor for the development of neurosensory-motor alterations that are suggestive of cerebral palsy.
PMID: 25415488 [PubMed - indexed for MEDLINE]

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CONCLUSIONS: Prematurity is an important risk factor for the development of neurosensory-motor alterations that are suggestive of cerebral palsy.
PMID: 25415488 [PubMed - indexed for MEDLINE]

**The Development of Extremely Premature Infants.**
Voss W, Hobbiebrunken E, Ungermann U, Wagner M, Damm G.
*Dtsch Arztebl Int. 2016 Dec 26;113(51-52):871-878. doi: 10.3238/arztebl.2016.0871.*

BACKGROUND: Until now, there has been no comprehensive long-term study in Germany on the development of extremely premature infants up to school age.
METHODS: From October 2004 to September 2008, in the German federal state of Lower Saxony, 437 infants born at a gestational age less than 28 weeks were followed up at the ages of 2 and 5 years, and some at the age of 10 years. The 5-year follow-up data were collated with the peri- and neonatological parameters and compared with the 2- and 10-year follow-up data.
RESULTS: The mortality of extremely premature infants was 25.1%. Among the five-year-olds studied, 14.1% showed cognitive impairment and 17.4% had cerebral palsy. 40.4% manifested abnormalities of speech or language, 33.1% had behavioral abnormalities, and 72.5% received therapeutic interventions. Infants in whom severe brain damage was diagnosed by ultrasonography shortly after birth were more likely to develop cerebral palsy (odds ratio [OR] 38.28, 99% confidence interval [12.55; 116.80]) and to have impaired cognitive development (OR 7.36 [2.52; 21.51]). The likelihood of cognitive impairment was also higher among infants whose mothers had a lower level of education (OR 3.83 [1.68; 8.77]). 73.1% (242 out of 331) of the two-year-olds were in the same category of cognitive function at the 5-year follow-up; 82.4% (65 out of 79) of the 5-year-olds were in the same category of cognitive function at the 10-year follow-up.
CONCLUSION: Many of these extremely premature infants had developmental disturbances, and many required therapeutic interventions. The risk factors revealed by this study may help identify patients who are in particular need of support, enabling targeted measures to be taken at the earliest possible stage in order to improve their cognitive and motor abilities. Nationwide, standardized follow-up at the age of 5 years would be desirable.
DOI: 10.3238/arztebl.2016.0871
PMID: 28130919 [PubMed - in process]

**The Role of Prematurity in Patients With Hemiplegic Cerebral Palsy.**
Zelnik N, Lahat E, Heyman E, Livne A, Schertz M, Sagie L, Fattal-Valevski A
*J Child Neurol. 2016 May;31(6):678-82. doi: 10.1177/0883073815610430. Epub 2015 Oct 23.*

A multicenter retrospective study was conducted to investigate the perinatal factors, imaging findings and clinical characteristics of hemiplegic cerebral palsy with a particular focus on children born prematurely. Our cohort included 135 patients of whom 42% were born prematurely; 16% were extreme premature infants who were born at 30 weeks or earlier. Nineteen (14%) were twins. Right hemiplegia was slightly more common and accounted for 59% of the patients. Imaging findings of intraventricular hemorrhage and periventricular leukomalacia were more prevalent in premature children whereas stroke, porencephaly, cerebral hemorrhage and cerebral atrophy were more evenly distributed in both term-born and prematurely-born children ($p < 0.01$). The overall prevalence of epilepsy in the cohort was 26% with no differences in full-term compared to prematurely-born children. Regardless of the gestational birth age, intellectual deficits were more common in the presence of comorbidity of both hemiplegia and epilepsy ($p < 0.05$).

DOI: 10.1177/0883073815610430
PMID: 26500242 [PubMed - indexed for MEDLINE]

**The role of prothrombotic factors in children with hemiplegic cerebral palsy.**
Türedi Yildirim A, Sütçü R, Köroğlu M, Delibaş N, Kişioğlu N, Akar N, Ergürhan İlha I.
*Minerva Pediatr. 2015 Aug;67(4):279-84. Epub 2014 Jul 18.*

AIM: Hemiplegic cerebral palsy (HCP) is a condition occurring as a consequence of a non-progressive damage of the brain with incomplete anatomical and physical development during the early period of life. Its etiology is

multifactorial, with the cause remaining unexplained in the majority of cases. This study aims to investigate whether thrombophilic factors correlates with the etiology in children with HCP.
METHODS: We included 36 children with HCP in the patient group, and 41 healthy children with no neurologic disorders in the control group. No significant difference was found between the two groups in terms of factor V leiden, methylenetetrahydrofolate reductase and prothrombin 20210A mutation frequency and protein C, protein S and antithrombin III levels.
RESULTS: Homocysteine levels were significantly higher in the group of patients with HCP as compared to the control group (P=0.012). Because we could not identify the origin of hyperhomocysteinemia as congenital or acquired, the impact of hyperhomocysteinemia on HCP was considered insignificant. Each thrombophilic disorder was assessed in terms of relatedness to atrophy, periventricular leukomalacia, infarct, congenital anomaly and porencephalic cyst, respectively. No significant correlation was detected between thrombophilic disorders and cranial imaging findings.
CONCLUSION: Our study has shown that thrombophilic factors are not involved in the etiology of HCP.
PMID: 25034217 [PubMed - indexed for MEDLINE]

## Génétique

**The genetic basis of cerebral palsy.**
Fahey MC, Maclennan AH, Kretzschmar D, Gecz J, Kruer MC
*Dev Med Child Neurol. 2017 Jan 1. doi: 10.1111/dmcn.13363. [Epub ahead of print]*

Although prematurity and hypoxic-ischaemic injury are well-recognized contributors to the pathogenesis of cerebral palsy (CP), as many as one-third of children with CP may lack traditional risk factors. For many of these children, a genetic basis to their condition is suspected. Recent findings have implicated copy number variants and mutations in single genes in children with CP. Current studies are limited by relatively small patient numbers, the underlying genetic heterogeneity identified, and the paucity of validation studies that have beenperformed. However, several genes mapping to intersecting pathways controlling neurodevelopment and neuronal connectivity have been identified. Analogous to other neurodevelopmental disorders such as autism and intellectual disability,the genomic architecture of CP is likely to be highly complex. Although we arejust beginning to understand genetic contributions to CP, new insights areanticipated to serve as a unique window into the neurobiology of CP and suggestnew targets for intervention.© 2017 Mac Keith Press.
DOI: 10.1111/dmcn.13363
PMID: 28042670 [PubMed - as supplied by publisher]

**Integrative Review of Genetic Factors Influencing Neurodevelopmental Outcomes in Preterm Infants.**
Blair LM, Pickler RH, Anderson C
*Biol Res Nurs. 2016 Mar;18(2):127-37. doi: 10.1177/1099800415605379. Epub 2015Sep 15.*

Preterm infants are at elevated risk for a host of neurodevelopmental problems, including disorders that appear later in life. Gene-environment interactions and prematurity may combine to increase the risk for poor neurodevelopmental outcomes. Increasing evidence supports a genetic link to risk for atypical development; however, no genomic risk profiles are currently used for infants without apparent genetic disorders. The purpose of this review was to synthesize recent evidence of genetic associations with atypical neurodevelopmental outcomes that may affect preterm infants who do not have a rare genetic disease. Electronic and hand-search strategies were used to find relevant articles that were English-language, peer-reviewed primary research or meta-analysis reports published between July 2009 and July 2014, involving human participants. Articles included in the analysis (N = 29) used a wide range of study designs and methodologies, complicating the analysis. An integrative-review design was used to synthesize the data. Numerous genes (n = 43) and additional large deletion copy number variants were associated with neurodevelopmental outcomes, including cognition, attention, perception, psychiatric disease, autism spectrum disorder, cerebral palsy, infant behavior, and alterations in brain architecture. The creation of genetic risk profiles for complex disorders of neurodevelopment is presently hindered by inconsistent genetic-association evidence, methodological considerations, reporting problems, and lack of replication. However, several avenues of investigation offer promise, including large (>100 kb) copy number variants and the candidate genes MET, NRG3, and SLC6A4, each of which werereported to have associations with neurodevelopmental outcomes in multiple,high-quality studies.

DOI: 10.1177/1099800415605379
PMID: 26374169 [PubMed - indexed for MEDLINE]

# Lésions - Prévention des lesions

## Données fondamentales

**Glucocorticoids Protect Neonatal Rat Brain in Model of Hypoxic-Ischemic Encephalopathy (HIE).**
Harding B, Conception K, Li Y, Zhang L
*Int J Mol Sci. 2016 Dec 22;18(1). pii: E17. doi: 10.3390/ijms18010017.*

Hypoxic-ischemic encephalopathy (HIE) resulting from asphyxia in the peripartum period is the most common cause of neonatal brain damage and can result in significant neurologic sequelae, including cerebral palsy. Currently therapeutic hypothermia is the only accepted treatment in addition to supportive care for infants with HIE, however, many additional neuroprotective therapies have been investigated. Of these, glucocorticoids have previously been shown to have neuroprotective effects. HIE is also frequently compounded by infectious inflammatory processes (sepsis) and as such, the infants may be more amenable to treatment with an anti-inflammatory agent. Thus, the present study investigated dexamethasone and hydrocortisone treatment given after hypoxic-ischemic (HI) insult in neonatal rats via intracerebroventricular (ICV) injection and intranasal administration. In addition, we examined the effects of hydrocortisone treatment in HIE after lipopolysaccharide (LPS) sensitization in a model of HIE and sepsis. We found that dexamethasone significantly reduced rat brain infarction size when given after HI treatment via ICV injection; however it did not demonstrate any neuroprotective effects when given intranasally. Hydrocortisone after HI insult also significantly reduced brain infarction size when given via ICV injection; and the intranasal administration showed to be protective of brain injury in male rats at a dose of 300 µg. LPS sensitization did significantly increase the brain infarction size compared to controls, and hydrocortisone treatment after LPS sensitization showed a significant decrease in brain infarction size when given via ICV injection, as well as intranasal administration in both genders at a dose of 300 µg. To conclude, these results show that glucocorticoids have significant neuroprotective effects when given after HI injury and that these effects may be even more pronounced when given in circumstances of additional inflammatory injury, such as neonatal sepsis.
**Free Article**
DOI: 10.3390/ijms18010017
PMID: 28025500 [PubMed - in process]

**Intranasal C3a treatment ameliorates cognitive impairment in a mouse model of neonatal hypoxic-ischemic brain injury.**
Morán J, Stokowska A, Walker FR, Mallard C, Hagberg H, Pekna M.
*Exp Neurol. 2017 Jan 4;290:74-84. doi: 10.1016/j.expneurol.2017.01.001. [Epub ahead of print]*

Perinatal asphyxia-induced brain injury is often associated with irreversible neurological complications such as intellectual disability and cerebral palsy but available therapies are limited. Novel neuroprotective therapies as well as approaches stimulating neural plasticity mechanism that can compensate for cell death after hypoxia-ischemia (HI) are urgently needed. We previously reported that single i.c.v. injection of complement-derived peptide C3a 1h after HI induction prevented HI-induced cognitive impairment when mice were tested as adults. Here, we tested the effects of intranasal treatment with C3a on HI-induced cognitive deficit. Using the object recognition test, we found that intranasal C3a treated mice were protected from HI-induced impairment of memory function assessed 6weeks after HI induction. C3a treatment ameliorated HI-induced reactive gliosis in the hippocampus, while it did not affect the extent of hippocampal tissue loss, neuronal cell density, expression of the pan-synaptic marker synapsin I or the expression of growth associated protein 43. In conclusion, our results reveal that brief pharmacological treatment with C3a using a clinically feasible non-invasive mode of administration ameliorates HI-induced cognitive impairment. Intranasal administration is a plausible route to deliver C3a into the brain of asphyxiated infants at high risk of developing hypoxic-ischemic encephalopathy.

DOI: 10.1016/j.expneurol.2017.01.001
PMID: 28062175 [PubMed - as supplied by publisher]

**Comparison of psychomotor outcome in patients with perinatal asphyxia with versus without therapeutic hypothermia at 4 years using the Ages and Stages Questionnaire screening tool.**
Zonnenberg IA, Koopman C, van Schie PE, Vermeulen RJ, Groenendaal F, van Weissenbruch MM
*Eur J Paediatr Neurol. 2016 Jul;20(4):545-8. doi: 10.1016/j.ejpn.2016.02.011. Epub 2016 Mar 2.*

INTRODUCTION: Therapeutic hypothermia improves outcome after perinatal asphyxia. The Ages and Stages Questionnaire is a screening tool to detect neurodevelopmental delay. In this study we examined the outcome of patients with perinatal asphyxia (defined as Apgar score <5 at 10 min, or continued need for resuscitation, or pH < 7.00 in umbilical cord or within one hour after birth) with and without therapeutic hypothermia treatment at the age of four years.
METHODS: Cohort study of patients with perinatal asphyxia admitted to the Neonatal Intensive Care Units of the VU University Medical Center, Amsterdam and the Wilhelmina Children's Hospital, Utrecht in the year 2008. Parents were asked to fill out the 48 months Ages and Stages Questionnaire (ASQ). In Wilhelmina Children's Hospital treatment with therapeutic hypothermia was implemented in 2008, in the VU University Medical Center in 2009, providing a historical cohort.
RESULTS/DISCUSSION: Twenty-three questionnaires were evaluated. Response rate of questionnaires for the VU Medical Center was 63% (n = 10) and Wilhelmina's Childrens Hospital 93% (n = 13). No significant differences were found in the mean scores between both groups. However, the untreated group scored more frequently under the -2 SD threshold. In the fine motor skills domain the difference was statistically significant (p = 0.031). In the treated group no patients developed cerebral palsy and in the untreated group two patients developed cerebral palsy.
CONCLUSION: In this study patients treated with hypothermia tend to have a better neurodevelopmental outcome. No significant differences were found between the two groups, apart from the fine motor skills.

DOI: 10.1016/j.ejpn.2016.02.011
PMID: 26970946 [PubMed - indexed for MEDLINE]

**Frequency Analysis and Feature Reduction Method For Prediction of Cerebral Palsy in Young Infants.**
Rahmati H, Martens H, Aamo OM, Stavdahl O, Stoen R, Adde L.
*IEEE Trans Neural Syst Rehabil Eng. 2016 Mar 8. doi: 10.1109/TNSRE.2016.2539390. [Epub ahead of print]*

The aim of this paper is to achieve a model for prediction of cerebral palsy based on motion data of young infants. The prediction is formulated as a classification problem to assign each of the infants to one of the healthy or with cerebral palsy groups. Unlike formerly proposed features that are mostly defined in the time domain, this study proposes a set of features derived from frequency analysis of infants' motions. Since cerebral palsy affects the variability of the motions, and frequency analysis is an intuitive way of studying variability, suggested features are suitable and consistent with the nature of the condition. In the current application, a wellknow problem, few subjects and many features, was initially encountered. In such a case, most classifiers get trapped in a sub-optimal model and, consequently, fail to provide sufficient prediction accuracy. To solve this problem, a feature selection method that determines features with significant predictive ability is proposed. The feature selection method decreases the risk of false discovery and, therefore, the prediction model is more likely to be valid and generalizable for future use. A detailed study is performed on the proposed features and the feature selection method: the classification results confirm their applicability. Achieved sensitivity of 86%, specificity of 92% and accuracy of 91% are comparable with state of the art clinical and expert-based methods for predicting cerebral palsy.
DOI: 10.1109/TNSRE.2016.2539390
PMID: 28113473 [PubMed - as supplied by publisher]

**Maternal side effects & fetal neuroprotection according to body mass index after magnesium sulfate in a multicenter randomized controlled trial.**
Vilchez G, Dai J, Lagos M, Sokol RJ
*J Matern Fetal Neonatal Med. 2017 Jan 23:1-9. doi: 10.1080/14767058.2017.1279143. [Epub ahead of print]*

OBJECTIVE: Evidence supports the need of dose-adjustment of several drugs according to body mass index (BMI) to prevent toxicity in the underweight, and ensure efficacy in obese women. However, for MgSO4 neuroprotection, the

effect of BMI on maternal toxicity and fetal neuroprotection is understudied. We analyze the effect of BMI on maternal/infant outcomes after MgSO4.
METHODS: Secondary analysis of a clinical trial that studied MgSO4 neuroprotection. Maternal side effects, magnesium cord levels, and offspring cerebral palsy/death were analyzed along BMI strata using ANOVA and chi-square test. Logistic regression was used to calculate adjusted odds ratios according to the treatment and BMI, using nonobese that received placebo as reference. Interaction analyses were performed to validate differential efficacy of BMI.
RESULTS: From 2241 women, more side effects and higher magnesium cord levels were seen in underweight women ($p = 0.05$). MgSO4 neuroprotection was effective in the non-obese ($p = 0.02$), but not in obese women ($p = 1.00$). In multivariate analyses, MgSO4 significantly reduced cerebral palsy only in nonobese women. Interaction analyses showed the moderator effect of BMI ($p = 0.169$). Increasing MgSO4 dose in obese mothers may ensure neuroprotective efficacy without representing increased maternal risks. Considering costs of studying this association, current analysis may form the basis for reasonable practice.
DOI: 10.1080/14767058.2017.1279143
PMID: 28056569 [PubMed - as supplied by publisher]

**MRI Patterns of brain injury and neurodevelopmental outcomes in neonates with severe anaemia at birth.**
Loureiro B, Martinez-Biarge M, Foti F, Papadaki M, Cowan FM(2), Wusthoff CJ
*Early Hum Dev. 2017 Jan 17;105:17-22. doi: 10.1016/j.earlhumdev.2017.01.001. [Epub ahead of print]*

AIMS: To define patterns of brain injury and associated neurodevelopmental outcomes in infants with severe neonatal anaemia.
METHODS: We studied 20 infants with severe anaemia at birth (haemoglobin<7g/dL). Clinical details were analysed for causes of anaemia and co-morbidities. All had early brain magnetic resonance imaging (MRI) scans, which were reviewed for injury pattern. Neurodevelopmental outcomes were assessed at a median age of 24months.
RESULTS: The aetiology of the anaemia was feto-maternal haemorrhage in 17 and antepartum haemorrhage in 3 infants. The predominant site of injury was the white matter, which was affected in all infants, with differing grades of severity and with cystic evolution in 45%. Only one infant showed an injury pattern typical of an acute severe hypoxic-ischaemic insult. Outcomes correlated closely to the severity of MRI findings. Cerebral palsy was seen only with the most severe neuroimaging patterns (n=6). Global developmental delay, learning or behavioural problems and seizures were common with moderate injury. Visual impairment occurred, particularly with posterior injury. Microcephaly developed in 45%.
INTERPRETATION: Severe neonatal anaemia at birth was associated with a white matter predominant pattern of injury, the severity of which was related to neurodevelopmental outcomes. Early MRI and long-term follow-up are advisable following severe neonatal anaemia.

DOI: 10.1016/j.earlhumdev.2017.01.001
PMID: 28107673 [PubMed - as supplied by publisher]

**Plasticity in the Neonatal Brain following Hypoxic-Ischaemic Injury.**
Rocha-Ferreira E, Hristova M.
*Neural Plast. 2016;2016:4901014. doi: 10.1155/2016/4901014. Epub 2016 Mar 7.*

Hypoxic-ischaemic damage to the developing brain is a leading cause of child death, with high mortality and morbidity, including cerebral palsy, epilepsy, and cognitive disabilities. The developmental stage of the brain and the severity of the insult influence the selective regional vulnerability and the subsequent clinical manifestations. The increased susceptibility to hypoxia-ischaemia (HI) of periventricular white matter in preterm infants predisposes the immature brain to motor, cognitive, and sensory deficits, with cognitive impairment associated with earlier gestational age. In term infants HI causes selective damage to sensorimotor cortex, basal ganglia, thalamus, and brain stem. Even though the immature brain is more malleable to external stimuli compared to the adult one, a hypoxic-ischaemic event to the neonate interrupts the shaping of central motor pathways and can affect normal developmental plasticity through altering neurotransmission, changes in cellular signalling, neural connectivity and function, wrong targeted innervation, and interruption of developmental apoptosis. Models of neonatal HI demonstrate three morphologically different types of cell death, that is, apoptosis, necrosis, and autophagy, which

crosstalk and can exist as a continuum in the same cell. In the present review we discuss the mechanisms of HI injury to the immature brain and the way they affect plasticity.
DOI: 10.1155/2016/4901014
PMCID: PMC4800097
PMID: 27047695 [PubMed - indexed for MEDLINE]

**Structural and Perfusion Abnormalities of Brain on MRI and Technetium-99m-ECD SPECT in Children With Cerebral Palsy: A Comparative Study.**
Rana KS, Narwal V, Chauhan L, Singh G, Sharma M, Chauhan S
*J Child Neurol. 2016 Apr;31(5):589-92. doi: 10.1177/0883073815604224. Epub 2015 Sep 9.*

Cerebral palsy has traditionally been associated with hypoxic ischemic brain damage. This study was undertaken to demonstrate structural and perfusion brain abnormalities. Fifty-six children diagnosed clinically as having cerebral palsy were studied between 1 to 14 years of age and were subjected to 3 Tesla magnetic resonance imaging (MRI). Brain and Technetium-99m-ECD brain single-photon emission computed tomography (SPECT) scan. Male to female ratio was 1.8:1 with a mean age of 4.16 ± 2.274 years. Spastic cerebral palsy was the most common type, observed in 91%. Birth asphyxia was the most common etiology (69.6%). White matter changes (73.2%) such as periventricular leukomalacia and corpus callosal thinning were the most common findings on MRI. On SPECT all cases except one revealed perfusion impairments in different regions of brain. MRI is more sensitive in detecting white matter changes, whereas SPECT is better in detecting cortical and subcortical gray matter abnormalities of perfusion.

DOI: 10.1177/0883073815604224
PMID: 26353878 [PubMed - indexed for MEDLINE]

# Détection – Diagnostic

## Données fondamentales

**Development and implementation of microsimulation models of neurological conditions.**
Finès P, Garner R, Bancej C, Bernier J, Manuel DG.
*Health Rep. 2016 Mar 16;27(3):3-9.*

BACKGROUND: As part of a program of the first National Population Health Study of Neurological Conditions launched in 2009, a series of microsimulation models of neurological conditions (called POHEM-Neurological meta-model) was developed to project health and economic impacts of seven neurological conditions (NCs)-Alzheimer's disease and other dementias, cerebral palsy, epilepsy, multiple sclerosis, Parkinson's disease, traumatic brain injury, and traumatic spinal cord injury-over a 20-year horizon.
DATA AND METHODS: The common framework of the seven models allows for dynamic, continuous-time, discrete-event simulation of synthetic large populations in which persons are subject to the risk of developing the NC under study and are assigned a value of functional health and a probability of receiving a caregiver and of entering long-term care. Calculations for transitions are done every year over the life course, and costs are accumulated throughout the life of the synthetic person. The need to reconcile empirical estimates of incidence and mortality with prevalence required implementation of "cure" parameters for two of the NCs.
RESULTS: The POHEM-Neurological meta-model integrates the latest Canadian microdata on neurological conditions and satisfies most criteria for validation of microsimulation models, including conceptualization, computer implementation, assessment of output plausibility, and comparison with external data. Limitations include an absence of risk factors and the lack of uncertainty measures.
INTERPRETATION: The POHEM-Neurological meta-model has been useful for projections of health and economic impacts of NCs on persons affected and their caregivers, and allows for comparison of specific scenarios to the base case.
PMID: 26983006 [PubMed - indexed for MEDLINE]

**A change in temporal organization of fidgety movements during the fidgety movement period is common among high risk infants.**

Sæther R, Støen R, Vik T, Fjørtoft T, Vågen RT, Silberg IE, Loennecken M, Møinichen UI, Lydersen S, Adde L

*Eur J Paediatr Neurol. 2016 Jul;20(4):512-7. doi: 10.1016/j.ejpn.2016.04.016. Epub 2016 May 6.*

AIM: General movement assessment (GMA) at 9-20 weeks post-term, can effectively predict cerebral palsy. Our aim was to evaluate intra-individual variability of the temporal organization of fidgety movements (FMs) in high risk infants.

MATERIAL AND METHODS: 104 High risk infants (66 males) with at least two video recordings from the FMs period participated. 45 of the infants had GA <28 weeks and/or BW ≤800 g. Mean post-term age at first and second assessments was 11.0 (8-16) and 14.0 (11-17) weeks, respectively, and median time-difference between the assessments was 2.0 (range: three days to six weeks) weeks. Video recordings were analyzed according to Prechtl's GMA.

RESULTS: 33 (32%) Infants were classified differently at first and second assessments. Six infants (6%) changed from normal to abnormal, and 10 (10%) changed from abnormal to normal FMs. Seven of the ten who changed classification from abnormal to normal were born before GA 26 weeks. A change between intermittent and continual, which are both considered normal, was observed in 17 (16%) infants.

CONCLUSION: A change in temporal organization of FMs is common in high risk infants. Especially in extremely preterm infants with abnormal FMs, more than one assessment should be performed before long-term prognosis is considered.



DOI: 10.1016/j.ejpn.2016.04.016
PMID: 27185580 [PubMed - indexed for MEDLINE]

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

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

*Dev Med Child Neurol. 2017 Jan 19. doi: 10.1111/dmcn.13386. [Epub ahead of print]*

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.



DOI: 10.1111/dmcn.13386
PMID: 28102574 [PubMed - as supplied by publisher]

**[Predictive value of cerebellar growth and general movements assessments for neurodevelopment of very preterm infants at 18-24 months' corrected age].**

[Article in Spanish; Abstract available in Spanish from the publisher]

Cunha M, Correa F, Cadete A, Oliveira A, Figueiredo H, Valerio P, Barroso R, Carreiro H
*Rev Neurol. 2017 Jan 16;64(2):63-69.*

INTRODUCTION: Fidgety movements assessments is very sensitive predicting long-term outcome or cerebral palsy of preterm, disrupted cerebellar growth has been reported in these patients.
AIM: To compare the predictive value of cerebellar ultrasound growth and fidgety movements assessments, for neurodevelopment outcome of very preterm at 18-24 month's corrected age (CA).
SUBJECTS AND METHODS: Prospective study of 88 infants cohort (<= 32 weeks' gestation), transverse cerebellar diameter was obtained by ultrasound via mastoid fontanel, in a weekly basis, until 40 weeks CA. Fidgety movements were assessed at 3 months CA. Neurodevelopment outcome at 18-24 month's CA was evaluated in 68 using Schedule of Growing Skills II Scale (SGS-II) and Amiel-Tison Neurologic Assessment (ATNA).
RESULTS: At term age, cerebellar growth was under 3rd percentile in 11 (10.3%). Fidgety movements were normal in 42 (61.8%) and abnormal or absent in 7 (10.3%). At 18-24 months CA, 54 (79.4%) were normal by the SGS-II and in 6 (8.8%) ATNA classified as cerebral palsy. Cerebellar diameter under 3rd percentile at term was associated with abnormal motor outcome and normal fidgety movements correlated with normal neurodevelopment.
CONCLUSION: Ultrasound cerebellar measurements and functional examinations (fidgety movements) have important complementary roles in predicting neurodevelopment of very preterm.
**Free Article**
PMID: 28074999 [PubMed - in process]

**Predictive value of General Movement Assessment for preterm infants' development at 2 years – implementation in clinical routine in a non-academic setting.**
De Bock F, Will H, Behrenbeck U, Jarczok MN, Hadders-Algra M, Philippi H
*Res Dev Disabil. 2017 Jan 20;62:69-80. doi: 10.1016/j.ridd.2017.01.012. [Epub ahead of print]*

BACKGROUND: General movements (GM) are used in academic settings to predict developmental outcome in infants born preterm. However, little is known about the implementation and predictive value of GM in non-academic settings.
AIMS: The aim of this study is twofold: To document the implementation of GM assessment (GMA) in a non-academic setting and to assess its predictive value in infants born preterm.
METHODS AND PROCEDURES: We documented the process of implementing GMA in a non-academic outpatient clinic. In addition, we assessed the predictive value of GMA at 1 and 3 months' corrected age for motor and cognitive development at 2 years in 122 children born <33 weeks' gestation. Outcome at two years was based upon the Bayley Scales of Infant Development-II (mental/psychomotor developmental index (MDI, PDI)) and a neurological examination. The infants' odds of atypical outcome (MDI or PDI ≤70 or diagnosis CP) and the predictive accuracy of abnormal GMA were calculated in a clinical routine scenario, which used all available GM information (primarily at 3 months or at 1 month, when 3 months were not available). In addition, separate analysis was undertaken for the samples of GMA at 1 and 3 months.
OUTCOMES AND RESULTS: Tips to facilitate GMA implementation are described. In our clinical routine scenario, children with definitely abnormal GM were more likely to have an atypical two-year outcome than children with normal GM (OR 13.2 (95% CI 1.56; 112.5); sensitivity 55.6%, specificity 82.1%). Definitely abnormal GM were associated with reduced MDI (-12.0, 95% CI -23.2; -0.87) and identified all children with cerebral palsy (CP) in the sample of GMA at 3 months only.
CONCLUSIONS AND IMPLICATIONS: GMA can be successfully implemented in a non-academic outpatient setting. In our clinical routine scenario, GMA allowed for adequate prediction of neurodevelopment in infants born preterm, thereby allaying concerns about diagnostic accuracy in non-academic settings.

DOI: 10.1016/j.ridd.2017.01.012
PMID: 28113095 [PubMed - as supplied by publisher]

**Predictive value of general movements' quality in low-risk infants for minor neurological dysfunction and behavioural problems at preschool age.**
Bennema AN, Schendelaar P, Seggers J, Haadsma ML, Heineman MJ, Hadders-Algra M
*Early Hum Dev. 2016 Mar;94:19-24. doi: 10.1016/j.earlhumdev.2016.01.010. Epub 2016 Feb 16.*

BACKGROUND: General movement (GM) assessment is a well-established tool to predict cerebral palsy in high-risk infants. Little is known on the predictive value of GM assessment in low-risk populations.
AIMS: To assess the predictive value of GM quality in early infancy for the development of the clinically relevant form of minor neurological dysfunction (complex MND) and behavioral problems at preschool age.
STUDY DESIGN: Prospective cohort study.
SUBJECTS: A total of 216 members of the prospective Groningen Assisted Reproductive Techniques (ART) cohort study were included in this study. ART did not affect neurodevelopmental outcome of these relatively low-risk infants born to subfertile parents.
OUTCOME MEASURES: GM quality was determined at 2 weeks and 3 months. At 18 months and 4 years, the Hempel neurological examination was used to assess MND. At 4 years, parents completed the Child Behavior Checklist; this resulted in the total problem score (TPS), internalizing problem score (IPS), and externalizing problem score (EPS). Predictive values of definitely (DA) and mildly (MA) abnormal GMs were calculated.
RESULTS: DA GMs at 2 weeks were associated with complex MND at 18 months and atypical TPS and IPS at 4 years (all $p<0.05$). Sensitivity and positive predictive value of DA GMs at 2 weeks were rather low (13%-60%); specificity and negative predictive value were excellent (92%-99%). DA GMs at 3 months occurred too infrequently to calculate prediction. MA GMs were not associated with outcome.
CONCLUSIONS: GM quality as a single predictor for complex MND and behavioral problems at preschool age has limited clinical value in children at low risk for developmental disorders.

DOI: 10.1016/j.earlhumdev.2016.01.010
PMID: 26894664 [PubMed - indexed for MEDLINE]

## Motricité - Mobilité – Posture

**Are electromyographic patterns during gait related to abnormality level of the gait in patients with spastic cerebral palsy?**
Syczewska M, Święcicka A
*Acta Bioeng Biomech. 2016;18(3):91-96.*

PURPOSE: One of the aims of the treatment in ambulant cerebral palsy (CP) patients is improvement of gait. The level of gait pathology is assessed by instrumented gait analysis, including surface electromyography. The aim of this study was to investigate the relation of the abnormality level of the gait and the co-contraction of the agonist-antagonist muscles, and relation between symmetry left /right leg in gait and symmetry of muscular activity. METHODS: Fifty one patients with cerebral palsy underwent clinical assessment and instrumented gait analysis, including surface electromyography. Signals were bilaterally collected from rectus femoris, medial and lateral hamstrings, tibialis anterior, lateral gastrocnemius and gluteus maximus. In older children additionally signals from soleus and lateral vastus were recorded. Sixteen gait variables were selected to calculate Gillette Gait Index, separately for left and right leg. From the envelopes a series of cross-correlation coefficients were calculated.
RESULTS: Weak correlations were found between averaged agonistantagonist correlation coefficient and Gillette Gait Index. Differences between hemiparetic less-involved legs, hemiparetic spastic legs, and diplegic legs were found for co-contraction of rectus femoris and biceps femoris and for averaged agonist-antagonist co-contraction. The differences between hemiparetic and diplegic groups were found for some muscle correlation coefficients.
CONCLUSIONS: The results obtained in this study show that the activity pattern of the leg muscles is specific to a given patient, and the dependence of the kinematics pathology on the abnormal activation pattern is not a direct one.
PMID: 27840431 [PubMed - indexed for MEDLINE]

**Biomechanical analysis of gait termination in 11-17year old youth at preferred and fast walking speeds.**
Ridge ST, Henley J, Manal K, Miller F, Richards JG
*Hum Mov Sci. 2016 Oct;49:178-85. doi: 10.1016/j.humov.2016.07.001. Epub 2016 Jul 15.*

In populations where walking and/or stopping can be difficult, such as in children with cerebral palsy, the ability to quickly stop walking may be beyond the child's capabilities. Gait termination may be improved with physical therapy. However, without a greater understanding of the mechanical requirements of this skill, treatment planning is difficult. The purpose of this study was to understand how healthy children successfully terminate gait in one step

when walking quickly, which can be challenging even for healthy children. Lower extremity kinematic and kinetic data were collected from 15 youth as they performed walking, planned, and unplanned stopping tasks. Each stopping task was performed as the subject walked at his/her preferred speed and a fast speed. The most significant changes in mechanics between speed conditions (preferred and fast) of the same stopping task were greater knee flexion angles (unplanned: +16.49±0.54°, p=0.00; planned: +15.75±1.1°, p=0.00) and knee extension moments (unplanned: +0.67±0.02N/kgm, p=0.00; planned: +0.57±0.23N/kgm, p=0.00) at faster speeds. The extra range of motion in the joints and extra muscle strength required to maintain the stopping position suggests that stretching and strengthening the muscles surrounding the joints of the lower extremity, particularly the knee, may be a useful intervention. 
DOI: 10.1016/j.humov.2016.07.001
PMID: 27423033 [PubMed - indexed for MEDLINE]

**Children with Spastic Cerebral Palsy Experience Difficulties Adjusting Their Gait Pattern to Weight Added to the Waist, While Typically Developing Children Do Not.**

Meyns P, Van Gestel L, Bar-On L, Goudriaan M, Wambacq H, Aertbeliën E, Bruyninckx H, Molenaers G, De Cock P, Ortibus E, Desloovere K
*Front Hum Neurosci. 2016 Dec 23;10:657. doi: 10.3389/fnhum.2016.00657. eCollection 2016.*

The prevalence of childhood overweight and obesity is increasing in the last decades, also in children with Cerebral Palsy (CP). Even though it has been established that an increase in weight can have important negative effects on gait in healthy adults and children, it has not been investigated what the effect is of an increase in body weight on the characteristics of gait in children with CP. In CP, pre and post three-dimensional gait analyses are performed to assess the effectiveness of an intervention. As a considerable amount of time can elapse between these measurements, and the effect of an alteration in the body weight is not taken into consideration, this effect of increased body weight is of specific importance. Thirty children with the predominantly spastic type of CP and 15 typically developing (TD) children were enrolled (age 3-15 years). All children underwent three-dimensional gait analysis with weight-free (baseline) and weighted (10% of the body weight added around their waist) trials. Numerous gait parameters showed a different response to the added weight for TD and CP children. TD children increased walking velocity, step- and stride length, and decreased double support duration with a slightly earlier timing of foot-off, while the opposite was found in CP. Similarly, increased ranges of motion at the pelvis (coronal plane) and hip (all planes), higher joint angular velocities at the hip and ankle, as well as increased moments and powers at the hip, knee and ankle were observed for TD children, while CP children did not change or even showed decreases in the respective measures in response to walking with added weight. Further, while TD children increased their gastrocnemius EMG amplitude during weighted walking, CP children slightly decreased their gastrocnemius EMG amplitude. As such, an increase in weight has a significant effect on the gait pattern in CP children. Clinical gait analysts should therefore take into account the negative effects of increased weight during pre-post measurements to avoid misinterpretation of treatment results. Overweight and obesity in CP should be counteracted or prevented as the increased weight has detrimental effects on the gait pattern.
DOI: 10.3389/fnhum.2016.00657
PMCID: PMC5226450
PMID: 28123360 [PubMed - in process]

**Development of a parent-reported questionnaire evaluating upper limb activity limitation in children with cerebral palsy.**

Preston N, Horton M, Levesley M, Mon-Williams M, O'Connor RJ
*Physiother Res Int. 2017 Jan 23. doi: 10.1002/pri.1684. [Epub ahead of print]*

BACKGROUND AND PURPOSE: Upper limb activity measures for children with cerebral palsy have a number of limitations, for example, lack of validity and poor responsiveness. To overcome these limitations, we developed the Children's Arm Rehabilitation Measure (ChARM), a parent-reported questionnaire validated for children with cerebral palsy aged 5-16 years. This paper describes both the development of the ChARM items and response categories and its psychometric testing and further refinement using the Rasch measurement model.
METHODS: To generate valid items for the ChARM, we collected goals of therapy specifically developed by therapists, children with cerebral palsy, and their parents for improving activity limitation of the upper limb. The activities, which were the focus of these goals, formed the basis for the items. Therapists typically break an activity

into natural stages for the purpose of improving activity performance, and these natural orders of achievement formed each item's response options. Items underwent face validity testing with health care professionals, parents of children with cerebral palsy, academics, and lay persons. A Rasch analysis was performed on ChARM questionnaires completed by the parents of 170 children with cerebral palsy from 12 hospital paediatric services. The ChARM was amended, and the procedure repeated on 148 ChARMs (from children's mean age: 10 years and 1 month; range: 4 years and 8 months to 16 years and 11 months; 85 males; Manual Ability Classification System Levels I = 9, II = 26, III = 48, IV = 45, and V = 18).
RESULTS: The final 19-item unidimensional questionnaire displayed fit to the Rasch model (chi-square p = .18), excellent reliability (person separation index = 0.95, α = 0.95), and no floor or ceiling effects. Items showed no response bias for gender, distribution of impairment, age, or learning disability.
DISCUSSION: The ChARM is a psychometrically sound measure of upper limb activity validated for children with cerebral palsy aged 5-16 years. The ChARM is freely available for use to clinicians and nonprofit organisations.

DOI: 10.1002/pri.1684
PMID: 28112465 [PubMed - as supplied by publisher]

**Effect of postural insoles on static and functional balance in children with cerebral palsy: a randomized controlled study.**
Christovão TC, Pasini H, Grecco LA, Ferreira LA, Duarte NA, Oliveira CS
*Braz J Phys Ther. 2015 Jan-Feb;19(1):44-51. doi: 10.1590/bjpt-rbf.2014.0072. Epub 2015 Feb 3.*

BACKGROUND: Improved gait efficiency is one of the goals of therapy for children with cerebral palsy (CP). Postural insoles can allow more efficient gait by improving biomechanical alignment.
OBJECTIVE: The aim of the present study was to determine the effect of the combination of postural insoles and ankle-foot orthoses on static and functional balance in children with CP.
METHOD: A randomized, controlled, double-blind, clinical trial. After meeting legal requirements and the eligibility criteria, 20 children between four and 12 years of age were randomly allocated either to the control group (CG) (n=10) or the experimental group (EG) (n=10). The CG used placebo insoles and the EG used postural insoles. The Berg Balance Scale, Timed Up-and-Go Test, Six-Minute Walk Test, and Gross Motor Function Measure-88 were used to assess balance as well as the determination of oscillations from the center of pressure in the anteroposterior and mediolateral directions with eyes open and closed. Three evaluations were carried out: 1) immediately following placement of the insoles; 2) after three months of insole use; and 3) one month after suspending insole use.
RESULTS: The EG achieved significantly better results in comparison to the CG on the Timed Up-and-Go Test as well as body sway in the anteroposterior and mediolateral directions.
CONCLUSION: Postural insoles led to an improvement in static balance among children with cerebral palsy, as demonstrated by the reduction in body sway in the anteroposterior and mediolateral directions. Postural insole use also led to a better performance on the Timed Up-and-Go Test.
**Free PMC Article**
DOI: 10.1590/bjpt-rbf.2014.0072
PMCID: PMC4351607
PMID: 25651134 [PubMed - indexed for MEDLINE]

**How to develop a phenomenological model of disability.**
Martiny KM
*Med Health Care Philos. 2015 Nov;18(4):553-65. doi: 10.1007/s11019-015-9625-x.*

During recent decades various researchers from health and social sciences have been debating what it means for a person to be disabled. A rather overlooked approach has developed alongside this debate, primarily inspired by the philosophical tradition called phenomenology. This paper develops a phenomenological model of disability by arguing for a different methodological and conceptual framework from that used by the existing phenomenological approach. The existing approach is developed from the phenomenology of illness, but the paper illustrates how the case of congenital disabilities, looking at the congenital disorder called cerebral palsy (CP), presents a fundamental problem for the approach. In order to understand such congenital cases as CP, the experience of disability is described as being gradually different from, rather than a disruption of, the experience of being abled, and it is argued that the experience of disability is complex and dynamically influenced by both intrinsic and extrinsic factors.

Different experiential aspects of disability- pre-reflective, attuned and reflective aspects-are described, demonstrating that the experience of disability comes in different degrees. Overall, this paper contributes to the debates about disability by further describing the personal aspects and experience of persons living with disabilities.
DOI: 10.1007/s11019-015-9625-x
PMID: 25652147 [PubMed - indexed for MEDLINE]

**Impaired Voluntary Movement Control and Its Rehabilitation in Cerebral Palsy.**
Gordon AM
*Adv Exp Med Biol. 2016;957:291-311. doi: 10.1007/978-3-319-47313-0_16.*

Cerebral palsy is caused by early damage to the developing brain, as the most common pediatric neurological disorder. Hemiplegia (unilateral spastic cerebral palsy) is the most common subtype, and the resulting impairments, lateralized to one body side, especially affect the upper extremity, limiting daily function. This chapter first describes the pathophysiology and mechanisms underlying impaired upper extremity control of cerebral palsy. It will be shown that the severity of impaired hand function closely relates to the integrity of the corticospinal tract innervating the affected hand. It will also shown that the developing corticospinal tract can reorganize its connectivity depending on the timing and location of CNS injury, which also has implications for the severity of hand impairments and rehabilitation. The mechanisms underlying impaired motor function will be highlighted, including deficits in movement execution and planning and sensorimotor integration. It will be shown that despite having unimanual hand impairments, bimanual movement control deficits and mirror movements also impact function. Evidence for motor learning-based therapies including Constraint-Induced Movement Therapy and Bimanual Training, and the possible pathophysiological predictors of treatment outcome and plasticity will be described. Finally, future directions for rehabilitations will be presented.
DOI: 10.1007/978-3-319-47313-0_16
PMID: 28035572 [PubMed - in process]

**Manual Ability Classification System (MACS): reliability between therapists and parents in Brazil.**
Silva DB, Funayama CA, Pfeifer LI
*Braz J Phys Ther. 2015 Jan-Feb;19(1):26-33. doi: 10.1590/bjpt-rbf.2014.0065. Epub 2015 Feb 3.*

BACKGROUND: The Manual Ability Classification System (MACS) has been widely used to describe the manual ability of children with cerebral palsy (CP); however its reliability has not been verified in Brazil.
OBJECTIVE: To establish the inter- and intra-rater reliability of the Portuguese-Brazil version of the MACS by comparing the classifications given by therapists and parents of children with CP.
METHOD: Data were obtained from 90 children with CP between the ages of 4 and 18 years, who were treated at the neurology and rehabilitation clinics of a Brazilian hospital. Therapists (an occupational therapist and a student) classified manual ability (MACS) through direct observation and information provided by parents. Therapists and parents used the Portuguese-Brazil version of the MACS. Intra- and inter-rater reliability was obtained using unweighted Kappa coefficient (k) and intra-class correlation coefficient (ICC). The Chi-square test was used to identify the predominance of disagreements in the classification of parents and therapists.
RESULTS: An almost perfect agreement resulted among therapists [K=0.90 (95% CI 0.83-0.97); ICC=0.97 (95%CI 0.96-0.98)], as well as with intra-rater (therapists), with Kappa ranging between 0.83 and 0.95 and ICC between 0.96 and 0.99 for the evaluator with more and less experience in rehabilitation, respectively. The agreement between therapists and parents was fair [K=0.36 (95% CI 0.22-0.50); ICC=0.79 (95% CI 0.70-0.86)].
CONCLUSIONS: The Portuguese version of the MACS is a reliable instrument to be used jointly by parents and therapists.
**Free PMC Article**
DOI: 10.1590/bjpt-rbf.2014.0065
PMCID: PMC4351605
PMID: 25651133 [PubMed - indexed for MEDLINE]

**Plantar flexor muscle weakness and fatigue in spastic cerebral palsy patients.**
Neyroud D, Armand S, De Coulon G, Sarah R Dias Da Silva, Maffiuletti NA, Kayser B, Place N
*Res Dev Disabil. 2017 Feb;61:66-76. doi: 10.1016/j.ridd.2016.12.015. Epub 2017 Jan 5.*

BACKGROUND: Patients with cerebral palsy develop an important muscle weakness which might affect the aetiology and extent of exercise-induced neuromuscular fatigue.
AIM: This study evaluated the aetiology and extent of plantar flexor neuromuscular fatigue in patients with cerebral palsy.
METHODS: Ten patients with cerebral palsy and 10 age- and sex-matched healthy individuals (~20 years old, 6 females) performed four 30-s maximal isometric plantar flexions interspaced by a resting period of 2-3s to elicit a resting twitch. Maximal voluntary contraction force, voluntary activation level and peak twitch were quantified before and immediately after the fatiguing task.
RESULTS: Before fatigue, patients with cerebral palsy were weaker than healthy individuals (341±134N vs. 858±151N, $p<0.05$) and presented lower voluntary activation (73±19% vs. 90±9%, $p<0.05$) and peak twitch (100±28N vs. 199±33N, $p<0.05$). Maximal voluntary contraction force was not significantly reduced in patients with cerebral palsy following the fatiguing task (-10±23%, $p>0.05$), whereas it decreased by 30±12% ($p<0.05$) in healthy individuals.
CONCLUSIONS: Plantar flexor muscles of patients with cerebral palsy were weaker than their healthy peers but showed greater fatigue resistance.
WHAT THIS PAPER ADDS: Cerebral palsy is a widely defined pathology that is known to result in muscle weakness. The extent and origin of muscle weakness were the topic of several previous investigations; however some discrepant results were reported in the literature regarding how it might affect the development of exercise-induced neuromuscular fatigue. Importantly, most of the studies interested in the assessment of fatigue in patients with cerebral palsy did so with general questionnaires and reported increased levels of fatigue. Yet, exercise-induced neuromuscular fatigue was quantified in just a few studies and it was found that young patients with cerebral palsy might be more fatigue resistant that their peers. Thus, it appears that (i) conflicting results exist regarding objectively-evaluated fatigue in patients with cerebral palsy and (ii) the mechanisms underlying this muscle fatigue - in comparison to those of healthy peers - remain poorly understood. The present study adds important knowledge to the field as it shows that when young adults with cerebral palsy perform sustained maximal isometric plantar flexions, they appear less fatigable than healthy peers. This difference can be ascribed to a better preservation of the neural drive to the muscle. We suggest that the inability to drive their muscles maximally accounts for the lower extent of exercise-induced neuromuscular fatigue in patients with cerebral palsy.

DOI: 10.1016/j.ridd.2016.12.015
PMID: 28064025 [PubMed - in process]

**Postural control during sit-to-stand movement and its relationship with upright position in children with hemiplegic spastic cerebral palsy and in typically developing children.**

Pavão SL, Santos AN, Oliveira AB, Rocha NA
*Braz J Phys Ther. 2015 Jan-Feb;19(1):18-25. doi: 10.1590/bjpt-rbf.2014.0069. Epub 2015 Feb 3.*

OBJECTIVE: The purpose of this study was to compare postural control in typically developing (TD) children and children with cerebral palsy (CP) during the sit-to-stand (STS) movement and to assess the relationship between static (during static standing position) and dynamic postural control (during STS movement) in both groups.
METHOD: The center of pressure (CoP) behavior of 23 TD children and 6 children with spastic hemiplegic CP (Gross Motor Function Classification System [GMFCS] I and II) was assessed during STS movement performance and during static standing conditions with the use of a force plate. The data obtained from the force plate were used to calculate CoP variables: anteroposterior (AP) and mediolateral (ML) amplitudes of CoP displacement and the area and velocity of CoP oscillation.
RESULTS: According to the Mann-Whitney test, children with CP exhibited higher CoP values in all of the analyzed variables during the beginning of STS movement. Pearson's correlation verified a positive correlation between the CoP variables during both static conditions and the performance of STS movement.
CONCLUSIONS: Children with spastic hemiplegic CP present major postural oscillations during the beginning of STS movement compared with typical children. Moreover, the observed relationship between postural control in static and dynamic conditions reveals the importance of body control in the static position for the performance of functional activities that put the body in motion, such as STS movement.
**Free PMC Article**
DOI: 10.1590/bjpt-rbf.2014.0069
PMCID: PMC4351604
PMID: 25651131 [PubMed - indexed for MEDLINE]

**Reliability and sources of variation of the ABILHAND-Kids questionnaire in children with cerebral palsy.**
de Jong LD, van Meeteren A, Emmelot CH, Land NE, Dijkstra PU
*Disabil Rehabil. 2017 Jan 9:1-6. doi: 10.1080/09638288.2016.1272139. [Epub ahead of print]*

PURPOSE: To determine reliability of the ABILHAND-Kids, explore sources of variation associated with these measurement results, and generate repeatability coefficients.
METHOD: A reliability study with a repeated measures design was performed in an ambulatory rehabilitation care department from a rehabilitation center, and a center for special education. A physician, an occupational therapist, and parents of 27 children with spastic cerebral palsy independently rated the children's manual capacity when performing 21 standardized tasks of the ABILHAND-Kids from video recordings twice with a three week time interval (27 first-, and 25 second video recordings available). Parents additionally rated their children's performance based on their own perception of their child's ability to perform manual activities in everyday life, resulting in eight ratings per child.
RESULTS: ABILHAND-Kids ratings were systematically different between observers, sessions, and rating method. Participant × observer interaction (66%) and residual variance (20%) contributed the most to error variance (9%). Test-retest reliability was 0.92. Repeatability coefficients (between 0.81 and 1.82 logit points) were largest for the parents' performance-based ratings.
CONCLUSION: ABILHAND-Kids scores can be reliably used as a performance- and capacity-based rating method across different raters. Parents' performance-based ratings are less reliable than their capacity-based ratings. Resulting repeatability coefficients can be used to interpret ABILHAND-Kids ratings with more confidence. Implications for Rehabilitation The ABILHAND-Kids is a valuable tool to assess a child?s unimanual and bimanual upper limb activities. The reliability of the ABILHANDS-Kids is good across different observers as a performance- and capacity-based rating method. Parents' performance-based ratings are less reliable than their capacity-based ones. This study has generated repeatability coefficients for clinical decision making.
DOI: 10.1080/09638288.2016.1272139
PMID: 28068864 [PubMed - as supplied by publisher]

**Recognizing the Common Origins of Dystonia and the Development of Human Movement: A Manifesto of Unmet Needs in Isolated Childhood Dystonias.**
Lin JP, Nardocci N.
*Front Neurol. 2016 Dec 19;7:226. doi: 10.3389/fneur.2016.00226. eCollection 2016.*

Dystonia in childhood may be severely disabling and often unremitting and unrecognized. Considered a rare disorder, dystonic symptoms in childhood are pervasive in many conditions including disorders of developmental delay, cerebral palsy (CP), autism, neurometabolic, neuroinflammatory, and neurogenetic disorders. Collectively, there is a need to recognize the role of early postures and movements which characterize phases of normal fetal, infant, and child development as a backdrop to the many facets of dystonia in early childhood neurological disorders and to be aware of the developmental context of dystonic symptoms. The role of cocontraction is explored throughout infancy, childhood, young adulthood, and in the elderly. Under-recognition of pervasive dystonic disorders of childhood, including within CP is reviewed. Original descriptions of CP by Gowers are reviewed and contemporary physiological demonstrations are used to illustrate support for an interpretation of the tonic labyrinthine response as a manifestation of dystonia. Early recognition and molecular diagnosis of childhood dystonia where possible are desirable for appropriate clinical stratification and future precision medicine and functional neurosurgery where appropriate. A developmental neurobiological perspective could also be useful in exploring new clinical strategies for adult-onset dystonia disorders focusing on environmental and molecular interactions and systems behaviors.
DOI: 10.3389/fneur.2016.00226
PMCID: PMC5165260
PMID: 28066314 [PubMed - in process]

**Research of the spatial-temporal gait parameters and pressure characteristic in spastic diplegia children.**
Pauk J, Ihnatouski M, Daunoraviciene K, Laskhousky U, Griskevicius J.
*Acta Bioeng Biomech. 2016;18(2):121-9.*

PURPOSE: Spastic diplegia is the most common form of cerebral palsy. It presents with symmetric involvement of the lower limbs and upper limbs. Children with spastic diplegia frequently experience problems with motor control, spasticity, and balance which lead to gait abnormalities. The aim of this study is twofold. Firstly, to determine the differences in spatial-temporal gait parameters and magnitude of plantar pressure distribution between children with spastic diplegia (CP) and typical children. Secondly, to compare and evaluate main changes of plantar pressure and spatial-temporal gait parameters instead of data between spastic diplegia children with prescribed ankle - solid foot orthosis (AFOs) and without using AFOs.
METHODS: The evaluation was carried out on 20 spastic diplegia children and 10 agematched children as a control group aged 6-15 years. Twenty children with spastic diplegia CP were divided into two groups: ten subjects with prescribed AFOs and ten subjects without use of assistive device. Patients used the AFOs orthosis for one year. Measurements included in-shoe plantar pressure distribution and spatial-temporal gait parameters.
RESULTS: Spatial-temporal gait parameters showed meaningful difference between study groups in velocity, stride length, step length and cadence ( $p < 0.05$). However no significant differences between patients with and without AFOs were found ( $p > 0.05$). Significant differences between typical and spastic diplegia children with AFOs were observed in the magnitude of plantar pressure under the toes, the metatarsal heads, the medial arch, and the heel ( $p < 0.05$). For typical subjects, the highest pressure amplitudes were found under the heel and the metatarsal heads, while the lowest pressure distribution was under the medial arch. In CP patients the lateral arch was strongly unloaded. The peak pressure under heel was shifted inside.
CONCLUSIONS: Collected data and calculated scores present a state of the gait in test groups, showed the difference and could be valuable for physicians in decision making by choosing qualitative therapy. Furthermore, it allows predicting probability of further possible changes in gait of spastic diplegia patients with AFOs and without it. In conclusion, our current results showed that the use of AFOs, prescribed on a clinical basis by doctors improves gait patterns and gait stability in children with spastic cerebral palsy.
PMID: 27405783 [PubMed - indexed for MEDLINE]

**Sensory processing disorders in children with cerebral palsy.**
Pavão SL, Rocha NA
*Infant Behav Dev. 2016 Nov 17;46:1-6. doi: 10.1016/j.infbeh.2016.10.007. [Epub ahead of print]*

OBJECTIVE: To evaluate sensory processing in children with CP using the Sensory Profile questionnaire and to compare results with the ones of children with typical development (TD).
METHODS: We assessed sensory processing of 59 TD children and 43 CP children using the Sensory Profile, a standardized parent reporting measure that records children's responses to sensory events in daily life. Mann-Whitney test was used to compare the results of sensory processing evaluation among the groups. Bonferroni correction was applied.
RESULTS: We found differences in sensory processing between groups in 16 out of the 23 categories evaluated in the Sensory Profile.
CONCLUSION: Our results pointed out to the existence of disturbances in the processing of sensory information in CP. Based on the importance of the sensory integration process for motor function, the presence of such important disturbances draw the attention to the implementation of sensory therapies which improve function in these children.

DOI: 10.1016/j.infbeh.2016.10.007
PMID: 27866043 [PubMed - as supplied by publisher]

**Squat test performance and execution in children with and without cerebral palsy.**
Eken MM, Harlaar J, Dallmeijer AJ, de Waard E, van Bennekom CA, Houdijk H
*Clin Biomech (Bristol, Avon). 2016 Dec 18;41:98-105. doi: 10.1016/j.clinbiomech.2016.12.006. [Epub ahead of print]*

BACKGROUND: Knowledge on lower extremity strength is imperative to informed decision making for children with cerebral palsy (CP) with mobility problems. However, a functional and clinically feasible test is not available. We aimed to determine whether the squat test is suitable for this purpose by investigating test performance and execution in children with cerebral palsy and typically developing (TD) peers.
METHODS: Squat test performance, defined by the number of two-legged squats until fatigue (max 20), was assessed in twenty children with bilateral CP (6-19years; gross motor function classification system I-III) and sixteen

TD children (7-16years). Muscle fatigue was assessed from changes in electromyography (EMG).Joint range-of-motion and net torque were calculated for each single squat, to investigate differences between groups and between the 2nd and last squat.
FINDINGS: Fifteen children with CP performed <20 squats (median=13, IQR=7-19), while all TD children performed the maximum of 20 squats. Median EMG frequency decreased and amplitude increased in mm. quadriceps of both groups. Ankle and knee range-of-motion were reduced in children with CP during a single squat by 10 to 15°. No differences between 2nd and last squat were observed, except for knee range-of-motion which increased in TD children and decreased in children with CP.
INTERPRETATION: Squat test performance was reduced in children with CP, especially in those with more severe CP. Muscle fatigue was present in both children with CP and TD peers, confirming that endurance of the lower extremity was tested. Minor execution differences between groups suggest that standardized execution is important to avoid compensation strategies. It is concluded that the squat test is feasible to test lower extremity strength in children with CP in a clinically meaningful way. Further clinimetric evaluation is needed before clinical implementation.

DOI: 10.1016/j.clinbiomech.2016.12.006
PMID: 28040656 [PubMed - as supplied by publisher]

**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 Jan 13. doi: 10.1111/dmcn.13385. [Epub ahead of print]*

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.

DOI: 10.1111/dmcn.13385
PMID: 28083887 [PubMed - as supplied by publisher]

**Statistical Parametric Mapping to Identify Differences between Consensus-Based Joint Patterns during Gait in Children with Cerebral Palsy.**
Nieuwenhuys A, Papageorgiou E, Desloovere K, Molenaers G, De Laet T
*PLoS One. 2017 Jan 12;12(1):e0169834. doi: 10.1371/journal.pone.0169834. eCollection 2017.*

Experts recently identified 49 joint motion patterns in children with cerebral palsy during a Delphi consensus study. Pattern definitions were therefore the result of subjective expert opinion. The present study aims to provide objective, quantitative data supporting the identification of these consensus-based patterns. To do so, statistical parametric mapping was used to compare the mean kinematic waveforms of 154 trials of typically developing children (n = 56) to the mean kinematic waveforms of 1719 trials of children with cerebral palsy (n = 356), which were classified following the classification rules of the Delphi study. Three hypotheses stated that: (a) joint motion patterns with 'no or minor gait deviations' (n = 11 patterns) do not differ significantly from the gait pattern of typically developing children; (b) all other pathological joint motion patterns (n = 38 patterns) differ from typically developing gait and the locations of difference within the gait cycle, highlighted by statistical parametric mapping,

concur with the consensus-based classification rules. (c) all joint motion patterns at the level of each joint (n = 49 patterns) differ from each other during at least one phase of the gait cycle. Results showed that: (a) ten patterns with 'no or minor gait deviations' differed somewhat unexpectedly from typically developing gait, but these differences were generally small (≤3°); (b) all other joint motion patterns (n = 38) differed from typically developing gait and the significant locations within the gait cycle that were indicated by the statistical analyses, coincided well with the classification rules; (c) joint motion patterns at the level of each joint significantly differed from each other, apart from two sagittal plane pelvic patterns. In addition to these results, for several joints, statistical analyses indicated other significant areas during the gait cycle that were not included in the pattern definitions of the consensus study. Based on these findings, suggestions to improve pattern definitions were made.

**Free Article**

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PMID: 28081229 [PubMed - in process]

**Status dystonicus in children: Early recognition and treatment prevent serious complications.**

Combe L, Abu-Arafeh I

*Eur J Paediatr Neurol. 2016 Nov;20(6):966-970. doi: 10.1016/j.ejpn.2016.07.005. Epub 2016 Jul 12.*

This is a retrospective study of all patients presenting to our paediatric unit with status dystonicus (SD) over a period of five years. Anonymous information was collected and a descriptive analysis is made. There were four episodes of SD in three children between 11 and 15 years of age. All children are known to have severe dyskinetic cerebral palsy and presented with an acute or sub-acute deterioration in their symptoms. Symptoms were triggered by infections in three of the four episodes. Early features included frequent and repetitive generalized muscle spasms, poor swallowing, poor sleep, distress and pain. Patients responded to supportive treatment, rehydration, benzodiazepines, baclofen and l-dopa. Intensive care was not necessary in any of the patients and patients made full recovery within 5-14 days. This report shows the value of early recognition and treatment of SD can be successful in preventing serious complications.



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PMID: 27444503 [PubMed - indexed for MEDLINE]

**Supports and barriers to implementation of routine clinical assessment for children with cerebral palsy: A mixed-methods study.**

Kerr C, Shields N, Quarmby L, Roberts K, Imms C; 'Best Service at the Best Time' group *.

*Disabil Rehabil. 2016 Dec 15:1-10. [Epub ahead of print]*

PURPOSE: The purpose of this study is to investigate supports and barriers to evidence-based routine clinical assessment of children with cerebral palsy.

METHOD: This mixed methods study included physiotherapists, occupational therapists and speech pathologists providing services to children with cerebral palsy (3-18 years) within five organizations across Australia. Four organizations initiated standardized routine clinical data collection (Commencing organizations), and one had previously mandated routine assessment (Comparison organization). Participants completed the Supports and Barriers Questionnaire (n = 227) and participated in focus groups (n = 8 groups, 37 participants). Quantitative data were summarized descriptively, qualitative data were analyzed thematically and comparisons between organizations assessed.

RESULTS: Organizational structures, resources, therapists within organizations, assessment tools, and children and families were, on average, viewed as supportive of routine clinical assessment. There were no differences between the Comparison and Commencing organizations except 'therapists within the organization' were viewed as more supportive by the Commencing organizations (p = 0.037). Five themes were derived from qualitative analyzes: motivation to adopt routine clinical assessment; acquiring and utilizing expertise; ensuring effective ongoing communication; availability and distribution of resources; and therapist perceptions of child and family wishes.

CONCLUSIONS: Organizations experience challenges to effective and sustained implementation of routine clinical assessment. Adequate resourcing and positive, clear communication were perceived as critical for success. Implications for Rehabilitation The value of routine clinical assessment of children with cerebral palsy is undisputed. Tailored solutions to organization-specific challenges are required when implementing routine clinical assessment

for children with cerebral palsy. Positive, clear communication of organizational priorities by management may assist AHPs to prioritize workload activities when changing practice.
DOI: 10.1080/09638288.2016.1258736
PMID: 27973929 [PubMed - as supplied by publisher]

**Test-retest Reproducibility of the Assessment of Motor and Process Skills in Children with Unilateral Cerebral Palsy.**
James S, Ziviani J, Ware RS, Boyd RN
*Phys Occup Ther Pediatr. 2016;36(2):144-54. doi: 10.3109/01942638.2015.1076555. Epub 2015 Nov 25.*

AIMS: To examine test-retest reproducibility of the Assessment of Motor and Process Skills (AMPS) in children aged 8-16 years with unilateral cerebral palsy (UCP).
METHODS: Thirty children with mild to moderate UCP (mean age = 11y 7m, SD 2y 4m; males = 18; Manual Ability Classification System level I = 10, II = 20; Gross Motor Function Classification System level I = 9, II = 21) enrolled in a large randomized controlled trial were recruited via consecutive series sampling. Children carried out two AMPS tasks over two consecutive days according to standardized AMPS administration procedures. The standard error of measurement (SEM), smallest detectable change (SDC), 95% limits of agreement using the Bland-Altman method, and intraclass correlation coefficients (ICC; 2,1) were calculated.
RESULTS: The SDC was 0.23 logits for the AMPS motor scale and 0.30 logits for the AMPS process scale. Test-retest reliability was excellent for both the AMPS motor scale (ICC = 0.93) and the AMPS process scale (ICC = 0.86). Intra-rater reliability (n = 10) was excellent for AMPS motor scale (ICC = 0.96) and AMPS process scale (ICC = 0.98).
CONCLUSIONS: The AMPS can be used by therapists with 8- to 16-year-old children with UCP as an outcome measure with changes in scores reflecting real changes in performance or capacity.
DOI: 10.3109/01942638.2015.1076555
PMID: 26606274 [PubMed - indexed for MEDLINE]

**The Cerebral Palsy Kinematic Assessment Tool (CPKAT): feasibility testing of a new portable tool for the objective evaluation of upper limb kinematics in children with cerebral palsy in the non-laboratory setting.**
Preston N, Weightman A, Culmer P, Levesley M, Bhakta B, Mon-Williams M.
*Disabil Rehabil Assist Technol. 2016;11(4):339-44. doi: 10.3109/17483107.2014.951974. Epub 2014 Aug 21.*

PURPOSE: Efficacy of treatment to improve upper-limb activity of children with cerebral palsy (CP) is typically evaluated outside clinical/laboratory environments through functional outcome measures (e.g. ABILHAND kids). This study evaluates CPKAT, a new portable laptop-based tool designed to objectively measure upper-limb kinematics in children with CP.
METHODS: Seven children with unilateral CP (2 females; mean age 10 years 2 months (SD 2 years 3 months), median age 9 years 6 months, range 6 years 5 months, MACS II-IV) were evaluated on copying, tracking and tracing tasks at their homes using CPKAT. CPKAT recorded parameters relating to spatiotemporal hand movement: path length, movement time, smoothness, path accuracy and root mean square error. The Wilcoxon signed ranks test explored whether CPKAT could detect differences between the affected and less-affected limb.
RESULTS: CPKAT detected intra-limb differences for movement time and smoothness (aiming), and path length (tracing). No intra-limb tracking differences were found, as hypothesised. These findings are consistent with other studies showing that movements of the impaired upper limb in unilateral CP are slower and less smooth.
CONCLUSION: CPKAT provides a potential solution for home-based assessment of upper limb kinematics in children with CP to supplement other measures and assess functional intervention outcomes. Further validation is required. Implications for Rehabilitation This paper demonstrates the feasibility of evaluating upper limb kinematics in home using CPKAT, a portable laptop-based evaluation tool. We found that CPKAT is easy to set-up and use in home environments and yields useful kinematic measures of upper limb function. CPKAT can complement less responsive patient reported or subjectively evaluated functional measures for a more complete evaluation of children with cerebral palsy. Thus, CPKAT can help guide a multi-disciplinary team to more effective intervention and rehabilitation for children with cerebral palsy.
DOI: 10.3109/17483107.2014.951974
PMID: 25144388 [PubMed - indexed for MEDLINE]

**The Edinburgh visual gait score - The minimal clinically important difference.**

Robinson LW, Clement ND, Herman J, Gaston MS
*Gait Posture. 2017 Jan 3;53:25-28. doi: 10.1016/j.gaitpost.2016.12.030. [Epub ahead of print]*

OBJECTIVE: The primary aim was to define the minimal clinically important difference (MCID) of the Edinburgh Visual Gait Score (EVGS) using correlations with the Gross Motor Function Classification System (GMFCS) and the Functional Assessment Questionnaire (FAQ). The secondary aim was to confirm the numerical value of the MCID in the Gait Profile Score (GPS).
METHOD: The EVGS and GPS scores for 151 patients with diplegic cerebral palsy (GMFCS Levels I-III) were retrospectively identified from a database held at the study centre. One-hundred and forty-one patients had FAQ data available.
RESULTS: The EVGS and GPS correlated with increasing GMFCS level ($p<0.001$) and FAQ score ($p<0.001$). A gradient of 3.8 (2.9-4.7) for the EVGS and 2.9 (2.1-3.7) for the GPS corresponded to a one-level change in GMFCS level. A gradient of 1.9 (1.3-2.4) for EVGS and 1.5 (1.1-2.0) for GPS corresponded to a one-point change in FAQ.
CONCLUSIONS: The authors propose an MCID value of 2.4 for the EVGS; representing the improvement in gait score after surgery that is likely to reflect a clinical improvement in function. This MCID is closely related to other studies defining post-operative improvements in kinematic data (GPS) and may offer guidance to post-surgical changes that might reasonably be expected to either improve or prevent deteriorating function.

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PMID: 28073083 [PubMed - as supplied by publisher]

**The Gross Motor Function Classification System Family Report Questionnaire: reliability between special-education teachers and caregivers.**
Ramrit S, Yonglitthipagon P, Janyacharoen T, Emasithi A, Siritaratiwat W
*Dev Med Child Neurol. 2016 Dec 14. doi: 10.1111/dmcn.13356. [Epub ahead of print]*

AIM: The aim of this study was to investigate the reliability of the Thai Gross Motor Function Classification System Family Report Questionnaire (GMFCS-FR) and the possibility of special-education teachers and caregivers in the community using this system in children with cerebral palsy (CP).
METHOD: The reliability was examined by two teachers and two caregivers who classified 21 children with CP aged 2 to 12 years. A GMFCS-FR workshop was organized for raters. The teachers and caregivers classified the mobility of 362 children. The rater reliability was analysed using the weighted kappa coefficient. The possibility of using the GMFCS-FR is reported. The reliability of using the GMFCS-FR in the community was analysed by the intraclass correlation coefficient.
RESULTS: The intrarater reliability ranged from 0.91 to 1.00. The interrater reliability between teachers was 0.85 (95% confidence interval [CI] 0.69-0.97) and between caregivers was 0.84 (95% CI 0.70-0.97). Ninety-seven percent of raters used the Thai GMFCS-FR correctly. The overall intraclass correlation coefficient between raters was 0.90 (95% CI 0.88-0.92).
INTERPRETATION: The Thai GMFCS-FR is a reliable system for classifying the motor function of young children with CP by teachers and caregivers in the community.

DOI: 10.1111/dmcn.13356
PMID: 27966216 [PubMed - as supplied by publisher]

**The Relationships Between Capacity and Performance in Youths With Cerebral Palsy Differ for GMFCS Levels.**
Ho PC, Chang CH, Granlund M, Hwang AW.
*Pediatr Phys Ther. 2017 Jan;29(1):23-29.*

PURPOSE: To examine change in, and longitudinal relationships between motor capacity and activity performance across the Gross Motor Function Classification System (GMFCS).
METHODS: Ninety-two youths with cerebral palsy were examined at 2 time points, 1 year apart, using the Gross Motor Function Measure-66 (GMFM-66) for motor capacity, and the Chinese version of the Activities Scale for Kids-Performance Version (ASKp-C) for activity performance. The score changes and capacity-to-performance/performance-to-capacity pathways were explored across GMFCS levels.

RESULTS: The GMFM-66 scores declined over time in GMFCS levels IV-V while ASKp-C scores increased in GMFCS level I. The correlations for both pathways in GMFCS levels I, III, and IV-V were significant with a higher correlation for performance-to-capacity pathway in GMFCS levels IV-V.
CONCLUSIONS: Longitudinal changes in and relationships between capacity and performance differ between GMFCS levels. The opportunities to perform activities need to be emphasized in GMFCS levels IV-V.
DOI: 10.1097/PEP.0000000000000332
PMID: 27984462 [PubMed - in process]

**The relevance of nerve mobility on function and activity in children with Cerebral Palsy.**
Marsico P, Tal-Akabi A, van Hedel HJ
*BMC Neurol. 2016 Oct 7;16(1):194.*

BACKGROUND: In children with cerebral palsy (CP), stiffness, caused by contractile and non-contractile structures, can influence motor performance. This study sought to determine whether the nerve mobility had a relevant impact on motor performance in children with CP. We hypothesized that a positive Straight Leg Raise (SLR) test, as well as smaller SLR hip angle, would relate to lower leg muscle strength, reduced motor capacity and less motor performance in children with CP.
METHODS: We applied a cross-sectional analysis on data including SLR, leg muscle strength, Gross Motor Function Measure (GMFM-66) and number of activity counts during daily life from thirty children with CP (6-18 years). We performed receiver operating characteristics and correlation analyses.
RESULTS: Positive SLR test could distinguish well between children with low versus high muscle strength and GMFM-66 scores. The SLR hip angle correlated significant with the level of disability and with muscle strength. The correlation with the GMFM-66 and the activity counts was fair.
CONCLUSION: This study suggests that neural restriction of SLR is higher on functional and activity outcome than the measured SLR hip range of motion. Further studies should investigate weather improving nerve mobility can lead to an amelioration of function in children with CP.
**Free PMC Article**
DOI: 10.1186/s12883-016-0715-z
PMCID: PMC5054625
PMID: 27717320 [PubMed - indexed for MEDLINE]

**The role of visual stimuli on standing posture in children with bilateral cerebral palsy.**
Lidbeck C, Bartonek A, Yadav P, Tedroff K, Åstrand P, Hellgren K, Gutierrez-Farewik EM
*BMC Neurol. 2016 Aug 24;16(1):151. doi: 10.1186/s12883-016-0676-2.*

BACKGROUND: In children with bilateral cerebral palsy (CP) maintaining a standing position can be difficult. The fundamental motor task of standing independently is achieved by an interaction between the visual, somatosensory, and vestibular systems. In CP, the motor disorders are commonly accompanied by sensory and perceptual disturbances. Our aims were to examine the influence of visual stimulion standing posture in relation to standing ability.
METHODS: Three dimensional motion analysis with surface electromyography was recorded to describe body position, body movement, and muscle activity during three standing tasks: in a self-selected position, while blindfolded, and during an attention-demanding task. Participants were twenty-seven typically-developing (TD) children and 36 children with bilateral CP, of which 17 required support for standing (CP-SwS) and 19 stood without support (CP-SwoS).
RESULTS: All children with CP stood with a more flexed body position than the TD children, even more pronounced in the children in CP-SwS. While blindfolded, the CP-SwS group further flexed their hips and knees, and increased muscle activity in knee extensors. In contrast, the children in CP-SwoS maintained the same body position but increased calf muscle activity. During the attention-demanding task, the children in CP-SwoS stood with more still head and knee positions and with less muscle activity.
CONCLUSIONS: Visual input was important for children with CP to maintain a standing position. Without visual input the children who required support dropped into a further crouched position. The somatosensory and vestibular systems alone could not provide enough information about the body position in space without visual cues as a reference frame. In the children who stood without support, an intensified visual stimulus enhanced the ability to

maintain a quiet standing position. It may be that impairments in the sensory systems are major contributors to the difficulties to stand erect in children with CP.

Free PMC Article

DOI: 10.1186/s12883-016-0676-2
PMCID: PMC4997695
PMID: 27557808 [PubMed - indexed for MEDLINE]

**Three-dimensional lumbar segment movement characteristics during paediatric cerebral palsy gait.**

Kiernan D, Malone A, O'Brien T, Simms CK

*Gait Posture. 2017 Jan 3;53:41-47. doi: 10.1016/j.gaitpost.2017.01.001. [Epub ahead of print]*

Kinematic analysis of the trunk during cerebral palsy (CP) gait has been well described. In contrast, movement of the lumbar spine is generally ignored. This is most likely due to the complex nature of the spine. As an alternative to using complex sensor protocols, this study modelled the lumbar region as a single segment and investigated characteristic patterns of movement during CP gait. In addition, the impact of functional level of impairment and the relationship with lower lumbar spinal loading were examined. Fifty-two children with CP (26 GMFCS I and 26 GMFCS II) and 26 controls were recruited. A full barefoot 3-dimensional kinematic and kinetic analysis were conducted. Lumbar segment movement demonstrated increased forward flexion for CP children. This movement became more pronounced according to GMFCS level with GMFCS II children demonstrating increases of up to 8°. In addition, a moderate correlation was present between lumbar flexion/extension and L5/S1 sagittal moments ($r=0.427$ in the global frame and $r=0.448$ with respect to the pelvis, $p<0.01$). Children with CP demonstrated increased movement of the lumbar region compared to TD, with movement becoming more excessive as GMFCS level increased. Excessive forward flexion and loading at the lumbar spine were linked. However, the moderate correlation suggests other contributors to increased loading were present. In conclusion, this study is a first step at identifying how lumbar segment movement is altered during CP gait. 

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PMID: 28088678 [PubMed - as supplied by publisher]

**Toolbox of multiple-item measures aligning with the ICF Core Sets for children and youth with cerebral palsy.**

Schiariti V, Tatla S, Sauve K, O'Donnell M

*Eur J Paediatr Neurol. 2016 Nov 4. pii: S1090-3798(16)30191-X. doi: 10.1016/j.ejpn.2016.10.007. [Epub ahead of print]*

Selecting appropriate measure(s) for clinical and/or research applications for children and youth with Cerebral Palsy (CP) poses many challenges. The newly developed International Classification of Functioning, Disability and Health (ICF) Core Sets for children and youth with CP serve as universal guidelines for assessment, intervention and follow-up. The aims of this study were: 1) to identify valid and reliable measures used in studies with children and youth with CP, 2) to characterize the content of each measure using the ICF Core Sets for children and youth with CP as a framework, and finally 3) to create a toolbox of psychometrically sound measures covering the content of each ICF Core Set for children and youth with CP. All clearly defined multiple-item measures used in studies with CP between 1998 and 2015 were identified. Psychometric properties were extracted when available. Construct of the measures were linked to the ICF Core Sets. Overall, 83 multiple-item measures were identified. Of these, 68 measures (80%) included reliability and validity testing. The majority of the measures were discriminative, generic and designed for school-aged children. The degree to which measures with proven psychometric properties represented the ICF Core Sets for children and youth with CP varied considerably. Finally, 25 valid and reliable measures aligned highly with the content of the ICF Core Sets, and as such, these measures are proposed as a novel ICF Core Sets-based toolbox of measures for CP. Our results will guide professionals seeking appropriate measures to meet their research and clinical needs worldwide.


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PMID: 27864012 [PubMed - as supplied by publisher]

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

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

*Clin Biomech (Bristol, Avon). 2016 Dec 3;41:87-91. doi: 10.1016/j.clinbiomech.2016.11.008. [Epub ahead of print]*

BACKGROUND: In clinical settings, the time varying analysis of gait data relies heavily on the experience of the individual(s) assessing these biological signals. Though three dimensional kinematics are recognised as time varying waveforms (1D), exploratory statistical analysis of these data are commonly carried out with multiple discrete or 0D dependent variables. In the absence of an a priori 0D hypothesis, clinicians are at risk of making type I and II errors in their analyis of time varying gait signatures in the event statistics are used in concert with prefered subjective clinical assesment methods. The aim of this communication was to determine if vector field waveform statistics were capable of providing quantitative corroboration to practically significant differences in time varying gait signatures as determined by two clinically trained gait experts.
METHODS: The case study was a left hemiplegic Cerebral Palsy (GMFCS I) gait patient following a botulinum toxin (BoNT-A) injection to their left gastrocnemius muscle.
FINDINGS: When comparing subjective clinical gait assessments between two testers, they were in agreement with each other for 61% of the joint degrees of freedom and phases of motion analysed. For tester 1 and tester 2, they were in agreement with the vector-field analysis for 78% and 53% of the kinematic variables analysed. When the subjective analyses of tester 1 and tester 2 were pooled together and then compared to the vector-field analysis, they were in agreement for 83% of the time varying kinematic variables analysed.
INTERPRETATION: These outcomes demonstrate that in principle, vector-field statistics corroborates with what a team of clinical gait experts would classify as practically meaningful pre- versus post time varying kinematic differences. The potential for vector-field statistics to be used as a useful clinical tool for the objective analysis of time varying clinical gait data is established. Future research is recommended to assess the usefulness of vector-field analyses during the clinical decision making process.

DOI: 10.1016/j.clinbiomech.2016.11.008
PMID: 28024228 [PubMed - as supplied by publisher]

## Traitement - Rééducation motrice et cognitive

**Parents' experiences and needs regarding physical and occupational therapy for their young children with cerebral palsy.**

Kruijsen-Terpstra AJ, Verschuren O, Ketelaar M, Riedijk L, Gorter JW, Jongmans MJ, Boeije H; LEARN 2 MOVE 2-3 Study Group. Collaborators: Verhoef M, Titulaer AF, Tuin M, van de Laar-Bakker YM, van Munster JC, Geerts MJ, Voorman JM, van Vulpen L, Luijten-Ansems CA, Gorter H, Janssen-Potten YJ, van den Heuvel HA, van der Hoek FD.
*Res Dev Disabil. 2016 Jun-Jul;53-54:314-22. doi: 10.1016/j.ridd.2016.02.012. Epub 2016 Mar 11.*

OBJECTIVE: To explore the experiences and needs of parents of young children (aged 2-4 years) with cerebral palsy (CP) regarding their child's physical and occupational therapy process in a rehabilitation setting.
METHODS: A qualitative design was used involving semi-structured interviews with 21 parents of young children with CP. Interviews were conducted until informational redundancy was achieved.
RESULTS: Three major themes were identified: Information, communication and partnership. A fourth, overarching theme emerged: The process of parent empowerment. Experiences and needs differed between parents and changed over time.
CONCLUSION: This study suggests that various themes play a key role in the experiences and needs of parents of young children with CP. The identified themes provide important insights into how and why service providers might change their approach.
PRACTICE IMPLICATIONS: Becoming empowered is a dynamic process for parents, in which both parents and service providers play a role. Service providers should continually adapt their role to parents' needs of information, communication and partnership, and they should support and facilitate parents in becoming empowered. For that, service providers should be educated on the process of parent empowerment, on ways to facilitate this process and on the importance of involving and interacting with parents. This allows families of young children with CP to be provided with services that best suit their needs.

DOI: 10.1016/j.ridd.2016.02.012
PMID: 26970858 [PubMed - indexed for MEDLINE]

**Pharmacologie Efficacite Tolérance**

**AbobotulinumtoxinA (Dysport(®)) Improves Function According to Goal Attainment in Children With Dynamic Equinus Due to Cerebral Palsy.**
Tilton A, Russman B, Aydin R, Dincer U, Escobar RG, Kutlay S, Lipczyk Z, Velez JC, Grandoulier AS, Tse A, Picaut P, Delgado MR
*J Child Neurol. 2017 Jan 1:883073816686910. doi: 10.1177/0883073816686910. [Epub ahead of print]*

This secondary analysis of a large (n = 241), randomized, double-blind study evaluated the efficacy of 2 doses of abobotulinumtoxinA + standard of care (SOC) versus placebo + SOC in enabling children with dynamic equinus due to cerebral palsy to achieve their functional goals using Goal Attainment Scaling. Most parents/caregivers selected goals targeting aspects of gait improvement as most relevant. Mean (95% confidence interval) Goal Attainment Scaling T scores at week 4 were higher for both abobotulinumtoxinA groups versus placebo (treatment difference vs placebo: 10 U/kg/leg: 5.32 [2.31, 8.32], P = .0006, and 15 U/kg/leg 4.65 [1.59, 7.71], P = .0031). Superiority of both abobotulinumtoxinA doses versus placebo was maintained at week 12. Best goal attainment T scores were higher in the abobotulinumtoxinA groups versus placebo for the common goals of improved walking pattern, decreased falling, decreased tripping, and improved endurance. These findings demonstrate that single injections of abobotulinumtoxinA (10 and 15 U/kg/leg) significantly improved the ability of pediatric cerebral palsy patients to achieve their functional goals.
DOI: 10.1177/0883073816686910
PMID: 28068857 [PubMed - as supplied by publisher]

**[Botulinum toxin A and physical therapy in gait in cerebral palsy]. [Article in Spanish; Abstract available in Spanish from the publisher]**
García-Sánchez SF, Gómez-Galindo MT, Guzmán-Pantoja JE.
*Rev Med Inst Mex Seguro Soc. 2017 Jan-Feb;55(1):18-24.*

BACKGROUND: Cerebral palsy (PCI) is the leading cause of disability in children. Botulinum toxin type A (TBA) is a treatment to improve the function and pattern in the gait, although with a few studies that quantify the improvement.
METHODS: Quasi-experimental study was conducted from May 2010 to September 2011, in Integrated Rehabilitation Center, in 36 patients with spastic PCI. Was evaluated: functionality of travel by the scale of Koman, speed of the gait with tone scale of Ashworth and arches of passive mobility, were applied TBA and was sent to 10 sessions of physical therapy, with measurements taken before, the 1st and 4th month.
RESULTS: 30 Patients completed the study, between the ages of 2 and 12 years, the majority had improvement in the functionality of the gear, tone, dorsiflexion and abduction of ankles to the motion, which was maintained at 4 months.
CONCLUSIONS: Botulinum toxin is an effective treatment to increase the arches of mobility and functionality of the gait of patients with hemiparesis and spastic paraparesis.
PMID: 28092243 [PubMed - in process]

**Botulinum Toxin Type A Injection for Spastic Equinovarus Foot in Children with Spastic Cerebral Palsy: Effects on Gait and Foot Pressure Distribution.**
Craing JY, Jung S, Rha DW, Park ES
*Yonsei Med J. 2016 Mar;57(2):496-504. doi: 10.3349/ymj.2016.57.2.496.*

PURPOSE: To investigate the effect of intramuscular Botulinum toxin type A (BoNT-A) injection on gait and dynamic foot pressure distribution in children with spastic cerebral palsy (CP) with dynamic equinovarus foot.
MATERIALS AND METHODS: Twenty-five legs of 25 children with CP were investigated in this study. BoNT-A was injected into the gastrocnemius (GCM) and tibialis posterior (TP) muscles under the guidance of ultrasonography. The effects of the toxin were clinically assessed using the modified Ashworth scale (MAS) and modified Tardieu scale (MTS), and a computerized gait analysis and dynamic foot pressure measurements using the F-scan system were also performed before injection and at 1 and 4 months after injection.

RESULTS: Spasticity of the ankle plantar-flexor in both the MAS and MTS was significantly reduced at both 1 and 4 months after injection. On dynamic foot pressure measurements, the center of pressure index and coronal index, which represent the asymmetrical weight-bearing of the medial and lateral columns of the foot, significantly improved at both 1 and 4 months after injection. The dynamic foot pressure index, total contact area, contact length and hind foot contact width all increased at 1 month after injection, suggesting better heel contact. Ankle kinematic data were significantly improved at both 1 and 4 months after injection, and ankle power generation was significantly increased at 4 months after injection compared to baseline data.
CONCLUSION: Using a computerized gait analysis and foot scan, this study revealed significant benefits of BoNT-A injection into the GCM and TP muscles for dynamic equinovarus foot in children with spastic CP.
**Free PMC Article**
DOI: 10.3349/ymj.2016.57.2.496
PMCID: PMC4740546
PMID: 26847306 [PubMed - indexed for MEDLINE]

**Comparative study of therapeutic response to baclofen vs tolperisone in spasticity.**
Agarwal S, Patel T, Shah N, Patel BM
*Biomed Pharmacother. 2017 Jan 10;87:628-635. doi: 10.1016/j.biopha.2017.01.005. [Epub ahead of print]*

BACKGROUND: Spasticity from the upper motor neuron syndrome can result from a variety of conditions affecting the cortex or spinal cord. Some of the more common conditions associated with spasticity include spinal cord injury, cerebral palsy, and post-stroke syndrome. In this study we compared the efficacy and safety of baclofen vs tolperisone in spasticity. One hundred fifty patients with cerebral palsy or post stroke or spinal cord injury associated spasticity were enrolled in present study. Group I comprised of Seventy-five patients receiving baclofen and group II comprised of 75 patients receiving tolperisone. For efficacy measurement 4 evaluation methods were used, 1) Modified Ashworth Scale for muscle tone, 2) Medical research council scale for muscle strength and 3) Barthel Index for functional outcome 4) Coefficient of efficacy. In efficacy evaluation, both groups showed significant improvement in muscle tone, muscle strength and functional outcome at week 6 (Group I, 1.55±0.053, 2.79+0.032, 59.31±1.32; Group II, 1.57±0.053, 3.04±0.032, 73±1.32 respectively). In between the group analysis, there was no significant difference in muscle tone improvement in both the groups after 6 weeks (Group I, 1.055±0.053 vs Group II, 1.57±0.053, $p>0.05$). Group II showed non-significant but greater improvement in muscle strength (Week 6; Group I, 2.79±0.032 vs Group II, 3.04±0.032, $p>0.07$). Improvement in functional outcomes was greater in group II as compared to group I (Group I, 59.31±1.32 vs Group II, 73±1.32, $p<0.05$). Overall efficacy coefficient was greater for group II (3.6) as compared to group I (2.3). Baclofen showed more side effects compared to tolperisone in, asthenia being the most frequent. Tolperisone offers greater improvement in activities of daily living compared to baclofen. Tolperisone is more tolerable drug as compared to baclofen.

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PMID: 28086137 [PubMed - as supplied by publisher]

**Effect of cerebrolysin on gross motor function of children with cerebral palsy: a clinical trial.**
Nasiri J, Safavifar F
*Acta Neurol Belg. 2017 Jan 10. doi: 10.1007/s13760-016-0743-x. [Epub ahead of print]*

Gross motor dysfunction is considered as the most challenging problem in cerebral palsy (CP). It is proven that improvement of gross motor function could reduce CP-related disabilities and provide better quality of life in this group of patients. Therefore, the aim of this trial is to evaluate the effectiveness of cerebrolysin (CBL) on gross motor function of children with CP who are undergoing treatment. In this clinical trial study, paediatric patients aged 18-75 months with spastic diplegic or quadriplegic cerebral palsy, who were under rehabilitation therapy, were selected and randomly allocated in control and CBL groups. Patients in CBL group underwent treatment with standard rehabilitation therapy plus CBL. The latter was administrated intramuscularly as a single daily dose of 0.1 cc/kg for 10 days and then continued weekly for 4 months. Gross motor function of participants in the two studied groups, before and after trial, was evaluated and compared using the validated Persian version of gross motor function classification system-expanded and revised (GMFCS-E&R). During this trial, 108 patients with CP were evaluated for eligibility. From these, 50 patients were enrolled and randomly allocated in the CBL and control groups. Four months after trial, the mean level of GMFCS decreased significantly in the two groups ($P < 0.05$). However, it was significantly

lower in the CBL group than in the control group (2.1 vs. 3.16, P < 0.05). The results of this trial indicated that CBL could improve gross motor function in patients with CP. This finding is consistent with neurotrophic and neuroprotective effects of CBL, which have been reported in various clinical trials in other neurological disorders. Further studies are recommended to establish the value of continued neuroprotection and to determine the pharmacokinetics/dynamics of CBL in this group of patients.
DOI: 10.1007/s13760-016-0743-x
PMID: 28074392 [PubMed - as supplied by publisher]

**Intramuscular nerve distribution patterns of anterior forearm muscles in children: a guide for botulinum toxin injection.**
Yang F, Zhang X, Xie X, Yang S, Xu Y, Xie P
*Am J Transl Res. 2016 Dec 15;8(12):5485-5493. eCollection 2016.*

Botulinum toxin (BoNT) can relieve muscle spasticity by blocking axon terminals acetylcholine release at the motor endplate (MEP) and is the safest and most effective agent for the treatment of muscle spasticity in children with cerebral palsy. In order to achieve maximum effect with minimum effective dose of BoNT, one needs to choose an injection site as near to the MEP zone as possible. This requires a detailed understanding about the nerve terminal distributions within the muscles targeted for BoNT injection. This study focuses on BoNT treatment in children with muscle spasms caused by cerebral palsy. Considering the differences between children and adults in anatomy, we used child cadavers and measured both the nerve entry points and nerve terminal sense zones in three deep muscles of the anterior forearm: flexor digitorum profundus (FDP), flexor pollicis longus (FPL), and pronator quadratus (PQ). We measured the nerve entry points by using the forearm midline as a reference and demonstrated intramuscular nerve terminal dense zones by using a modified Sihler's nerve staining technique. The locations of the nerve entry points and that of the nerve terminal dense zones in the muscles were compared. We found that all nerve entry points are away from the corresponding intramuscular nerve terminal dense zones. Simply selecting nerve entry points as the sites for BoNT injection may not be an optimal choice for best effects in blocking muscle spasm. We propose that the location of the nerve terminal dense zones in each individual muscle should be used as the optimal target sites for BoNT injection when treating muscle spasms in children with cerebral palsy.
**Free PMC Article**
PMCID: PMC5209499
PMID: 28078019 [PubMed]

**Pharmacokinetics and pharmacodynamics of incobotulinumtoxinA influencing the clinical efficacy in post- stroke spasticity.**
Zeuner KE, Deuschl G
*Expert Opin Drug Metab Toxicol. 2016;12(4):457-66. doi: 10.1517/17425255.2016.1152262. Epub 2016 Feb 29.*

INTRODUCTION: Post-stroke spasticity is a disabling neurological condition and may have a significant impact on quality of life. Ability to carry out activities of daily living is often compromised and painful contractures in the affected limbs may also develop. The prevalence of spasticity may be as high as 40% within the first year after the initial stroke event. Management of this condition focuses on improving muscle tone, function and pain. IncobotulinumtoxinA is effective in treating focal spasticity.
AREAS COVERED: This review will summarize outcomes from incobotulinumtoxin A phase III trials in upper limb spasticity. Pharmacodynamics and pharmacokinetics will also be discussed along with future studies and possible indications.
Literature searches used for this review include; PubMed and www.clinicaltrials.gov searches. Congress abstracts and case reports are not included.
EXPERT OPINION: IncobotulinumtoxinA, is a 150 kiloDalton neurotoxin without complexing proteins and is well tolerated in patients with spasticity. There is an 80% improvement reported on spasticity and disability in several phase III studies. In the future, higher doses for upper and lower limb spasticity may be considered. Antibody formation does not seem to limit the administration of higher doses. Prospective studies are evaluating the efficacy of incobotulinumtoxin in children and adolescents with cerebral palsy. Furthermore, the clinical efficacy and immunogenic status of other botulinum neurotoxin A subtypes are currently under investigation.
DOI: 10.1517/17425255.2016.1152262
PMID: 26882333 [PubMed - indexed for MEDLINE]

**The Effect of Treatment on Stereognosis in Children With Hemiplegic Cerebral Palsy.**
Petersen E, Tomhave W, Agel J, Bagley A, James M, Van Heest A.
*J Hand Surg Am. 2016 Jan;41(1):91-6. doi: 10.1016/j.jhsa.2015.06.126. Epub 2015 Nov 21.*

PURPOSE: To determine if rehabilitation alone or combined with surgery or botulinum toxin injection improved stereognosis in children with hemipleg
ic cerebral palsy.
METHODS: Inclusion criteria were children with spastic hemiplegic cerebral palsy who had stereognosis testing 2 separate times with documentation of intervening treatment. Sixty-three children were included, 30 girls and 33 boys at an average age of 9.1 years (range, 4.4-16.0 years). Twelve standardized objects were used for manual identification. Baseline and postintervention stereognosis results were recorded for the hemiplegic and the dominant limb of each patient. The patients were separated into 3 groups based on intervening treatment: surgery with rehabilitation (27 patients), botulinum toxin injection with rehabilitation (19 subjects), and rehabilitation alone (7 subjects). Results were also analyzed by patient age group.
RESULTS: Baseline testing of the hemiplegic limb revealed that 27 patients (43%) exhibited severe stereognosis impairment (0-4 objects identified correctly), 18 (28%) were moderately impaired (5-8 objects), 13 (21%) were mildly impaired (9-11 objects), and 5 (8%) had intact stereognosis (12 objects). There was no statistically significant difference in change in stereognosis scores postintervention among the 3 different treatment groups or between patients who had surgery and those who did not have surgery. There was no statistically significant difference in stereognosis function or postintervention change based on patient age at time of testing.
CONCLUSIONS: In this study, 92% of children with spastic hemiplegic cerebral palsy had stereognosis impairment with a wide spectrum of severity. After operative or nonoperative treatment interventions, stereognosis as a secondary outcome measure was not changed.
TYPE OF STUDY/LEVEL OF EVIDENCE: Therapeutic III.

DOI: 10.1016/j.jhsa.2015.06.126
PMID: 26614592 [PubMed - indexed for MEDLINE]

## Chirurgie

**Distal femoral extension and shortening osteotomy as a part of multilevel surgery in children with cerebral palsy.**
Klotz MC, Hirsch K, Heitzmann D, Maier MW, Hagmann S, Dreher T
*World J Pediatr. 2016 Dec 23. doi: 10.1007/s12519-016-0086-y. [Epub ahead of print]*

BACKGROUND: There are several reports describing an increase in anterior pelvic tilt after hamstring lengthening in children with cerebral palsy (CP). Distal femoral extension and shortening osteotomy (DFESO) is an alternative treatment for correction of fl exed knee gait, but investigations analyzing outcome and infl uence on adjacent joint are few in the literature. The purpose of this study was to analyze the influence of DFESO on knee and pelvis in children with CP. Furthermore, it was of interest if an additional patellar tendon advancement (PA) infl uences outcome.
METHODS: In this retrospective study, 31 limbs of 22 children (GMFCS I-III; mean age: 12.1±3.1 years), who received DFESO were included and kinematic parameters (knee, pelvis) measured by 3-D-gait analysis were compared before and at least 1 year after surgery (mean follow-up period: 15.6 months).
RESULTS: After surgery, during stance phase minimum knee flexion improved significantly by 20.5° ($P<0.001$) and mean anterior pelvic tilt increased by 4.0 degrees ($P=0.045$). In 16 limbs, the postoperative increase in maximum anterior pelvic tilt was more than 5°. Limbs who received an additional PA showed the biggest increase in anterior pelvic tilt.
CONCLUSIONS: DFESO is an effective method for correction of fl exed knee gait in children with CP. Furthermore, the results of this study indicate that DFESO may lead to an increase in anterior pelvic tilt, which may lead to a recurrence of fl exed knee gait. In this context, PA seemed to aggravate the effect on the pelvis.
DOI: 10.1007/s12519-016-0086-y
PMID: 28074440 [PubMed - as supplied by publisher]

**Experience in Perioperative Management of Patients Undergoing Posterior Spine Fusion for Neuromuscular**

**Scoliosis.**
Pesenti S, Blondel B, Peltier E, Launay F, Fuentes S, Bollini G, Viehweger E, Jouve JL
*Biomed Res Int. 2016;2016:3053056. doi: 10.1155/2016/3053056. Epub 2016 Dec 12.*

The objective of this investigation was to determine the outcome of spine fusion for neuromuscular (NM) scoliosis, using Unit Rod technique, with emphasis on complications related to preoperative general health. Between 1997 and 2007, 96 consecutive patients with neuromuscular scoliosis operated on with Unit Rod instrumentation were retrospectively reviewed. The inclusion criteria were diagnosis of NM scoliosis due to cerebral palsy (CP) and muscular dystrophy (DMD). Patient's preoperative general health, weight, and nutrition were collected. Different radiographic and clinical parameters were evaluated. There were 66 CP patients (59 nonwalking) and 30 DMD patients (24 nonwalking). Mean age at surgery was 16.5 years and 13.9 years, respectively. All radiographic measurements improved significantly. Wound infection rate was 16.7% (11% of reoperation rate in CP; 10% in DMD; 3 hardware removal cases). No pelvic fracture due to rod irritation was observed. Unit Rod technique provides good radiographic and clinical outcomes even if this surgery is associated with a high complication rate. It is a quick, simple, and reliable technique. Perioperative management strategy should decrease postoperative complications and increases outcome. A standardized preoperative patient evaluation and preparation including respiratory capacity and nutritional, digestive, and musculoskeletal status are mandatory prior to surgery.
**Free PMC Article**
DOI: 10.1155/2016/3053056
PMCID: PMC5183752
PMID: 28058256 [PubMed - indexed for MEDLINE]

**Monosegmental laminoplasty for selective dorsal rhizotomy--operative technique and influence on the development of scoliosis in ambulatory children with cerebral palsy.**
Funk JF, Haberl H
*Childs Nerv Syst. 2016 May;32(5):819-25. doi: 10.1007/s00381-016-3016-3. Epub 2016 Jan 13.*

PURPOSE: Selective dorsal rhizotomy (SDR) reduces spasticity in children with cerebral palsy (CP) and is performed either through a lumbosacral multilevel laminectomy or a single-level laminectomy at the medullary conus. Spinal interventions generally involve the risk of subsequent instability depending on the extent of structural weakening. Destabilizing spasticity in CP might further increase this risk for both options. Laminoplasty is frequently applied to reduce instability through anatomical restoration, although the unavoidable interruption of interspinous ligaments might be a reason for inconsistent results. We report on a novel technique of laminoplasty, achieving complete restoration of the dorsal column.
METHODS: One hundred sixteen ambulatory children with gross motor function classification scale (GMFCS) level I to III were submitted to SDR through a single-level approach. The lamina was reinserted with a previously unreported technique of laminoplasty. Osseous reintegration of the excised lamina was supposed, if its spinous process was located in place on late follow-up radiographs. Scoliosis was described via Cobb's angle.
RESULTS: At a mean follow-up of 33 months, radiographs were available from 72 children with a mean age at surgery of 7.2 years. Sixty-two out of the 72 reinserted laminae were supposed to be vital and reintegrated. Seven children developed a predominantly mild scoliosis. No association was found between development of scoliosis and GMFCS level or age.
CONCLUSIONS: This novel laminoplasty technique provides the least invasive approach for SDR. The incidence of scoliosis after this single-level approach is comparable to the natural history of ambulatory CP children.
DOI: 10.1007/s00381-016-3016-3
PMID: 26759019 [PubMed - indexed for MEDLINE]

**Percutaneous Hamstring Lengthening Surgery is as Effective as Open Lengthening in Children With Cerebral Palsy.**
Nazareth A, Rethlefsen S, Sousa TC, Mueske NM, Wren TA, Kay RM.
*J Pediatr Orthop. 2016 Dec 22. doi: 10.1097/BPO.0000000000000924. [Epub ahead of print]*

BACKGROUND: Surgical lengthening of the hamstrings is often performed to correct crouch gait in children with cerebral palsy (CP). Previous studies have demonstrated the effectiveness of open hamstring lengthening (oHSL) in improving knee extension static and dynamic range of motion; however, literature regarding percutaneous

hamstring lengthening (pHSL) is limited. The purpose of this study was to investigate the effect of open versus pHSL for improving crouch gait and knee function in children with CP.
METHODS: This retrospective cohort study included 87 ambulatory children with CP who underwent HLS surgery with both preoperative and postoperative gait analysis (mean time, 29.4±19.9 mo after surgery) testing between 1997 and 2015. In total, 65 patients underwent oHLS surgery (mean age, 8.5±2.5 y) and 22 patients underwent pHSL surgery (mean age, 8.3±2.3 y). Lower extremity three-dimensional kinematic data were collected while subjects walked at a self-selected speed. Outcome variables for operative limbs were compared within and between groups using t tests, χ tests, and multiple regression analysis.
RESULTS: Significant postoperative decreases in knee flexion at initial contact were seen for both open (Δ12.7±13.4 degrees; P<0.001) and percutaneous (Δ19.1±13.1 degrees; P<0.001) groups. Increased postoperative maximum knee extension in stance was found for both open (Δ8.2±16.8 degrees; P=0.001) and percutaneous (Δ14.4±16.5 degrees; P=0.001) groups. No significant differences between open and percutaneous groups were found when comparing postoperative changes in kinematic variables between groups after adjusting for covariates. Postoperative changes in static range of motion were similar between lengthening groups.
CONCLUSIONS: pHSL is as effective as open lengthening in improving stance phase knee kinematics during gait in children with CP. This is the first study to compare the kinematic effects of open versus pHSL in the pediatric population. Percutaneous lengthening is tolerated well by patients, and as it allows for rapid rehabilitation it may be preferable to the open procedure.
LEVEL OF EVIDENCE: Level III-retrospective comparative study.
DOI: 10.1097/BPO.0000000000000924
PMID: 28009799 [PubMed - as supplied by publisher]

**Orthopaedic Surgery in Dystonic Cerebral Palsy.**
Blumetti FC, Wu JC, Barzi F, Axt MW, Waugh MC, Selber P.
*J Pediatr Orthop. 2016 Dec 23. doi: 10.1097/BPO.0000000000000919. [Epub ahead of print]*

BACKGROUND: Outcomes after orthopaedic interventions in patients with dystonic cerebral palsy (DCP) are historically regarded as unpredictable. This study aims to evaluate the overall outcome of orthopaedic surgery in children with DCP.
METHOD: Children with DCP who underwent lower limb orthopaedic surgery with a minimum follow-up of 12 months were included. Data collected included age at time of surgery, surgical procedures performed, Gross Motor Function Classification System (GMFCS) level, and Barry Albright Dystonia Scale (BADS) score. The cohort was divided into 2 groups. Group 1 (GMFCS levels I to III), mean age 12 years 7 months and group 2 (GMFCS levels IV to V), mean age 10 years 7 months. Group 1 had surgery aimed at deformity correction to improve gait and mobility, and group 2 for the management or prevention of hip displacement. Outcome measures analyzed were: the incidence of unpredictable results related to surgery and early recurrence of deformity in both groups. Functional mobility scale scores were evaluated for group 1 and hip migration percentage for group 2. Linear mixed models were used to take into account repeated measures over time and correlations between measurements from the same patient.
RESULTS: Group 1 (n=18); had low BADS scores and were considered to have mild dystonia. Three children experienced unpredictable results, 2 had early recurrence of deformity, 3 had a decline, and 1 child improved in the functional mobility scale.Group 2 (n=19); had high BADS scores and were considered to have moderate to severe dystonia. Nine surgical events involved bony procedures and 15 were soft tissue surgery only. One surgical event lead to unpredictable results and 2 children had early recurrence of deformity. Postoperatively, a linear trend of increasing migration percentage [0.49% (95% confidence interval, 0.23-0.74; P=0.0002)] was seen up to 21 months. There was no significant change after 21 months [-0.08% (95% confidence interval, -0.24 to +0.041; P=0.18)].
CONCLUSIONS: This study suggests that unpredictable results and early recurrence of deformity following orthopaedic surgery in children with DCP are not as common as previously regarded. Furthermore, functional mobility and hip morphology can be improved.
LEVEL OF EVIDENCE: Level IV-this is a case-series.
DOI: 10.1097/BPO.0000000000000919
PMID: 28027144 [PubMed - as supplied by publisher]

**Results and complications of percutaneous pelvic osteotomy and intertrochanteric varus shortening osteotomy in 54 consecutively operated GMFCS level IV and V cerebral palsy patients.**

Canavese F, Marengo L, de Coulon G.
*Eur J Orthop Surg Traumatol. 2017 Jan 12. doi: 10.1007/s00590-017-1902-3. [Epub ahead of print]*

PURPOSE: This retrospective study evaluated mid-to-long-term outcome of a minimally invasive percutaneous pelvic osteotomy (PPO) approach combined with varus derotational shortening osteotomy (VDRSO) and soft tissue release in children with severe CP.
METHODS: A retrospective review was performed of all patients presenting with a diagnosis of CP with hip subluxation or dislocation treated surgically by simultaneous soft tissue release, VDRSO, and PPO between 2002 and 2015. Eligible patients included those with a diagnosis of spastic quadriplegia or CP GMFCS level IV or V with unilateral or bilateral hip subluxation or dislocation and surgical treatment of the deformity by simultaneous soft tissue release, VDRSO and PPO. All anterior-posterior (AP) radiographs of the pelvis were reviewed and Reimers migration percentage (MP) and acetabular angle (AA) were measured. RESULTS: In total, 54 children and adolescents (34 boys, 20 girls) with CP GMFCS level IV and V were treated during study period: 38 (70.4%) classified GMFCS level IV and 16 (29.6%) classified GMFCS level V. A total of 64 consecutive hips underwent simultaneous PPO associated with VDRSO. Overall, at the time of chart and radiograph review, mean age was 9.1 ± 3.3 years (range 4-16.5) and mean follow-up was 43.9 ± 19.5 months (range 3-72). Mean migration percentage improved from 66.8 ± 19.8% (range 33-100) preoperatively to 8.1 ± 16.5% (range 0-70) at last follow-up. Mean acetabular angle improved from 32.7° ± 7.1° (range 20-50) preoperatively to 14° ± 6.7° (range 0-27) at last follow-up. Only one case of bone graft dislodgment was observed. We did not observe any cases of avascular necrosis of the femoral head. All operated hips were pain free at the time of last follow-up.
CONCLUSION: PPO through a less invasive surgical approach offers a valuable alternative to standard techniques as it gives similar outcome but with less muscle stripping and less time in surgery.
LEVEL OF EVIDENCE: III.
DOI: 10.1007/s00590-017-1902-3
PMID: 28083677 [PubMed - as supplied by publisher]

**The Direct Anterior Approach for Complex Primary Total Hip Arthroplasty: The Extensile Acetabular Approach on a Regular Operating Room Table.**
Molenaers B, Driesen R, Molenaers G, Corten K
*J Arthroplasty. 2016 Dec 22. pii: S0883-5403(16)30901-9. doi: 10.1016/j.arth.2016.12.016. [Epub ahead of print]*

BACKGROUND: The direct anterior approach on a regular operating room table has been reported with low dislocation rates. This might be beneficial for complex primary total hip arthroplasty (THA) such as in patients with cerebral palsy or following femoral or pelvic osteotomies. Extending the approach is often required to overcome problems such as acetabular deformities or severe contractures.
METHODS: We retrospectively evaluated the results and complications of 29 patients with 37 complex primary THA in which an extensile approach was used. The extensile approach is described. Functional scores were collected in case the patient was ambulatory independently (n = 17).
RESULTS: The average age was 35 years (range 15-85) with a mean follow-up of 39 months (range 12-60). There were 3 (8%) intra-operative and 4 (11%) early post-operative complications (<3 months), of which 3 (8%) were anterior dislocations. Late complications (>3 months) consisted of a fibrous ingrown stem, a socket loosening following a pelvic fracture, and a late hematogenous infection (8%). Seventy-one percent of the complications occurred in the first 18 cases (49%) indicating a learning curve. The mean post-operative Harris Hip Score was 79 (range 56-97).
CONCLUSION: Complex THA can be safely conducted through the extensile anterior approach on a regular operating room table with the use of conventional implants, even in cases with a high risk of dislocation.

DOI: 10.1016/j.arth.2016.12.016
PMID: 28087159 [PubMed - as supplied by publisher]

**The management of scoliosis in children with cerebral palsy: a review.**
Cloake T, Gardner A
*J Spine Surg. 2016 Dec;2(4):299-309. doi: 10.21037/jss.2016.09.05.*

Children who suffer with cerebral palsy (CP) have a significant chance of developing scoliosis during their early years and adolescence. The behavior of this scoliosis is closely associated with the severity of the CP disability and unlike idiopathic scoliosis, it continues to progress beyond skeletal maturity. Conservative measures may slow the progression of the curve, however, surgery remains the only definitive management option. Advances in surgical technique over the last 50 years have provided methods to effectively treat the deformity while also reducing complication rates. The increased risk of surgical complications with these complex patients make decisions about treatment challenging, however with careful pre-operative optimization and post-operative care, surgery can offer a significant improvement in quality of life. This review discusses the development of scoliosis in CP patient, evaluates conservative and surgical treatment options and assesses post-operative outcome.

Free PMC Article
DOI: 10.21037/jss.2016.09.05
PMCID: PMC5233861
PMID: 28097247 [PubMed - in process]

## Réadaptation fonctionnelle

**Biofeedback interventions for people with cerebral palsy: a systematic review protocol.**

MacIntosh A, Vignais N, Biddiss E.

*Syst Rev. 2017 Jan 13;6(1):3. doi: 10.1186/s13643-017-0405-y.*

BACKGROUND: Cerebral palsy is a life-long disability that affects motor control and activities of daily living. Depending on the type of cerebral palsy, some individuals may have trouble performing tasks with one or both of their arms and/or legs. Different strategies exist to help develop motor capacity. Biofeedback therapy is a commonly applied rehabilitation strategy. In biofeedback therapy, information about the motor behavior while completing a task is given back to the individual to help improve their performance. This can provide valuable information that would otherwise be unknown to the individual. Biofeedback may also have a unique method of operation in clinical populations, such as people with cerebral palsy. Therefore, it is important to identify the most effective mechanisms for specific populations. This review aims to evaluate the effects of biofeedback interventions that have been used towards improving motor performance and motor learning in people with cerebral palsy.
METHODS: Using a customized strategy, MEDLINE, CINAHL, Embase, PsycINFO, Cochrane Central Register of Controlled Trials, SCOPUS, SPORTDiscus, and PEDro databases will be searched. Two independent reviewers will screen titles and abstracts, review full texts for inclusion criteria, and extract data from relevant articles using a standardized template. Quality of evidence and risk of bias will be assessed through the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) methodology.
DISCUSSION: Several studies have investigated biofeedback-based interventions for people with cerebral palsy. However, there is a great variety and limited consensus regarding how to implement biofeedback mechanisms. This systematic review will consolidate the current evidence to direct future study and develop effective biofeedback rehabilitation strategies.
SYSTEMATIC REVIEW REGISTRATION: PROSPERO ID: CRD42016047612.

DOI: 10.1186/s13643-017-0405-y
PMCID: PMC5237305
PMID: 28086958 [PubMed - in process]

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

Liu L, Chen X, Lu Z, Cao S, Wu, Zhang X.

*IEEE Trans Neural Syst Rehabil Eng. 2016 Apr 29. doi: 10.1109/TNSRE.2016.2560906. [Epub ahead of print]*

This paper focuses on the development of an upper limb rehabilitation training system designed for use by children with cerebral palsy (CP). It attempts to meet the requirements of in-home training by taking advantage of the combination of portable accelerometers (ACC) and surface electromyography (SEMG) sensors worn on the upper limb to capture functional movements. In the proposed system, the EMG-ACC acquisition device works essentially as wireless game controller, and three rehabilitation games were designed for improving upper limb motor function under a clinician's guidance. The games were developed on the Android platform based on a physical engine called Box2D. The results of a system performance test demonstrated that the developed games can respond to the upper limb actions within 210ms. Positive questionnaire feedbacks from twenty CP subjects who participated in the game

test verified both the feasibility and usability of the system. Results of a long-term game training conducted with three CP subjects demonstrated that CP patients could improve in their game performance through repetitive training, and persistent training was needed to improve and enhance the rehabilitation effect. According to our experimental results, the nove multi-feedback SEMG-ACC-based user interface improved the users' initiative and performance in rehabilitation training.
DOI: 10.1109/TNSRE.2016.2560906
PMID: 28113559 [PubMed - as supplied by publisher]

**Does Context Matter? Mastery Motivation and Therapy Engagement of Children with Cerebral Palsy.**
Miller L, Ziviani J, Ware RS, Boyd RN
*Phys Occup Ther Pediatr. 2016;36(2):155-70. doi: 10.3109/01942638.2015.1076556. Epub 2015 Nov 13.*

AIMS: To determine if mastery motivation at baseline predicts engagement in two goal-directed upper limb (UL) interventions for children with unilateral cerebral palsy (UCP).
METHODS: Participants were 44 children with UCP, mean age 7 years 10 months, Manual Ability Classification System level I (N = 23) or II (N = 21). Twenty-six children received intensive novel group-based intervention (Hybrid Constraint Induced Movement Therapy, hCIMT) and 18 received distributed individual occupational therapy (OT). Caregivers completed the Dimensions of Mastery Questionnaire (DMQ) parent-proxy report at baseline. Children's engagement was independently rated using the Pediatric Volitional Questionnaire (PVQ). Associations between children's mastery motivation and engagement were examined using linear regression.
RESULTS: Children who received hCIMT had lower DMQ persistence at baseline (p = .05) yet higher PVQ volitional (p = .04) and exploration (p = .001) scores. Among children who received hCIMT, greater object-oriented persistence was associated with task-directedness (β 0.25, p = .05), seeking challenges (β = 0.51, p = .02), exploration (β = 0.10, p = .03), and volitional scores (β = 0.23, p = .01).
CONCLUSION: Despite having lower levels of persistence prior to engaging in UL interventions, children who received hCIMT demonstrated greater engagement in goal-directed tasks than children who received individual OT. Within hCIMT, children's motivational predisposition to persist with tasks manifested in their exploration and engagement in therapy.
DOI: 10.3109/01942638.2015.1076556
PMID: 26565438 [PubMed - indexed for MEDLINE]

**Effect of r-TMS over standard therapy in decreasing muscle tone of spastic cerebral palsy patients.**
Gupta M, Lal Rajak B, Bhatia D, Mukherjee A
*J Med Eng Technol. 2016;40(4):210-6. doi: 10.3109/03091902.2016.1161854. Epub 2016 Mar 24.*

Spastic cerebral palsy (CP) is the one of most common neurological disorders occurring due to damage to the immature brain or any other brain lesion at the time of birth. To aid in making the life of the CP patient meaningful, several interventions such as medical, surgical and rehabilitation have been employed to date. Besides these, recently repetitive Transcranial magnetic stimulation (r-TMS) is a new found approach which is being employed for treating various neurological and psychological conditions. The aim of this study was to observe the effects of r-TMS on muscle spasticity in CP patients by stimulating the motor cortex area of the brain, which is responsible for muscle movements. In this study, 20 subjects diagnosed with CP were recruited and 10 each were placed in two groups, namely the research group (RG) (mean age, height and weight were 7.99 (SD = 4.66) years, 116.7 (SD = 23.57) cm and 21.40 (SD = 10.95) kg, respectively) and the control group (CG) (mean age, height and weight were 8.41 (SD = 4.32) years, 107.9 (SD = 26.33) cm, 21.40 (SD = 12.63) kg, respectively). r-TMS frequencies of 5 Hz and 10 Hz were administered for 15 min daily to patients in RG followed by standard therapy (ST) of 1 h duration daily for 20 days. Moreover, the patients in the control group (CG) were given only standard therapy (ST) of 1 h duration for 20 days. Modified Ashworth Scale (MAS) was used as an outcome measure to determine the level of muscle spasticity. A pre-assessment of MAS score was performed on both RG and CG to determine the level of spasticity prior to starting therapy; and similarly post-assessment after 20 days was done to observe the changes post-therapy. Statistical analysis of pre vs post MAS scores showed that few muscles showed reduction in muscle tightness after administering only ST in the CG. On the contrary, the RG that underwent r-TMS therapy combined with ST showed a significant decrease ($p < 0.05$) in muscle tightness for all the muscles selected for the therapy.
DOI: 10.3109/03091902.2016.1161854
PMID: 27010377 [PubMed - indexed for MEDLINE]

**Effects of whole-body vibration training on physical function, bone and muscle mass in adolescents and young adults with cerebral palsy.**

Gusso S, Munns CF, Colle P, Derraik JG, Biggs JB, Cutfield WS, Hofman PL

*Sci Rep. 2016 Mar 3;6:22518. doi: 10.1038/srep22518.*

We performed a clinical trial on the effects of whole-body vibration training (WBVT) on muscle function and bone health of adolescents and young adults with cerebral palsy. Forty participants (11.3-20.8 years) with mild to moderate cerebral palsy (GMFCS II-III) underwent 20-week WBVT on a vibration plate for 9 minutes/day 4 times/week at 20 Hz (without controls). Assessments included 6-minute walk test, whole-body DXA, lower leg pQCT scans, and muscle function (force plate). Twenty weeks of WBVT were associated with increased lean mass in the total body (+770 g; p = 0.0003), trunk (+410 g; p = 0.004), and lower limbs (+240 g; p = 0.012). Bone mineral content increased in total body (+48 g; p = 0.0001), lumbar spine (+2.7 g; p = 0.0003), and lower limbs (+13 g; p < 0.0001). Similarly, bone mineral density increased in total body (+0.008 g/cm(2); p = 0.013), lumbar spine (+0.014 g/cm(2); p = 0.003), and lower limbs (+0.023 g/cm(2); p < 0.0001). Participants reduced the time taken to perform the chair test, and improved the distance walked in the 6-minute walk test by 11% and 35% for those with GMFCS II and III, respectively. WBVT was associated with increases in muscle mass and bone mass and density, and improved mobility of adolescents and young adults with cerebral palsy.

**Free PMC Article**

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PMCID: PMC4776132
PMID: 26936535 [PubMed - indexed for MEDLINE]

**Effects of the standing program with hip abduction on hip acetabular development in children with spastic diplegia cerebral palsy.**

Macias-Merlo L, Bagur-Calafat C, Girabent-Farrés M, A Stuberg W

*Disabil Rehabil. 2016;38(11):1075-81. doi: 10.3109/09638288.2015.1100221. Epub 2015 Oct 30.*

PURPOSE: Early identification and intervention with conservative measures is important to help manage hip dysplasia in children with a high adductor and iliopsoas tone and delay in weight bearing. The effect of a daily standing program with hip abduction on hip acetabular development in ambulatory children with cerebral palsy was studied.

METHOD: The participants were 26 children with spastic diplegia cerebral palsy (CP), classified at Level III according to the Gross Motor Function Classification System (GMFCS). Thirteen children stood with hip abduction at least 1 h daily from 12 to 14 months of age to 5 years with an individually fabricated standing frame with hip abduction.

RESULTS: At the age of 5 years, radiologic results of the study group were compared with a comparison group of 13 children with spastic diplegia CP who had not taken part in a standing program. The migration percentage in all children who stood with abduction remained within stable limits (13-23%) at 5 years of age, in comparison to children who did not stand in abduction (12-47%) (p < 0.01).

CONCLUSIONS: The results indicate that a daily standing program with hip abduction in the first 5 years may enhance acetabular development in ambulatory children with spastic diplegia CP.

IMPLICATIONS FOR REHABILITATION: Abnormal acetabular development is a problem related to mobility problems and spasticity muscles around the hip. The literature suggests that postural management and standing programs could reduce levels of hip subluxation and increase function in children with cerebral palsy. A standing program with hip abduction can be a beneficial to develop more stable hips in children with spastic diplegic GMFCS level III.

DOI: 10.3109/09638288.2015.1100221
PMID: 26517269 [PubMed - indexed for MEDLINE]

**Evaluation of group versus individual physiotherapy following lower limb intra-muscular Botulinum Toxin-Type A injections for ambulant children with cerebral palsy: A single-blind randomized comparison trial.**

Thomas RE, Johnston LM, Sakzewski L, Kentish MJ, Boyd RN

*Res Dev Disabil. 2016 Jun-Jul;53-54:267-78. doi: 10.1016/j.ridd.2016.02.014. Epub 2016 Mar 5.*

This study aimed to evaluate efficacy of group (GRP) versus individual (IND) physiotherapy rehabilitation following lower limb intramuscular injections of Botulinum Toxin-Type A (BoNT-A) for ambulant children with cerebral palsy

(CP). Following lower limb BoNT-A injections, 34 children were randomly allocated to GRP (n=17; mean age 7y8m SD 2.0; 13 males; Gross Motor Function Classification System (GMFCS) I=5, II=8, III=4) or IND physiotherapy (n=17; mean age 8y7m SD 2.0; 11 males; GMFCS I=9, II=5, III=3). Primary outcomes were the Canadian Occupational Performance Measure (COPM) and Edinburgh Visual Gait Score (EVGS) assessed at baseline, 10 and 26 weeks post intervention. There were no baseline differences between groups. GRP intervention had greater, but not clinically meaningful, improvement in COPM satisfaction (estimated mean difference EMD 1.7, 95% CI 0.4-3.1; p<0.01) at 26 weeks. Both groups demonstrated clinically significant improvements in COPM performance and satisfaction, but minimal change in quality of gait (EVGS). Six hours of direct physiotherapy (either GRP or IND) with an additional indirect dose (median 16 episodes) of individualized home programme activities following lower limb BoNT-A injections, however, was inadequate to drive clinically meaningful changes in lower limb motor outcomes.

DOI: 10.1016/j.ridd.2016.02.014
PMID: 26955912 [PubMed - indexed for MEDLINE]

**Explosive Resistance Training Increases Rate of Force Development in Ankle Dorsiflexors and Gait Function in Adults With Cerebral Palsy.**
Kirk H, Geertsen SS, Lorentzen J, Krarup KB, Bandholm T, Nielsen JB.
*J Strength Cond Res. 2016 Oct;30(10):2749-60. doi: 10.1519/JSC.0000000000001376.*

Kirk, H, Geertsen, SS, Lorentzen, J, Krarup, KB, Bandholm, T, and Nielsen, JB. Explosive resistance training increases rate of force development in ankle dorsiflexors and gait function in adults with cerebral palsy. J Strength Cond Res 30(10): 2749-2760, 2016-Alterations in passive elastic properties of muscles and reduced ability to quickly generate muscle force contribute to impaired gait function in adults with cerebral palsy (CP). In this study, we investigated whether 12 weeks of explosive and progressive heavy-resistance training (PRT) increases rate of force development of ankle dorsiflexors (RFDdf), improves gait function, and affects passive ankle joint stiffness in adults with CP. Thirty-five adults (age: 36.5; range: 18-59 years) with CP were nonrandomly assigned to a PRT or nontraining control (CON) group in this explorative trial. The PRT group trained ankle dorsiflexion, plantarflexion, leg press, hamstring curls, abdominal curls, and back extension 3 days per week for 12 weeks, with 3 sets per exercise and progressing during the training period from 12 to 6 repetition maximums. RFDdf, 3-dimensional gait analysis, functional performance, and ankle joint passive and reflex-mediated muscle stiffness were evaluated before and after. RFDdf increased significantly after PRT compared to CON. PRT also caused a significant increase in toe lift late in swing and a significantly more dorsiflexed ankle joint at ground contact and during stance. The increased toe-lift amplitude was correlated to the increased RFDdf (r = 0.73). No other between-group differences were observed. These findings suggest that explosive PRT may increase RFDdf and facilitate larger range of movement in the ankle joint during gait. Explosive PRT should be tested in clinical practice as part of a long-term training program for adults with CP.
DOI: 10.1519/JSC.0000000000001376
PMID: 26890969 [PubMed - indexed for MEDLINE]

**Measuring Neuroplasticity Associated with Cerebral Palsy Rehabilitation: An MRI based Power Analysis.**
Reid LB, Pagnozzi AM, Fiori S, Boyd RN, Dowson N, Rose SE
*Int J Dev Neurosci. 2017 Jan 24. pii: S0736-5748(16)30358-6. doi: 10.1016/j.ijdevneu.2017.01.010. [Epub ahead of print]*

Researchers in the field of child neurology are increasingly looking to supplement clinical trials of motor rehabilitation with neuroimaging in order to better understand the relationship between behavioural training, brain changes, and clinical improvements. Randomised controlled trials are typically accompanied by sample size calculations to detect clinical improvements but, despite the large cost of neuroimaging, not equivalent calculations for concurrently acquired imaging neuroimaging measures of changes in response to intervention. To aid in this regard, a power analysis was conducted for two measures of brain changes that may be indexed in a trial of rehabilitative therapy for cerebral palsy: cortical thickness of the impaired primary sensorimotor cortex, and fractional anisotropy of the impaired, delineated corticospinal tract. Power for measuring fractional anisotropy was assessed for both region-of-interest-seeded and fMRI-seeded diffusion tractography. Taking into account practical limitations, as well as data loss due to behavioural and image-processing issues, estimated required participant numbers were 101, 128 and 59 for cortical thickness, region-of-interest-based tractography, and fMRI-seeded tractography, respectively. These numbers are not adjusted for study attrition. Although these participant numbers

may be out of reach of many trials, several options are available to improve statistical power, including careful preparation of participants for scanning using mock simulators, careful consideration of image processing options, and enrolment of as homogeneous a cohort as possible. This work suggests that smaller and moderate sized studies give genuine consideration to harmonising scanning protocols between groups to allow the pooling of data.

DOI: 10.1016/j.ijdevneu.2017.01.010
PMID: 28130065 [PubMed - as supplied by publisher]

**Standing activity intervention and motor function in a young child with cerebral palsy: A case report.**
Audu O, Daly C
*Physiother Theory Pract. 2017 Feb;33(2):162-172. doi: 10.1080/09593985.2016.1265621. Epub 2017 Jan 10.*

PURPOSE: There is limited evidence to fully justify the use of standing interventions for children with cerebral palsy (CP). This case report describes the impact of an 8-week standing program on motor function in a child with severe CP living in western Africa.
METHODS: The subject was diagnosed with ischemic - hypoxic encephalopathy shortly after birth and with CP at 12 months of age. Gross Motor Function Classification of CP was level IV. Early attempts at physical therapy were interrupted by limited access to medical services. At 18 months, a standing program using a locally constructed standing frame was initiated. The standing intervention was completed at home 5 times a week for 8 weeks. Motor skills were assessed at baseline and post-intervention using the Gross Motor Function Measure (GMFM-66).
RESULTS: Scores on the GMFM-66 increased from 28 at baseline to 37.4 in 8 weeks. Improvements in motor function included improved head control, improved upper extremity function, and increased sitting ability.
CONCLUSIONS: Implementation of a home-based standing program may have contributed to improved motor skills for this child. Further research is needed to determine the effect of standing interventions on functional motor development for children with severe CP.
DOI: 10.1080/09593985.2016.1265621
PMID: 28071965 [PubMed - in process]

**The Effects of Acute Intense Physical Exercise on Postural Stability in Children With Cerebral Palsy.**
Leineweber MJ, Wyss D, Dufour SK, Gane C, Zabjek K, Bouyer LJ, Maltais DB, Voisin JI, Andrysek J.
*Adapt Phys Activ Q. 2016 Jul;33(3):271-82. doi: 10.1123/APAQ.2015-0115.*

This study evaluated the effects of intense physical exercise on postural stability of children with cerebral palsy (CP). Center of pressure (CoP) was measured in 9 typically developing (TD) children and 8 with CP before and after a maximal aerobic shuttle-run test (SRT) using a single force plate. Anteroposterior and mediolateral sway velocities, sway area, and sway regularity were calculated from the CoP data and compared between pre- and postexercise levels and between groups. Children with CP demonstrated significantly higher pre-SRT CoP velocities than TD children in the sagittal (18.6 ± 7.6 vs. 6.75 1.78 m/s) and frontal planes (15.4 ± 5.3 vs. 8.04 ± 1.51 m/s). Post-SRT, CoP velocities significantly increased for children with CP in the sagittal plane (27.0 ± 1.2 m/s), with near-significant increases in the frontal plane (25.0 ± 1.5m/s). Similarly, children with CP evidenced larger sway areas than the TD children both pre- and postexercise. The diminished postural stability in children with CP after short but intense physical exercise may have important implications including increased risk of falls and injury.
DOI: 10.1123/APAQ.2015-0115
PMID: 27623610 [PubMed - indexed for MEDLINE]

**Younger Children with Cerebral Palsy Respond Better Than Older Ones to Therapist-Based Constraint-Induced Therapy at Home on Functional Outcomes and Motor Control.**
Chen HC, Kang LJ, Chen CL, Lin KC, Chen FC, Wu KP
*Phys Occup Ther Pediatr. 2016;36(2):171-85. doi: 10.3109/01942638.2015.1101042. Epub 2015 Dec 7.*

AIMS: To examine the differences in efficacy of home-based constraint-induced therapy (CIT) on functional outcomes and motor control in two age groups of children with cerebral palsy (CP).
METHODS: Twenty-three children with spastic unilateral CP receiving 4-week home-based CIT by a therapist were divided into younger (6-8 years; n = 11) and older (9-12 years; n = 12) groups. The home-based CIT involved intensive functional training of the more affected upper-limb while restraining the less affected upper-limb. The outcome

measures were Peabody Developmental Motor Scale-2nd edition (PDMS-2) that was being used in a modified way, Functional Independence Measure for Children (WeeFIM), and reach-to-grasp kinematic parameters, including reaction time (RT), normalized movement time (MT), normalized movement units (MUs), peak velocity (PV), and maximum grip aperture (MGA). The outcome measures were assessed at baseline, 4-weeks (post-treatment), 3- and 6-months (follow-up).
RESULTS: The younger group showed greater changes in visual motor integration skills and RT at all post-tests after intervention than the older group. Groups had comparable changes on any other measures.
CONCLUSIONS: Younger children with CP responded better to home-based CIT on some areas of upper-limb functions and reach-to-grasp motor control strategies than older children.
DOI: 10.3109/01942638.2015.1101042
PMID: 26643052 [PubMed - indexed for MEDLINE]

**The effect of deep cross friction massage on spasticity of children with cerebral palsy: A double-blind randomised controlled trial.**
Rasool F, Memon AR, Kiyani MM, Sajjad AG.
*J Pak Med Assoc. 2017 Jan;67(1):87-91.*

OBJECTIVE: To find out the effect of deep cross-friction massage on spasticity in children with cerebral palsy.
METHODS: This double-blind randomised controlled trial was conducted at the National Institute of Rehabilitation Medicine, Islamabad, Pakistan, from January to July 2013, and comprised paediatric patients with spastic diplegic cerebral palsy. The participants were equally divided into control and treatment groups by a staff member unaware of the treatment (allocation ratio 1:1). The control group received routine physiotherapy, while the experimental group was additionally given deep cross-friction massage for 30 minutes, 5 times a week lasting 6 weeks. The outcome was measured using Modified Ashworth Scale and functional level scale before the treatment and 6 weeks later. Baseline information and characteristics of the patients were also recorded. SPSS 20 was used for data analysis.
RESULTS: Of the 60 patients, there were 30(50%) in each group. The control group consisted of 14(46.7%) males and 16(53.3%) females compared to 16(53.3%) males and 14(46.7%) females in the experimental group (p=0.72). The overall mean age was 6.03±1.73 years. All patients (100%) were followed up for a period of 6 weeks and there was not a significant (p=0.26) improvement in experimental group compared to control group evident on Modified Ashworth Scale. The experimental group, however, had significant improvement after 6 weeks compared to the baseline values (p<0.001). However, functional level did not improve (p=0.55) by the end of study.
CONCLUSIONS: Deep cross-friction massage is an efficacious treatment option for the management of spasticity in children with cerebral palsy.
**Free Article**
PMID: 28065961 [PubMed - in process]

**The functional effect of segmental trunk and head control training in moderate-to-severe cerebral palsy: A randomized controlled trial.**
Curtis DJ, Woollacott M, Bencke J, Lauridsen HB, Saavedra S, Bandholm T, Sonne-Holm S.
*Dev Neurorehabil. 2017 Jan 3:1-10. doi: 10.1080/17518423.2016.1265603. [Epub ahead of print]*

PURPOSE: To determine whether segmental training is more effective in improving gross motor function in children and young people with moderate-to-severe cerebral palsy than conventional physiotherapy.
METHODS: Twenty-eight participants were randomized to a segmental training or control group. Outcomes were Gross Motor Function Measure (GMFM), Pediatric Evaluation of Disability Inventory (PEDI), Segmental Assessment of Trunk Control (SATCo), and postural sway at baseline, at primary endpoint (6 months), and at follow-up (12 months).
RESULTS: There were no significant differences in either GMFM, PEDI, or SATCo scores at primary endpoint or follow-up. There were significant reductions in anterior-posterior head angular sway and trunk sway in the segmental training group at primary endpoint but not at follow-up.
CONCLUSION: Segmental training was not superior to usual care in improving GMFM. Improvements in head and trunk sway were greater in the segmental training group at primary endpoint but not at follow-up.
DOI: 10.1080/17518423.2016.1265603
PMID: 28045553 [PubMed - as supplied by publisher]

## Robots – Exosquelette

**Evaluation of the effectiveness of robotic gait training and gait-focused physical therapy programs for children and youth with cerebral palsy: a mixed methods RCT.**
Wiart L, Rosychuk RJ, Wright FV.
*BMC Neurol. 2016 Jun 2;16:86. doi: 10.1186/s12883-016-0582-7.*

BACKGROUND: Robot assisted gait training (RAGT) is considered to be a promising approach for improving gait-related gross motor function of children and youth with cerebral palsy. However, RAGT has yet to be empirically demonstrated to be effective. This knowledge gap is particularly salient given the strong interest in this intensive therapy, the high cost of the technology, and the requirement for specialized rehabilitation centre resources.
METHODS: This is a research protocol describing a prospective, multi-centre, concurrent mixed methods study comprised of a randomized controlled trial (RCT) and an interpretive descriptive qualitative design. It is a mixed methods study designed to determine the relative effectiveness of three physical therapy treatment conditions (i.e., RAGT, a functional physical therapy program conducted over-ground (fPT), and RAGT + fPT) on gait related motor skills of ambulatory children with cerebral palsy. Children with cerebral palsy aged 5-18 years who are ambulatory (Gross Motor Function Classification System Levels II and III) will be randomly allocated to one of four treatment conditions: 1) RAGT, 2) fPT, 3) RAGT and fPT combined, or 4) a maintenance therapy only control group. The qualitative component will explicate child and parent experiences with the interventions, provide insight into the values that underlie their therapy goals, and assist with interpretation of the results of the RCT.
DISCUSSION: n/a.
TRIAL REGISTRATION: NCT02391324 Registered March 12, 2015.
**Free PMC Article**
DOI: 10.1186/s12883-016-0582-7
PMCID: PMC4890515
PMID: 27255908 [PubMed - indexed for MEDLINE]

**Robotic gait rehabilitation and substitution devices in neurological disorders: where are we now?**
Calabrò RS, Cacciola A, Bertè F, Manuli A, Leo A, Bramanti A, Naro A, Milardi D, Bramanti P
*Neurol Sci. 2016 Apr;37(4):503-14. doi: 10.1007/s10072-016-2474-4. Epub 2016 Jan 18.*

Gait abnormalities following neurological disorders are often disabling, negatively affecting patients' quality of life. Therefore, regaining of walking is considered one of the primary objectives of the rehabilitation process. To overcome problems related to conventional physical therapy, in the last years there has been an intense technological development of robotic devices, and robotic rehabilitation has proved to play a major role in improving one's ability to walk. The robotic rehabilitation systems can be classified into stationary and overground walking systems, and several studies have demonstrated their usefulness in patients after severe acquired brain injury, spinal cord injury and other neurological diseases, including Parkinson's disease, multiple sclerosis and cerebral palsy. In this review, we want to highlight which are the most widely used devices today for gait neurological rehabilitation, focusing on their functioning, effectiveness and challenges. Novel and promising rehabilitation tools, including the use of virtual reality, are also discussed.
DOI: 10.1007/s10072-016-2474-4
PMID: 26781943 [PubMed - indexed for MEDLINE]

**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, increased numbers, in specific populations and with relevant outcome measures to both confirm effectiveness and clarify training schedules.
**Free PMC Article**
DOI: 10.1186/s12984-016-0214-x
PMCID: PMC5217646
PMID: 28057016 [PubMed - in process]

**WAKE-up exoskeleton to assist children with Cerebral Palsy: design and preliminary evaluation in level walking.**
Patane F, Rossi S, Del Sette F, Taborri J, Cappa P.
*IEEE Trans Neural Syst Rehabil Eng. 2017 Jan 11. doi: 10.1109/TNSRE.2017.2651404. [Epub ahead of print]*

This paper presents the modular design and control of a novel compliant lower limb multi-joint exoskeleton for the rehabilitation of ankle knee mobility and locomotion of pediatric patients with neurological diseases, such as Cerebral Palsy (CP). The device consists of an untethered powered knee-ankle-foot orthosis (KAFO), addressed as WAKE-up (Wearable Ankle Knee Exoskeleton), characterized by a position control and capable of operating synchronously and synergistically with the human musculoskeletal system. The WAKE-up mechanical system, control architecture and feature extraction are described. Two test benches were used to mechanically characterize the device. The full system showed a maximum value of hysteresis equal to 8.8 % and a maximum torque of 5.6 N m/rad. A Pre-clinical use was performed, without body weight support, by four typically developing children and three children with CP. The aims were twofold: (i) to test the structure under weight-bearing conditions and (ii) to ascertain its ability to provide appropriate assistance to the ankle and the knee during overground walking in a real environment. Results confirm the effectiveness of the WAKE-up design in providing torque assistance in accordance to the volitional movements especially in the recovery of correct foot landing at the start of the gait cycle.
DOI: 10.1109/TNSRE.2017.2651404
PMID: 28092566 [PubMed - as supplied by publisher]

## Stimulation cérébrale - Stimulation neurosensorielle

**Bilateral globus pallidus internus deep brain stimulation for dyskinetic cerebral palsy supports Success of cochlear implantation in a 5-year old ex-24 week preterm twin with absent cerebellar hemispheres.**
Lin JP, Kaminska M, Perides S, Gimeno H, Baker L, Lumsden DE, Britz A, Driver S, Fitzgerald-O'Connor A, Selway R.
*Eur J Paediatr Neurol. 2016 Dec 10. pii: S1090-3798(16)30259-8. doi: 10.1016/j.ejpn.2016.11.017. [Epub ahead of print]*

BACKGROUND: Early onset dystonia (dyskinesia) and deafness in childhood pose significant challenges for children and carers and are the cause of multiple disability. It is particularly tragic when the child cannot make use of early cochlear implantation (CI) technology to relieve deafness and improve language and communication, because severe cervical and truncal dystonia brushes off the magnetic amplifier behind the ears. Bilateral globus pallidus internus (GPi) deep brain stimulation (DBS) neuromodulation can reduce dyskinesia, thus supporting CI neuromodulation success.

METHODS: We describe the importance of the order of dual neuromodulation surgery for dystonia and deafness. First with bilateral GPi DBS using a rechargeable ACTIVA-RC neurostimulator followed 5 months later by unilateral CI with a Harmony (BTE) Advanced Bionics Hi Res 90 K cochlear device. This double neuromodulation was performed in series in a 12.5 kg 5 year-old ex-24 week gestation-born twin without a cerebellum.
RESULTS: Relief of dyskinesia enabled continuous use of the CI amplifier. Language understanding and communication improved. Dystonic storms abated. Tolerance of sitting increased with emergence of manual function. Status dystonicus ensued 10 days after ACTIVA-RC removal for infection-erosion at 3 years and 10 months. He required intensive care and DBS re-implantation 3 weeks later together with 8 months of hospital care. Today he is virtually back to the level of functioning before the DBS removal in 2012 and background medication continues to be slowly weaned.
CONCLUSION: This case illustrates that early neuromodulation with DBS for dystonic cerebral palsy followed by CI for deafness is beneficial. Both should be considered early i.e. under the age of five years. The DBS should precede the CI to maximise dystonia reduction and thus benefits from CI. This requires close working between the paediatric DBS and CI services.

**Free PMC Article**


DOI: 10.1016/j.ejpn.2016.11.017
PMID: 28017556 [PubMed - as supplied by publisher]

**Effects of spinal cord stimulation on motor functions in children with cerebral palsy.**

Solopova IA, Sukhotina IA, Zhvansky DS, Ikoeva GA, Vissarionov SV, Baindurashvili AG, Edgerton VR, Gerasimenko YP, Moshonkina TR.

*Neurosci Lett. 2017 Jan 4;639:192-198. doi: 10.1016/j.neulet.2017.01.003. [Epub ahead of print]*

Is it possible to regulate the functional properties of abnormally developed spinal neuronal locomotor networks using transcutaneous spinal cord stimulation? This question has been studied in twenty-eight participants (~9 yrs) with spastic cerebral palsy, and mainly Gross Motor Function Classification System for Cerebral Palsy level III. The participants were randomly assigned to two groups. The experimental group received transcutaneous spinal cord stimulation at two spinal levels (over T11 and L1 spinous processes), combined with locomotor treadmill training, whereas the participants of the control group received locomotor treadmill training only. After spinal cord stimulation in the experimental group we found an incremental increase in knee torque whereas in the control group this effect was absent. The amplitude of hip motion increased in both groups. A decrease of co-activation of hip and muscles of the lower extremities was observed in the experimental group while in the control group co-activation decreased only in hip muscles. The results support the idea that locomotor function can be improved significantly with the combination of training and transcutaneous spinal cord stimulation than with training alone.

DOI: 10.1016/j.neulet.2017.01.003
PMID: 28063935 [PubMed - as supplied by publisher]

## Réalité virtuelle - Jeux video

**Balance improvement after physical therapy training using specially developed serious games for cerebral palsy children: preliminary results.**

Bonnechère B, Omelina L, Jansen B, Van Sint Jan S.

*Disabil Rehabil. 2017 Feb;39(4):403-406. doi: 10.3109/09638288.2015.1073373. Epub 2015 Aug 3.*

PURPOSE: Cerebral palsy (CP) leads to various clinical signs mainly induced by muscle spasticity and muscle weakness. Among these ones impaired balance and posture are very common. Traditional physical therapy exercise programs are focusing on this aspect, but it is difficult to motivate patients to regularly perform these exercises, especially at home without therapist supervision. Specially developed serious games (SG) could therefore be an interesting option to motivate children to perform specific exercise for balance improvement.
METHOD: Ten CP children participated in this study. Patients received four sessions of SG included into conventional therapy (1 session of 30 min a week during 4 weeks). Trunk control and balance were assessed using Trunk Control Motor Scale (TCMS) before and after interventions.

RESULTS: Children presented a significant improvement in TCMS global score after interventions [37.6 (8.7) and 39.6 (9.5) before and after interventions, respectively, p = 0.04].
CONCLUSION: SG could therefore be an interesting option to integrate in the conventional treatment of CP children. Implication for Rehabilitation Cerebral palsy (CP) leads to balance issues. Rehabilitation exercises are not performed (enough) at home. Serious games (SG) could increase patients' motivation. SG increase balance control of CP children.
DOI: 10.3109/09638288.2015.1073373
PMID: 28033958 [PubMed - in process]

**Effectiveness of virtual reality rehabilitation for children and adolescents with cerebral palsy: an updated evidence-based systematic review.**
Ravi DK, Kumar N, Singhi P.
*Physiotherapy. 2016 Sep 27. pii: S0031-9406(16)30064-5. doi: 10.1016/j.physio.2016.08.004. [Epub ahead of print]*

BACKGROUND: The use of virtual reality systems in the motor rehabilitation of children with cerebral palsy is new, and thus the scientific evidence for its effectiveness needs to be evaluated through a systematic review.
OBJECTIVE: To provide updated evidence-based guidance for virtual reality rehabilitation in sensory and functional motor skills of children and adolescents with cerebral palsy.
DATA SOURCES: PubMed, PEDro, Web of Science, OTseeker, PsycINFO and Cochrane Library were searched from their earliest records up to 1 June, 2016.
STUDY SELECTION: Two reviewers applied the population intervention comparison outcome (PICO) question to screen the studies for this review.
DATA EXTRACTION: Information on study design, subjects, intervention, outcome measures and efficacy results were extracted into a pilot-tested form. Method quality was assessed independently by two reviewers using the Downs and Black checklist.
DATA SYNTHESIS: Thirty-one studies included 369 participants in total. Best evidence synthesis was applied to summarize the outcomes, which were grouped according to International Classification of Functioning, Disability and Health. Moderate evidence was found for balance and overall motor development. The evidence is still limited for other motor skills.
CONCLUSIONS: This review uncovered additional literature showing moderate evidence that virtual reality rehabilitation is a promising intervention to improve balance and motor skills in children and adolescents with cerebral palsy. The technique is growing, so long-term follow-up and further research are required to determine its exact place in the management of cerebral palsy.
Systematic review registration number PROSPERO 2015:CRD42015026048.

DOI: 10.1016/j.physio.2016.08.004
PMID: 28109566 [PubMed - as supplied by publisher]

**The Effect of Additional Virtual Reality Training on Balance in Children with Cerebral Palsy after Lower Limb Surgery: A Feasibility Study.**
Meyns P, Pans L, Plasmans K, Heyrman L, Desloovere K, Molenaers G.
*Games Health J. 2017 Jan 4. doi: 10.1089/g4h.2016.0069. [Epub ahead of print]*

OBJECTIVE: Impaired balance is disabling for children with cerebral palsy (CPc), especially for CPc who recently underwent lower limb surgery. Positive results of using virtual reality (VR) in balance rehabilitation have been published in several outpatient populations. We investigated the feasibility of applying additional VR training focused on sitting balance in CP inpatients of a rehabilitation center after lower limb surgery. Additionally, we investigated the rate of enjoyment of VR training compared with conventional physiotherapy.
MATERIALS AND METHODS: Eleven spastic CPc (4/7 males/females) following rehabilitation after lower limb orthopedic surgery were included (5-18 years). The control group received conventional physiotherapy. The intervention group received additional VR training. Balance was measured using the Trunk Control Measurement Scale every 3 weeks of the rehabilitation period. Enjoyment was analyzed using a 10-point Visual Analog Scale.

RESULTS: Providing additional VR training was feasible in terms of recruitment, treatment adherence, and assessment adherence. Both groups improved sitting balance after therapy. The current games were not perceived as more enjoyable than conventional physiotherapy.
CONCLUSION: Including additional VR training to conventional physiotherapy is feasible and might be promising to train sitting balance in CPc after lower limb surgery. Future research should take equal patient allocation and training duration between groups into consideration.
DOI: 10.1089/g4h.2016.0069
PMID: 28051880 [PubMed - as supplied by publisher]

**Training to use a commercial brain-computer interface as access technology: a case study.**
Taherian S, Selitskiy D, Pau J, Davies TC, Owens RG
*Disabil Rehabil Assist Technol. 2016;11(4):345-50. doi: 10.3109/17483107.2014.967313. Epub 2014 Oct 1.*

PURPOSE: This case study describes how an individual with spastic quadriplegic cerebral palsy was trained over a period of four weeks to use a commercial electroencephalography (EEG)-based brain-computer interface (BCI).
METHOD: The participant spent three sessions exploring the system, and seven sessions playing a game focused on EEG feedback training of left and right arm motor imagery and a customised, training game paradigm was employed.
RESULTS: The participant showed improvement in the production of two distinct EEG patterns. The participant's performance was influenced by motivation, fatigue and concentration. Six weeks post-training the participant could still control the BCI and used this to type a sentence using an augmentative and alternative communication application on a wirelessly linked device.
CONCLUSIONS: The results from this case study highlight the importance of creating a dynamic, relevant and engaging training environment for BCIs. Implications for Rehabilitation Customising a training paradigm to suit the users' interests can influence adherence to assistive technology training. Mood, fatigue, physical illness and motivation influence the usability of a brain-computer interface. Commercial brain-computer interfaces, which require little set up time, may be used as access technology for individuals with severe
disabilities.
DOI: 10.3109/17483107.2014.967313
PMID: 25270615 [PubMed - indexed for MEDLINE]

## Thérapies cellulaires

**Concise Review: Stem Cell Interventions for People With Cerebral Palsy: Systematic Review With Meta-Analysis.**
Novak I, Walker K, Hunt RW, Wallace EM, Fahey M, Badawi N.
*Stem Cells Transl Med. 2016 Aug;5(8):1014-25. doi: 10.5966/sctm.2015-0372. Epub 2016 May 31.*

Evidence for stem cells as a potential intervention for cerebral palsy is emerging. Our objective was to determine the efficacy and safety of stem cells for improving motor and cognitive function of people with cerebral palsy.Searches were conducted in October 2015 in CENTRAL, EMBASE, MEDLINE, and Cochrane Libraries. Randomized controlled trials and controlled clinical trials of stem cells for cerebral palsy were included. Two authors independently decided upon included trials, extracted data, quality, and risk of bias. The primary outcome was gross motor function. Secondary outcomes were cognitive function and adverse events (AEs). Effects were expressed as standardized mean differences (SMD) with 95% confidence intervals (CI), using a random-effects model. Five trials comprising 328 participants met inclusion criteria. Four cell types were studied: olfactory ensheathing, neural, neural progenitors, and allogeneic umbilical cord blood (UCBs). Transplantation procedures differed from central nervous system neurosurgical transplantation to intravenous/arterial infusion. Participants were followed short-term for only 6 months. Evidence of variable quality indicated a small statistically significant intervention effect from stem cells on gross motor skills (SMD 1.27; 95% CI 0.22, 2.33), with UCBs most effective. There were insufficient and heterogeneous data to compare cognitive effects. Serious Aes were rare (n = 4/135 [3%] stem cells; n = 3/139 [2%] controls). Stem cells appeared to induce short-term improvements in motor skills. Different types of stem cell interventions were compared, meaning the data were heterogeneous and are a study limitation. Further randomized controlled trials are warranted, using rigorous methodologies.
SIGNIFICANCE: Stem cells are emerging as a scientifically plausible treatment and possible cure for cerebral palsy, but are not yet proven. The lack of valid animal models has significantly hampered the scope of clinical trials. Despite the state of current treatment evidence, parents remain optimistic about the potential improvements from

stem cell intervention and feel compelled to exhaust all therapeutic options, including stem cell tourism. Receiving unproven therapies from unvalidated sources is potentially dangerous. Thus it is essential that researchers and clinicians stay up to date. A systematic review and meta-analysis summarizing and aggregating current research data may provide more conclusive evidence to inform treatment decision making and help direct future research.

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PMCID: PMC4954458 [Available on 2017-08-01]
PMID: 27245364 [PubMed - indexed for MEDLINE]

**Neuroregenerative potential of intravenous G-CSF and autologous peripheral blood stem cells in children with cerebral palsy: a randomized, double-blind, cross-over study.**
Rah WJ, Lee YH, Moon JH, Jun HJ, Kang HR, Koh H, Eom HJ, Lee JY, Lee YJ, Kim JY, Choi YY, Park K, Kim MJ, Kim SH.
*J Transl Med. 2017 Jan 21;15(1):16. doi: 10.1186/s12967-017-1120-0.*

OBJECTIVE: We performed a randomized, double-blind, cross-over study to assess the neuroregenerative potential of intravenous granulocyte colony-stimulating factor (G-CSF) followed by infusion of mobilized peripheral blood mononuclear cells (mPBMCs) in children with cerebral palsy (CP).
METHODS: Children with non-severe CP were enrolled in this study. G-CSF was administered for 5 days, then mPBMCs were collected by apheresis and cryopreserved. One month later (M1), recipients were randomized to receive either mPBMCs or a placebo infusion, and these treatment groups were switched at 7 months (M7) and observed for another 6 months (M13). We assessed the efficacy of treatment by evaluating neurodevelopmental tests, as well as by brain magnetic resonance imaging-diffusion tensor imaging (MRI-DTI) and (18)F-fluorodeoxyglucose (FDG) brain positron emission tomography-computed tomography (PET-CT) scanning to evaluate the anatomical and functional changes in the brain.
RESULTS: Fifty-seven patients aged 4.3 ± 1.9 (range 2-10) years and weighing 16.6 ± 4.9 (range 11.6-56.0) kg were enrolled in this study. The administration of G-CSF as well as the collection and reinfusion of mPBMCs were safe and tolerable. The yield of mPBMCs was comparable to that reported in studies of pediatric donors without CP and patients with nonhematologic diseases. 42.6% of the patients responded to the treatment with higher neurodevelopmental scores than would normally be expected. In addition, larger changes in neurodevelopment test scores were observed in the 1 month after G-CSF administration (M0-M1) than during the 6 months after reinfusion with mPBMCs or placebo (M1-M7 or M7-M13).Patients who received G-CSF followed by mPBMC infusion at 7 months (T7 group) demonstrated significantly more neurodevelopmental improvement than patients who received G-CSF followed by mPBMC infusion at 1 month (T1 group). In contrast to the results of neurodevelopment tests, the results of MRI-DTI at the end of this study showed greater improvement in the T1 group. Although we observed metabolic changes to the cerebellum, thalamus and cerebral cortex in the (18)F-FDG brain PET-CT scans, there were no significant differences in such changes between the mPBMC and placebo group or between the T1 and T7 group.
CONCLUSIONS: Neurodevelopmental improvement was seen in response to intravenous G-CSF followed by mPBMC reinfusion, particularly to the G-CSF alone even without mPBMC reinfusion. Further studies using a larger number of mPBMCs for the infusion which could be collected by repeated cycles of apheresis or using repeated cycles of G-CSF alone, are needed to clarify the effect of mPBMC reinfusion or G-CSF alone (Trial registration: ClinicalTrials.gov, NCT02983708.
Registered 5 December, 2016, retrospectively registered).
DOI: 10.1186/s12967-017-1120-0
PMID: 28109298 [PubMed - in process]

**Stem cells therapy in cerebral palsy: A systematic review.**
Kułak-Bejda A, Kułak P, Bejda G, Krajewska-Kułak E, Kułak W
*Brain Dev. 2016 Sep;38(8):699-705. doi: 10.1016/j.braindev.2016.03.002. Epub 2016 Apr 20.*

The aim of this study was to systematically present the best available stem cell therapies for children with cerebral palsy (CP). The databases Medline, PubMed, EMBASE, and the Cochrane Controlled Trials Register for RCTs were searched for studies published from 1967 to August 2015. Systematic reviews, randomised controlled trials (RCTs), controlled trials, uncontrolled trials, cohort studies, open-label studies, and a meta-analysis were analysed. Of 360 articles, seven fulfilled the inclusion criteria: one RCT and six were open-label trials. In these studies, one application

of stem cells for children with CP was typical, and the total number of cells administered to patients ranged from 10(6) to 10(8)/kg. Different routes of cell delivery were used, though in most studies motor development was applied as an indicator of primary outcomes. In three articles, neuroimaging studies were also implemented to confirm the efficacy of the therapies. Observation periods varied from 3months to 5years, and patients'tolerance of the therapy was generally good. Stem cell therapy may improve some symptoms in patients with CP, though larger studies are needed to examine the impact of stem cell therapy upon CP.

DOI: 10.1016/j.braindev.2016.03.002
PMID: 27004672 [PubMed - indexed for MEDLINE]

## Modèles animaux

**Association of environmental enrichment and locomotor stimulation in a rodent model of cerebral palsy: Insights of biological mechanisms.**
Meireles AL, Marques MR, Segabinazi E, Spindler C, Piazza FV, Salvalaggio GS, Augustin OA, Achaval M, Marcuzzo S.
*Brain Res Bull. 2016 Dec 7;128:58-67. doi: 10.1016/j.brainresbull.2016.12.001. [Epub ahead of print]*

Several physiotherapy approaches are used with different aims in the treatment of cerebral palsy (CP), such as the early stimulation and the locomotor training, but their biological effects, isolated or combined, are not completely known. In animals models, these strategies can be compared, with due translational restrictions, to the environmental enrichment (EE), that involves the enhancement of animal's physical and social environment, and locomotor stimulation (LS), that can be performed using the treadmill adapted for rats. This study was designed to describe which biological and functional mechanisms underlying rehabilitative process in clinical practice. Male rat pups were initially divided in two groups: control (healthy) and submitted to a CP model. Then, pups were divided in eight groups: CP, CPEE, CPLS, CPEELS and its respectively control groups. Functional outcomes were assessed at the postnatal day (P) 31 and P52. The tibialis anterior and soleus muscles, tibia bone parameters, the expression of synaptophysin in the primary motor cortex (M1) and ventral horn (VH) of the spinal cord, were evaluated. The association of therapies was able to improve the functional assessments and musculoskeletal parameters. Isolated therapies presented complementary benefits in CP, but the association of therapies proved to be a fundamental and effective strategy to functional recovery, besides alter positively all biological tissues evaluated in this study.

DOI: 10.1016/j.brainresbull.2016.12.001
PMID: 27940102 [PubMed - as supplied by publisher]

## Autres

**Acupuncture for Children with Cerebral Palsy: A Systematic Review Protocol.**
Guo T, Zhu B, Zhang Q, Yang Y, He Q, Zhang X, Tai X
*JMIR Res Protoc. 2017 Jan 5;6(1):e2. doi: 10.2196/resprot.5944.*

BACKGROUND: Cerebral palsy (CP), a childhood disease of high morbidity and serious harmfulness, has no effective therapies to completely relieve the associated pain. Acupuncture has been used widely in China to alleviate several CP symptoms, such as pain and motion disorders, despite the deficiency of high-quality evidence related to this practice.
OBJECTIVE: The aim of this systematic review protocol is to assess the efficacy and safety of acupuncture for the treatment of children with CP.
METHODS: The following electronic databases will be searched: Cochrane Library, Web of Science, EBASE, Springer, World Health Organization International Clinical Trials Registry Platform, China National Knowledge Infrastructure, Wan-fang database, Chinese Biomedical Literature Database, Chinese Scientific Journal Database, and other sources. All published randomized controlled trials from inception to December 2016 will be included. RevMan V.5.3 software will be implemented for the assessment of bias risk, data synthesis, subgroup analysis, and meta-analyses if inclusion conditions are met. Individuals recruited into the trials will include children with all types of CP, and these individuals will be involved as coresearchers to develop and evaluate the efficacy and safety of acupuncture for the treatment of children with CP. Due to language barriers, only English and Chinese articles will be retrieved.

RESULTS: The systematic review will synthesize the available knowledge surrounding acupuncture for children with CP. The findings will be synthesized to determine the efficacy and safety of acupuncture for children with CP. CONCLUSIONS: The review has not been completed. This protocol presents a proper method to implement the systematic review, and ensures transparency for the completed review. Findings from the systematic review will be disseminated in a peer-reviewed journal and results will be presented at relevant conferences. The data of individual patients will not be included, so ethical approval is not required.
TRIAL REGISTRATION: PROSPERO registration number: CRD42016038275,
http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42016038275 (Archived by WebCite at http://www.webcitation/6nGxoJrqm.
**Free Article**
DOI: 10.2196/resprot.5944
PMID: 28057608 [PubMed - in process]

**Attitudes to and beliefs about animal assisted therapy for children with disabilities**.
Yap E, Scheinberg A, Williams K.
*Complement Ther Clin Pract. 2017 Feb;26:47-52. doi: 10.1016/j.ctcp.2016.11.009. Epub 2016 Nov 24.*

OBJECTIVES: This study assessed the attitudes and beliefs surrounding animal-assisted therapy (AAT) for the rehabilitation of children with disabilities at the Royal Children's Hospital (RCH), focusing specifically on cerebral palsy (CP), autism spectrum disorder (ASD) and acquired brain injury (ABI). This was an initial step to inform future AAT research and to understand the feasibility of interventions.
DESIGN/SETTING/OUTCOME MEASURES: An online survey asking participants their opinions about the inclusion of AAT, and potential barriers to its introduction in a tertiary hospital setting was advertised on the RCH Intranet from 3 March 2015 to 3 April 2015.
RESULTS: A total of 128 participants responded to the survey request, from a range of specialties and departments. Almost all survey respondents reported that animal-assisted therapy would be helpful in the physical or behavioral management of children affected by CP (98%), ASD (99%) and ABI (96%), and 98% of survey respondents supported the inclusion of AAT in the RCH. Ninety-two percent recommended AAT in the inpatient setting and 52% of the respondents suggest that it should be administered as a pre-determined program with set activities. Additionally, qualitative responses provided suggestions that AAT should be used to provide comfort in high stress environments such as prior to medical and surgical procedures.
CONCLUSIONS: The majority of staff are supportive of the inclusion of AAT in the RCH, indicating more research is needed to establish whether AAT is acceptable to children and families as part of their care.

DOI: 10.1016/j.ctcp.2016.11.009
PMID: 28107849 [PubMed - in process]

**Changes in Cardiorespiratory Responses and Kinematics With Hippotherapy in Youth With and Without Cerebral Palsy.**
Rigby BR, Gloeckner AR, Sessums S, Lanning BA, Grandjean PW.
*Res Q Exerc Sport. 2017 Jan 11:1-10. doi: 10.1080/02701367.2016.1266458. [Epub ahead of print]*

PURPOSE: The purpose of this study was to characterize pelvic displacement and cardiorespiratory responses to simulated horseback riding and walking in youth with cerebral palsy and to compare responses to youth without cerebral palsy before and after 8 weeks of hippotherapy.
METHOD: Eight youth with cerebral palsy (Mage = 10 ± 4 years; Mheight = 137 ± 24 cm; Mweight = 32 ± 16 kg) and 8 youth without cerebral palsy (Mage = 11 ± 2 years; Mheight = 149 ± 14 cm; Mweight = 48 ± 15 kg) underwent a hippotherapy intervention. Participants completed simulated horseback riding at an intensity approximating a fast walk (0.65 Hz) and walked on a treadmill (1 mph, 0% grade) before and after hippotherapy. Pelvic displacement along the anterior-posterior, vertical, and medial-lateral axes, heart rate, oxygen consumption, ventilation, and blood pressure were measured at rest and during steady-state exercise in both exercise modes.
RESULTS: Kinematics and cardiorespiratory responses were similar between the 2 groups during simulated horseback riding ($p > .05$ for all) before the intervention. Significantly greater cardiorespiratory responses were observed in the youth with cerebral palsy compared with the group without cerebral palsy while walking before and after the intervention ($p < .05$, effect sizes 26% to 237% greater). Eight weeks of hippotherapy did not alter

responses, but anecdotal improvements in gait, balance, posture, and range of motion were observed in those with cerebral palsy.
CONCLUSION: These results contribute to our understanding regarding the efficacy of hippotherapy as an intervention to improve functional abilities in those with cerebral palsy.
DOI: 10.1080/02701367.2016.1266458
PMID: 28075704 [PubMed - as supplied by publisher]

**Laser acupuncture as an adjunctive therapy for spastic cerebral palsy in children.**
Dabbous OA, Mostafa YM, El Noamany HA, El Shennawy SA, El Bagoury MA
*Lasers Med Sci. 2016 Aug;31(6):1061-7. doi: 10.1007/s10103-016-1951-6. Epub 2016 May 4.*

Laser acupuncture is widely used as an alternative line of treatment in several chronic pediatric diseases. To investigate whether biostimulation by low-level laser on acupuncture points adds a clinical benefit to conventional physiotherapy in hemiplegic spastic cerebral palsy (CP) children. Forty spastic hemiplegic cerebral palsy children by age 1-4 years were chosen from the pediatric outpatient clinic of the National Institute of Laser Enhanced Sciences (NILES), Cairo University, and Menofyia University hospitals. They were randomly divided into control and study groups; 20 children each. Both groups received physiotherapy for 3 months, while only the study group also received laser acupuncture (low-level laser 650 nm with 50 mW power was applied at each acupoint for 30 s giving an energy density of 1.8 J/cm(2)). Preassessment and postassessment of muscle tone, the range of motion (ROM), and gross motor function measurements (GMFMs) were obtained, and the results were statistically analyzed. Comparison between posttreatment measures for the control vs. Study groups showed significant difference in muscle tone (wrist flexors and plantar flexors) in favor of the study group, while range of motion showed no significant differences. GMFM showed no significant difference in total score while there was a significant difference in goal total score (sum of % scores for each dimension identified as goal area divided by number of goal areas) in favor of the study group. Laser acupuncture has a beneficial effect on reducing spasticity in spastic cerebral palsy and may be helpful in improving their movement.
DOI: 10.1007/s10103-016-1951-6
PMID: 27147077 [PubMed - indexed for MEDLINE]

**Protocol for a prospective observational study of conventional treatment and traditional Korean medicine combination treatment for children with cerebral palsy.**
Yoo JE, Yun YJ, Shin YB, Kim NK, Kim SY, Shin MJ, Yu SA
*BMC Complement Altern Med. 2016 Jun 8;16:172. doi: 10.1186/s12906-016-1161-6.*

BACKGROUND: Cerebral palsy leads to many complications as well as delayed motor development, and early intensive rehabilitation in infancy, which is based on the theory of brain plasticity, is emphasized. In addition to conventional treatment, including physical, occupational, or speech-language therapies, children also have a demand for traditional Korean medicine interventions such as acupuncture or herbal medicine; however, a lack of evidence has made traditional Korean medicine difficult to implement in practice. We planned a multicentre, prospective, observational study to assess the effectiveness, safety and cost-effectiveness of conventional treatment and traditional Korean medicine combination treatment for children with cerebral palsy.
METHODS/DESIGN: Three hundred children with cerebral palsy aged 6 to 78 months will be recruited from six institutions. Data from each child are collected every month for a one-year period, during which time treatment might be changed or discontinued. A qualified investigator visits the sites to measure effectiveness variables, including Gross Motor Function Measure and Paediatric Evaluation of Disability Inventory. Adverse events and cost-effectiveness variables are collected using surveys conducted at baseline, mid-study, and end of study, as well as monthly tracking surveys. In the analyses, participants will be classified into two groups: group A children will be the conventional treatment group with physical, occupational, speech-language or other conventional rehabilitation therapies, whereas group B children will be the combination treatment group with traditional Korean medicine interventions, that is, herbal medicine, chuna, moxibustion and acupuncture, in addition to conventional treatment.
DISCUSSION: Only a few clinical case reports have evaluated the effectiveness and safety of traditional Korean medicine; therefore, more data are required to provide optimal information to children with cerebral palsy and their guardians. We hypothesized that traditional Korean medicine combination treatment for children with cerebral palsy would have benefits compared with conventional therapy alone. The findings of this study might provide

informative data for conducting economic evaluations and developing clinical research on combination treatment for cerebral palsy in South Korea.
TRIAL REGISTRATION: NCT02223741.
Free PMC Article
DOI: 10.1186/s12906-016-1161-6
PMCID: PMC4897905
PMID: 27267182 [PubMed - indexed for MEDLINE]

**What is hippotherapy? The indications and effectiveness of hippotherapy.**
Koca TT, Ataseven H
*North Clin Istanb. 2016 Jan 15;2(3):247-252. doi: 10.14744/nci.2016.71601. eCollection 2015.*

Hippotherapy is a form of physical, occupational and speech therapy in which a therapist uses the characteristic movements of a horse to provide carefully graded motor and sensory input. A foundation is established to improve neurological function and sensory processing, which can be generalized to a wide range of daily activities. Unlike therapeutic horseback riding (where specific riding skills are taught), the movement of the horse is a means to a treatment goal when utilizing hippotherapy as a treatment strategy. Hippotherapy has been used to treat patients with neurological or other disabilities, such as autism, cerebral palsy, arthritis, multiple sclerosis, head injury, stroke, spinal cord injury, behavioral disorders and psychiatric disorders. The effectiveness of hippotherapy for many of these indications is unclear, and more research has been needed. Here, we purpose to give information about hippotherapy which is not known adequately by many clinicians and health workers.
Free PMC Article
DOI: 10.14744/nci.2016.71601
PMCID: PMC5175116
PMID: 28058377 [PubMed - in process]

## Langage – Communication

**Assessment With Children Who Need Augmentative and Alternative Communication (AAC): Clinical Decisions of AAC Specialists.**
Lund SK, Quach W, Weissling K, McKelvey M, Dietz A
*Lang Speech Hear Serv Sch. 2017 Jan 18:1-13. doi: 10.1044/2016_LSHSS-15-0086. [Epub ahead of print]*

Purpose: The purpose of this study was to explore how speech-language pathologists (SLPs) who are augmentative and alternative communication (AAC) specialists approach the assessment process for 2 case studies, 1 child with cerebral palsy and 1 with autism spectrum disorder. The aim of the study was to answer the following questions: (a) How do clinicians with expertise approach the AAC assessment process for children with developmental disabilities? (b) Can any initial hypothesis be drawn about how SLPs approach the assessment of children with motor versus social interactive deficits?
Method: This study used a phenomenological qualitative design. The researchers conducted 2 in-depth, semistructured interviews with 8 SLPs who specialized in AAC and self-identified as primarily working with children.
Results: Four major themes emerged from the data: area of assessment, method of assessment, evaluation preparation, and parent education. Each major theme contained multiple subthemes and categories within those subthemes.
Conclusions: Participants discussed similar areas of assessment for both cases, indicating that some aspects of AAC assessment are universal. However, the specific aspects of what they were assessing and how they went about assessing them differed between the 2 cases. The results of the current study provide an outline of an assessment protocol for children with complex communication needs.
DOI: 10.1044/2016_LSHSS-15-0086
PMID: 28114681 [PubMed - as supplied by publisher]

**Single-Trial Analysis of Inter-Beat Interval Perturbations Accompanying Single-Switch Scanning: Case Series of Three Children With Severe Spastic Quadriplegic Cerebral Palsy.**
Leung B, Chau T.
*IEEE Trans Neural Syst Rehabil Eng. 2016 Feb;24(2):261-71. doi:10.1109/TNSRE.2015.2441737. Epub 2015 Jun 8.*

Single-switch access in conjunction with scanning remains a fundamental solution in restoring communication for many children with profound physical disabilities. However, untimely switch inaction and unintentional switch activations can lead to user frustration and impede functional communication. A previous preliminary study, in the context of a case series with three single-switch users, reported that correct, accidental and missed switch activations could elicit cardiac deceleration and increased phasic skin conductance on average, while deliberate switch non-use was associated with autonomic nonresponse. The present study investigated the possibility of using blood volume pulse recordings from the same three pediatric single-switch users to track the aforementioned switch events on a single-trial basis. Peaks of the line length time series derived from the empirical mode decomposition of the inter-beat interval time series matched, on average, a high percentage (above 80%) of single-switch events, while unmatched peaks coincided moderately (below 37%) with idle time during scanning. These results encourage further study of autonomic measures as complementary information channels to enhance single-switch access.
DOI: 10.1109/TNSRE.2015.2441737
PMID: 26068545 [PubMed - indexed for MEDLINE]

**The Impact of Contrastive Stress on Vowel Acoustics and Intelligibility in Dysarthria.**
Connaghan KP, Patel R
*J Speech Lang Hear Res. 2017 Jan 1;60(1):38-50. doi: 10.1044/2016_JSLHR-S-15-0291.*

Purpose: To compare vowel acoustics and intelligibility in words produced with and without contrastive stress by speakers with spastic (mixed-spastic) dysarthria secondary to cerebral palsy (DYSCP) and healthy controls (HCs).
Method: Fifteen participants (9 men, 6 women; age M = 42 years) with DYSCP and 15 HCs (9 men, 6 women; age M = 36 years) produced sentences containing target words with and without contrastive stress. Forty-five healthy listeners (age M = 25 years) completed a vowel identification task of DYSCP productions. Vowel acoustics were compared across stress conditions and groups using 1st (F1) and 2nd (F2) formant measures. Perceptual intelligibility was compared across stress conditions and dysarthria severity.
Results: F1 and F2 significantly increased in stressed words for both groups,although the degree of change differed. Mean Euclidian distance between vowels also increased with stress. The relative probability of vowels falling within the target F1 × F2 space was greater for HCs but did not differ with stress. Stress production resulted in greater listener vowel identification accuracy for speakers with mild dysarthria.
Conclusions: Contrastive stress affected vowel formants for both groups. Perceptual results suggest that some speakers with dysarthria may benefit from a contrastive stress strategy to improve vowel intelligibility.
DOI: 10.1044/2016_JSLHR-S-15-0291
PMID: 28114612 [PubMed - in process]

## Douleur

**Pain extent and function in youth with physical disabilities.**
Miró J, de la Vega R, Tomé-Pires C, Sánchez-Rodríguez E, Castarlenas E, Jensen MP(, Engel JM.
*J Pain Res. 2017 Jan 5;10:113-120. doi: 10.2147/JPR.S121590. eCollection 2017.*

BACKGROUND: The aim of this study was to increase our understanding of the role that spatial qualities of pain (location and extent) play in functioning, among youths with disabilities and chronic pain.
METHODS: One-hundred and fifteen youths (mean age 14.4 years; SD ±3.3 years) with physical disabilities and chronic pain were interviewed and were asked to provide information about pain locations and their average pain intensity in the past week, and to complete measures of pain interference, psychological function and disability. Most of the participants in this sample were males (56%), Caucasian (68%), and had a cerebral palsy (34%) or muscular dystrophy (25%) problem. Most participants did not report high levels of disability ( [Formula: see text], SD ±9.5, range 0-60) or global pain intensity ( [Formula: see text], SD ±2.4, range 0-10).
RESULTS: Pain at more than one body site was experienced by 91% of participants. There were positive associations between pain extent with pain interference (r = 0.30) and disability (r = 0.30), and a negative association with psychological function (r = -0.38), over and above average pain intensity. Additionally, pain intensity in the back (as opposed to other locations) was associated with more pain interference (r = 0.29), whereas pain intensity in the shoulders was associated with less psychological function (r = -0.18), and pain intensity in the bottom or hips was associated with more disability (r = 0.29).

CONCLUSION: The findings support the need to take into account pain extent in the assessment and treatment of youths with physical disabilities and chronic pain, call our attention about the need to identify potential risk factors of pain extent, and develop and evaluate the benefits of treatments that could reduce pain extent and target pain at specific sites.

**Free Article**

DOI: 10.2147/JPR.S121590
PMID: 28115871 [PubMed - in process]

# Autres Troubles / Troubles concomitants

## Troubles respiratoires

**Change in Pulmonary Function after Incentive Spirometer Exercise in Children with Spastic Cerebral Palsy: A Randomized Controlled Study.**

Choi JY, Rha DW, Park ES

*Yonsei Med J. 2016 May;57(3):769-75. doi: 10.3349/ymj.2016.57.3.769.*

PURPOSE: The aim of this study was to investigate the effect of incentive spirometer exercise (ISE) on pulmonary function and maximal phonation time (MPT) in children with spastic cerebral palsy (CP).

MATERIALS AND METHODS: Fifty children with CP were randomly assigned to two groups: the experimental group and the control group. Both groups underwent comprehensive rehabilitation therapy. The experimental group underwent additional ISE. The forced vital capacity (FVC), forced expiratory volume at one second ($FEV_1$), $FEV_1$/FVC ratio, peak expiratory flow (PEF), and MPT were assessed as outcome measures before and after 4 weeks of training.

RESULTS: There were significant improvements in FVC, $FEV_1$, PEF, and MPT in the experimental group, but not in the control group. In addition, the improvements in FVC, $FEV_1$, and MPT were significantly greater in the experimental group than in the control group.

CONCLUSION: The results of this randomized controlled study support the use of ISE for enhancing pulmonary function and breath control for speech production in children with CP.

**Free PMC Article**

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PMCID: PMC4800370
PMID: 26996580 [PubMed - indexed for MEDLINE]

## Troubles musculosquelettiques, des tissus conjonctifs et osseux

**Optimizing bone health in cerebral palsy across the lifespan.**

Trinh A, Fahey MC, Brown J, Fuller PJ, Milat F.

*Dev Med Child Neurol. 2017 Feb;59(2):232-233. doi: 10.1111/dmcn.13355.*

**Free Article**

DOI: 10.1111/dmcn.13355
PMID: 28044317 [PubMed - in process]

## Nutrition – Troubles nutritionnels

**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, Benfer KA, Bell KL.

*Am J Clin Nutr. 2017 Jan 11. pii: ajcn137810. doi: 10.3945/ajcn.116.137810. [Epub ahead of print]*

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 ± SD recruitment age: 2.8 ± 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.

DOI: 10.3945/ajcn.116.137810
PMID: 28077375 [PubMed - as supplied by publisher]

**Complications of PEG are not related to age - The result of 10-year multicenter survey.**
Szlagatys-Sidorkiewicz A, Borkowska A, Popińska K, Toporowska-Kowalska E, Grzybowska-Chlebowczyk U, Wernicka A, Hapyn E, Sibilska M, Gębora-Kowalska B, Więcek S, Zagożdżon P, Kierkuś J
*Adv Med Sci. 2016 Mar;61(1):1-5. doi: 10.1016/j.advms.2015.07.006. Epub 2015 Aug 8.*

PURPOSE: The aim of this study was to analyze whether the insertion of Percutaneous Endoscopic Gastrostomy (PEG) during infancy is related to higher
morbidity. Moreover, we analyzed the structure of indications to PEG placement in various age groups of pediatric patients.
MATERIAL/METHODS: The study involved medical data of children after PEG insertion from six Polish endoscopic centers: infants (<12 months of age), toddlers (12-36 months), and preadolescents (>36 months).
RESULTS: The overall prevalence of early complications associated with PEG insertion was 5.14%; while they were noted in infants and preadolescents, none were recorded in toddlers. The analyzed age groups did not differ significantly in terms of the prevalence of late complications. Cerebral palsy (34.86%) and other chronic neurological conditions (34.29%) were the most frequent indications to PEG insertion in the whole group. Patients with congenital heart defects and multiple defect syndrome were inserted PEG at the youngest age; in contrast, the age at insertion was the highest in cystic fibrosis patients.
CONCLUSIONS: The early qualification to nutritional intervention via endoscopically formed gastrostomy can have important clinical implications with regards to improved therapeutic outcomes and reduced morbidity rates.

DOI: 10.1016/j.advms.2015.07.006
PMID: 26342669 [PubMed - indexed for MEDLINE]

**The nutritional state of children and adolescents with cerebral palsy is associated with oral motor dysfunction and social conditions: a cross sectional study.**
Pinto VV, Alves LA, Mendes FM , Ciamponi AL.
*BMC Neurol. 2016 Apr 26;16:55. doi: 10.1186/s12883-016-0573-8.*

BACKGROUND: Cerebral palsy (CP) is the main cause of severe physical impairment during childhood and has commonly shown oral motor association. It has been considered as the main cause of the high prevalence of problems in children's nutrition. Respiration, chewing, swallowing, speaking and facial expressionare part of the orofacial motor functions and when affected they can interfere in children's well-being. The aim of this study was to correlate two methods of orofacial motor evaluation, analyze the influence of orofacial motor functional impairment on the nutritional status of children and adolescents with CP, and the association between socioeconomic factors.
METHODS: Seventy children and adolescents with CP were selected, age range 6-16 years and following the exclusion criteria previously determined; 129 normoreactive children (control group), sex and age-matched to patients with CP. For the orofacial motor analysis two evaluation instruments were applied, the "Oral Motor

Assessment Scale" (OMAS) and "Nordic Orofacial Test-Screening" (NOT-S). The anthropometric evaluation was based on the World Health Organization (WHO) and followed the criteria recommended by the Brazilian Ministry of Health. RESULTS: There was statistically significant correlation between the oral motor methods of evaluation ($r = -0.439$, $p < 0.0001$). Concerning the nutritional status evaluation, being overweight was associated with dystonic and mixed CP forms variables ($p = 0.034$), mother with no partnership ($p = 0.045$) and mild oral motor impairment ($p = 0.028$). CONCLUSION: It could be concluded that, the weight's gain by children and adolescents might be favored by a better functional oral motor performance and social factors.

**Free PMC Article**

DOI: 10.1186/s12883-016-0573-8
PMCID: PMC4847222
PMID: 27117791 [PubMed - indexed for MEDLINE]

## Sphère bucco-dentaire – Troubles de la déglutition

**A Virtual Environment to Improve the Detection of Oral-Facial Malfunction in Children with Cerebral Palsy.**

Martín-Ruiz ML, Máximo-Bocanegra N, Luna-Oliva L.

*Sensors (Basel). 2016 Mar 26;16(4):444. doi: 10.3390/s16040444.*

The importance of an early rehabilitation process in children with cerebral palsy (CP) is widely recognized. On the one hand, new and useful treatment tools such as rehabilitation systems based on interactive technologies have appeared for rehabilitation of gross motor movements. On the other hand, from the therapeutic point of view, performing rehabilitation exercises with the facial muscles can improve the swallowing process, the facial expression through the management of muscles in the face, and even the speech of children with cerebral palsy. However, it is difficult to find interactive games to improve the detection and evaluation of oral-facial musculature dysfunctions in children with CP. This paper describes a framework based on strategies developed for interactive serious games that is created both for typically developed children and children with disabilities. Four interactive games are the core of a Virtual Environment called SONRIE. This paper demonstrates the benefits of SONRIE to monitor children's oral-facial difficulties. The next steps will focus on the validation of SONRIE to carry out the rehabilitation process of oral-facial musculature in children with cerebral palsy.

**Free PMC Article**

DOI: 10.3390/s16040444
PMCID: PMC4850958
PMID: 27023561 [PubMed - indexed for MEDLINE]

**Could lower leg Wartenberg test be used as a predictor of restrictions in temporomandibular joint movements in CP patients?**

Syczewska M, Szczerbik E, Graff K, Olczak-Kowalczyk D, Dąbrowska-Gontarczyk A, Kalinowska M, Jelonek E.

*Acta Bioeng Biomech. 2016;18(2):3-7.*

PURPOSE: Patients with spasticity suffer not only from neurological problems but also from various dentistry problems due to spasticity of the jaw muscles. Measurements of motion in temporomandibular joints should reflect the amount of abnormal muscle tone of these muscles. The aim of this study was to find out if the measurements of temporomandibular joint movements performed with the ultrasound Zebris device are different in cerebral palsy patients than in healthy subjects; and to find out if the information on the degree of spasticity in the lower legs provided by the Wartenberg test could be used to predict the degree of spasticty in the jaw muscles.
METHOD: Twenty five healthy subjects and 25 cerebral palsy patients participated in the study. Two types of measurements were performed: temporomandibular movements measured with Zebris device, and instrumented Wartenberg test.
RESULTS: The laterotrusion and opening movements are different in CP patients than in healthy subjects. Laterotrusion movement correlates with velocity measured during the Wartenberg test.
CONCLUSION: This finding suggests that high spasticity in the lower legs could indicate jaw movement restrictions in CP patients.

PMID: 27405291 [PubMed - indexed for MEDLINE]

**Factors in the Efficacy, Safety, and Impact on Quality of Life for Treatment of Drooling with Botulinum Toxin Type A in Patients with Cerebral Palsy.**

Gonzalez-L MD, Martinez C, Bori Y Fortuny I, Suso-Vergara S.

*Am J Phys Med Rehabil. 2017 Feb;96(2):68-76. doi: 10.1097/PHM.0000000000000525.*

OBJECTIVE: To assess the efficacy and safety of botulinum toxin A (BoNT-A) injected in both submandibular and parotid versus only in parotid glands as a treatment for drooling in patients with spastic and dyskinetic cerebral palsy (CP), including an assessment of impact on quality of life (QoL) based on items from the International Classification of Functioning, Disability, and Health (ICF) core set.

DESIGN: Forty patients with CP 18 years or older (mean, 21.8 years) participated in a prospective, single-center, randomized controlled interventional study. All participants were classified as Gross Motor Function Classification System level III or higher and all had significant drooling as defined in prior studies. One group (group A) was treated with 100 U of BoNT-A, and another group (group B) served as control. In the treatment group, all patients first received combined parotid and submandibular injections, and then parotid injections only. The main outcome variables were a postinjection decrease in the drooling quotient (DQ) of 50% or more, total flow of 30% or more, and QoL as assessed by a set of 10 items related to drooling from the ICF.

RESULTS: The proportion of patients who achieved at least 50% reduction in DQ was 45% in group A versus 0.0% in group B; 0.0% (P = 0.0012); and of those who achieved at least 30% reduction in total flow was 90% in group A versus 10% in group B (P < 0.0001). Within group A, 42.1% of the dyskinetic patients versus 58.0% of the spastic ones showed 50% or better response in DQ, which is not a statistically significant difference (P = 0.8045). With regard to ICF questions, group A showed statistically significant improvements in several related items. There did not seem to be a significant difference in overall response for providing parotid-only injections. Additional correlations and uncommon adverse effect experiences are also reviewed.

CONCLUSION: Botulinum toxin A injection of the salivary glands is frequently effective and generally safe for the treatment of drooling in patients with either spastic or dyskinetic CP, both in objective measurement of saliva production and subjective symptoms related to the condition. There does not seem to be a significant advantage of injecting both submandibular and parotid glands
over injecting parotid glands alone.

DOI: 10.1097/PHM.0000000000000525
PMID: 28099276 [PubMed - in process]

**Mechanical control of biofilm in children with cerebral palsy: a randomized clinical trial.**

Ferraz NK, Tataounoff J, Nogueira LC, Ramos-Jorge J, Ramos-Jorge ML, Pinheiro ML.

*Int J Paediatr Dent. 2015 May;25(3):213-20. doi: 10.1111/ipd.12132. Epub 2014 Sep 8.*

BACKGROUND: Dental biofilm removal is difficult and can be ineffective in individuals with cerebral palsy.

OBJECTIVE: Determine the effectiveness of brushing with an electric toothbrush on and off in comparison with manual brushing for the removal of biofilm in children aged four to 16 years with cerebral palsy.

METHODS: A crossover, randomized, simple-blind, clinical trial was conducted. The examiner was blinded to the brushing method (G1: manual; G2: electric toothbrush on; and G3: electric toothbrush off). The order was determined randomly. The participants (n = 40) were examined before and after brushing performed by caregivers using the Turesky-Quigley-Hein biofilm index. Statistical analysis involved the paired t-test, Wilcoxon, Kruskal-Wallis, and anova tests.

RESULTS: Biofilm was significantly reduced with the three brushing methods (P <0.001) (mean reductions: 47.6% in G1; 47.4% in G2; 44.5% in G3). Significant differences were found between G1 and G3 (P < 0.001) and between G2 and G3 (P = 0.007). No significant difference was found between G1 and G2 (P = 0.06).

CONCLUSION: All methods reduced biofilm. Effectiveness was similar between manual brushing and with the electric toothbrush on, whereas both these methods achieved better results in comparison with the electric toothbrush switched off.



DOI: 10.1111/ipd.12132
PMID: 25200983 [PubMed - indexed for MEDLINE]

**Oral Health Quality of Life in Children with Cerebral Palsy: Parental Perceptions.**

El Ashiry EA, Alaki SM, Nouri SM.
*J Clin Pediatr Dent. 2016;40(5):375-87. doi: 10.17796/1053-4628-40.5.375.*

OBJECTIVE: To assess the parents' perception of the oral health-related quality of life (OHRQOL) in children with Cerebral Palsy (CP) and compare it with normally developing children.
STUDY DESIGN: 63 children with CP were recruited from 8 disability centers, and 99 healthy controls were recruited from 5 elementary schools. The ages of the children in both groups were from 6-12 years. The Franciscan Hospital for Children Oral Health-Related Quality of Life (FHC-OHRQOL) was used to measure the OHRQOL and an oral examination was conducted in the schools/centers of the children to assess the teeth, gingival health, and oral hygiene.
RESULTS: The FHC-OHRQOL showed a significant difference in 3 out of 4 sections indicating lower OHRQOL in the CP group. The examination showed no significant difference in the dental and gingival health and in the level of oral hygiene.
CONCLUSION: The OHRQOL of children with CP is significantly lower than that of normally developing children although the oral health status of children with CP is not significantly different from that of normally developing children.
DOI: 10.17796/1053-4628-40.5.375
PMID: 27617378 [PubMed - indexed for MEDLINE]

**The Effect of Nebulized Glycopyrrolate on Posterior Drooling in Patients with Brain Injury: Two Cases of Different Brain Lesions.**
Lee ZI , Yu KJ, Lee DH, Hong SK, Woo SB, Kim JM, Park D.
*Am J Phys Med Rehabil. 2017 Jan 9. doi: 10.1097/PHM.0000000000000669. [Epub ahead of print]*

Posterior drooling, which can lead to substantial respiratory morbidity, including unexplained lung diseases and recurrent pneumonia, is an important issue in the rehabilitation unit. There are various treatment options for posterior drooling, including pharmacologic therapy, oral motor or behavioral therapy, biofeedback, local glandular injection of botulinum toxin, irradiation, and surgery. Among them, nebulized glycopyrrolate has the following advantages: It is noninvasive and is relatively free of central adverse effects because it does not cross the blood-brain barrier unlike other anticholinergics. Although there has been one case report regarding the effectiveness of nebulized glycopyrrolate for drooling in a motor neuron patient, there have not been any reports on its effectiveness for posterior drooling. Herein, we report two cases (an 82-year-old male bilateral hemiplegic stroke patient and a 1-year-old female cerebral palsy infant with bilaterally spastic hemiplegia of posterior drooling treated with nebulized glycopyrrolate) and identify salivary aspiration and the effect of nebulized glycopyrrolate using radionuclide salivagram. Considering its advantages and effectiveness, nebulized glycopyrrolate should be considered as one of the reliable methods to manage posterior drooling in patients with impaired cognition or swallowing difficulties, such as severe brain injury.
DOI: 10.1097/PHM.0000000000000669
PMID: 28081026 [PubMed - as supplied by publisher]

**Transdermal Scopolamine Withdrawal Syndrome Case Report in the Pediatric Cerebral Palsy Population.**
Chowdhury NA(1), Sewatsky ML, Kim H.
*Am J Phys Med Rehabil. 2017 Jan 9. doi: 10.1097/PHM.0000000000000665. [Epub ahead of print]*

Sialorrhea in children with cerebral palsy (CP) results in aspiration, decreased social integration, and poor quality of life. Management options include transdermal anticholinergics such as the scopolamine patch. A controlled clinical trial has proven botulinum toxin (BTX) injections into the salivary glands are an effective alternative to transdermal anticholinergics with a safer side effect profile. Multiple studies of the injections in diverse populations demonstrate reduction in saliva production with improvement in quality of life and decrease in hospitalization-associated costs. The authors describe a 15-year-old boy with spastic quadriplegic CP who developed emesis, nausea, and lethargy 1 day after the first injection of botulinum toxin A (BTX-A) to his salivary glands for sialorrhea management. The authors ascribed his symptoms to scopolamine withdrawal. Given the lack of exposure in the medical literature, there is minimal awareness of the withdrawal syndrome from transdermal scopolamine in children with or without CP, resulting in delayed diagnosis and potential complications. Treatment of the withdrawal syndrome has been successful with meclizine though safety and efficacy has not been established in children younger than 12 despite

frequent clinical and over-the-counter use. Prompt diagnosis of the transdermal scopolamine withdrawal syndrome can result in quicker treatment and a shorter hospital stay.
DOI: 10.1097/PHM.0000000000000665
PMID: 28081025 [PubMed - as supplied by publisher]

## Troubles urinaires

**Neurogenic Lower Urinary Tract Dysfunction in Adults with Cerebral Palsy: Outcomes following a Conservative Management Approach.**
Goldfarb RA, Pisansky A, Fleck J, Hoversten P, Cotter KJ, Katorski J, Liberman D, Elliott SP.
*J Urol. 2016 Apr;195(4 Pt 1):1009-13. doi: 10.1016/j.juro.2015.10.085. Epub 2015 Oct 20.*

PURPOSE: Cerebral palsy is characterized by motor impairment following injury to the developing brain. Neurogenic lower urinary tract dysfunction is estimated to affect at least a third of children with cerebral palsy. However there are limited data as patients transition to adulthood. We sought to describe the symptoms, sequelae and management of neurogenic lower urinary tract dysfunction in adults with cerebral palsy.
MATERIALS AND METHODS: We retrospectively reviewed the charts of adult patients with cerebral palsy between 2011 and 2014. Patients with prior bladder reconstruction or catheterization based bladder drainage were excluded from study. Cerebral palsy severity was determined using GMFCS (Gross Motor Function Classification System). A conservative evaluation and treatment paradigm was used. Noninvasive treatments were encouraged. Specifically clean intermittent catheterization, which is often not feasible, is avoided unless urinary retention, hydronephrosis or refractory lower urinary tract symptoms develop.
RESULTS: There were 121 patients included in final analysis. Median age was 25 and 61 patients (50%) had GMFCS level V. Noninvasive management failed in 28 of 121 patients (23%) as defined by hydronephrosis in 9, persistent urinary retention in 10 and refractory lower urinary tract symptoms/incontinence in 9. Urethral clean intermittent catheterization was poorly tolerated. Of all patients 25% showed evidence of urolithiasis during the study period. Surgical intervention was rare and associated with significant morbidity.
CONCLUSIONS: Adults with cerebral palsy may present with variable signs and symptoms of neurogenic lower urinary tract dysfunction. Conservative treatment was successful in more than 75% of patients. Clean intermittent catheterization was poorly tolerated in patients in whom conservative treatment failed. Surgical intervention was rarely indicated and it should be reserved for select individuals.

DOI: 10.1016/j.juro.2015.10.085
PMID: 26498055 [PubMed - indexed for MEDLINE]

## Troubles visuels

**Long-Term Results of Bilateral Medial Rectus Muscle Recession in Children with Developmental Delay.**
Zehavi-Dorin T, Ben-Zion I, Mezer E, Wygnanski-Jaffe T.
*Strabismus. 2016;24(1):7-11. doi: 10.3109/09273972.2015.1130064. Epub 2016 Mar 8.*

PURPOSE: To assess the long-term results of a reduced amount of medial rectus recession in children with esotropia and developmental delay.
METHODS: A retrospective chart analysis of 42 children with developmental delay who had undergone surgery for esotropia during a 20-year period in a large referral center was performed. The pre- and postoperative angle of deviation was calculated for each subject as the mean of distant and near angles measured by a cover test or the Krimsky measurement. Surgical success was categorized as esotropia or exotropia of ≤10 prism diopters (PD). The main outcome measure was a stable surgical result after several years of follow-up.
RESULTS: The chart review identified 42 children who met inclusion criteria, with a mean age of 2.9 years (range, 0.8-10 years). The mean angle of esotropia prior to surgery was 44.29 ± 13.9 PD (range 20-80 PD). All patients had bilateral medial rectus muscle recessions, with a mean surgical dosage of 5.04 ± 0.62 mm per muscle, on average 0.66 mm less than the standard amount. The average postoperative follow-up was 4.6 years (median 3.67 years, range 8 months-15 years). Twenty-four children (57%) achieved surgical success, 13 (31%) were undercorrected, and 5 (12%) were overcorrected. Ten of the 18 with an unsuccessful surgical outcome underwent a second procedure. The overall surgical success rate for all patients after all procedures was 71%.

CONCLUSIONS: The main reason for surgical failure after bilateral medial rectus muscle recession (BMR) in developmentally delayed children remains residual esotropia. However, with time, more patients demonstrated consecutive exotropia. Although it is difficult to achieve a stable long-term ocular alignment in children with developmental delay, satisfactory results may be achieved with additional surgical procedures. The optimal amount of primary recession and whether to perform the surgical schedules according to the Parks tables or to reduce the amount of the recession when operating on children with developmental delay is still debatable.
DOI: 10.3109/09273972.2015.1130064
PMID: 26954620 [PubMed - indexed for MEDLINE]

## Fatigue

**Walking-induced muscle fatigue impairs postural control in adolescents with unilateral spastic cerebral palsy.**
Vitiello D, Pochon L, Malatesta D, Girard O, Newman CJ, Degache F.
*Res Dev Disabil. 2016 Jun-Jul;53-54:11-8. doi: 10.1016/j.ridd.2016.01.019. Epub 2016 Feb 4.*

BACKGROUND: Fatigue is likely to be an important limiting factor in adolescents with spastic cerebral palsy (CP).
AIMS: To determine the effects of walking-induced fatigue on postural control adjustments in adolescents with unilateral CP and their typically developing (TD) peers.
METHODS: Ten adolescents with CP (14.2 ± 1.7 yr) and 10 age-, weight- and height-matched TD adolescents (14.1 ± 1.9 yr) walked for 15 min on a treadmill at their preferred walking speed. Before and after this task, voluntary strength capacity of knee extensors (MVC) and postural control were evaluated in 3 conditions: eyes open (EO), eyes closed (EC) and with dual cognitive task (EODT).
RESULTS: After walking, MVC decreased significantly in CP (-11%, P<0.05) but not in TD. The CoP area was only significantly increased in CP (90%, 34% and 60% for EO, EC and EODT conditions, respectively). The CoP length was significantly increased in the EO condition in CP and TD (20% and 21%) and was significantly increased in the EODT condition by 18% in CP only.
CONCLUSIONS: Unlike TD adolescents, treadmill walking for 15 min at their preferred speed lead to significant knee extensor strength losses and impairments in postural control in adolescents with unilateral spastic CP.

DOI: 10.1016/j.ridd.2016.01.019
PMID: 26851383 [PubMed - indexed for MEDLINE]

## Troubles du sommeil

**Hyperbaric oxygen therapy is safe and effective for the treatment of sleep disorders in children with cerebral palsy.**
Long Y, Tan J, Nie Y, Lu Y, Mei X, Tu C.
*Neurol Res. 2017 Jan 12:1-9. doi: 10.1080/01616412.2016.1275454. [Epub ahead of print]*

OBJECTIVE: To observe the effects of hyperbaric oxygen (HBO2) therapy on the treatment of sleep disorders and its safety in children with cerebral palsy (CP).
METHODS: A total of 71 recruited children were divided into two groups based on age: group 1, aged between 2 and 4 years; and group 2, aged between 4 and 6 years. The effects of HBO2 therapy on sleep quality were observed.
RESULTS: The total sleep items (TSIs) were significantly different in the two groups between pre-HBO2, post 10 HBO2 sessions, and post 20 HBO2 sessions ($p < 0.01$). A total of 15/38 (39.5%) participants in group 1 and 8/21 (38.0%) in group 2 presented difficulty in falling asleep; 17/38 (44.7%) in group 1 and 4/21 (19.0%) in group 2 had a short duration of sleep during the night; and 20/38 (52.6%) in group 1 and 11/21 (52.4%) in group 2 woke up easily in the night. No significant difference in the average TSIs in 59 participants was found after 10 HBO2 sessions. Eight participants had insomnia after the first 5 sessions, and three in group 2 had nocturnal hyperkinesia after 15 sessions. A seizure during decompression was observed in 2/59 participants (2/419 sessions).
DISCUSSION: These results indicate that HBO2 therapy is beneficial to improve sleep and is safe for children with CP; however, further studies are necessary to explore the mechanisms of HBO2 on sleep.
DOI: 10.1080/01616412.2016.1275454
PMID: 28079475 [PubMed - as supplied by publisher]

## Qualité de vie – Retentissement dans la vie quotidienne

**An exploratory study investigating the multidimensional factors impacting the health and well-being of young adults with cerebral palsy.**

Sienko SE.

*Disabil Rehabil. 2017 Jan 9:1-10. doi: 10.1080/09638288.2016.1274340. [Epub ahead of print]*

BACKGROUND: For young adults with cerebral palsy, changes in psychological and social development, in conjunction with the progression of musculoskeletal deformities and the onset of secondary conditions, make the transition to adulthood a difficult developmental phase. Preliminary evidence shows that many of the physical impairments reported in adults with cerebral palsy begin during late adolescence; however, there is little information about prevalence of impairments and the combined role impairments, psychological and social factors have on the health and well-being of young adults with cerebral palsy.
METHODS: A cross-sectional, multidimensional survey approach was used to examine the ambulatory decline, pain, pain interference, depression, fatigue, locus of control, emotional support, overall health status and satisfaction with life of young adults with cerebral palsy, age 18-30 years.
RESULTS: Ninety-seven surveys (57 self-report and 40 proxy report) were completed across all gross motor function classification system levels. No significant differences were found amongst functional levels for pain, pain interference, fatigue or depression. Only pain interference significantly contributed to the variance in health status, while emotional support significantly contributed to the variance in satisfaction with life.
CONCLUSIONS: The large percentage of young adults in this study reporting pain, fatigue and depression indicates that the onset of these impairments may begin at an earlier age. This study found that emotional support from family facilitates improved health status and enhanced satisfaction with life in young adults with cerebral palsy. Similar to physical impairments, social and psychological factors also contribute to the health and well-being of young adults with cerebral palsy, a holistic approach to care that includes preventative strategies to address both mental and physical health outcomes should begin well in advance to their transition into young adulthood in order to mitigate the impact these factors have on health and well-being during this critical developmental time. Implications for Rehabilitation Pain, fatigue and depression were reported for all levels of GMFCS and should be assessed and addressed with appropriate treatment early in order to determine whether there are surgical, pharmacological, rehabilitative or counseling services that could be implemented at a younger age to improve outcomes in young adulthood. For young adults with CP, emotional support plays a significant role in the health status and satisfaction with life and strategies to enhancing support beyond the family could enhance health status and satisfaction with life.
DOI: 10.1080/09638288.2016.1274340
PMID: 28068863 [PubMed - as supplied by publisher]

**Does early communication mediate the relationship between motor ability and social function in children with cerebral palsy?**

Lipscombe B, Boyd RN, Coleman A, Fahey M, Rawicki B, Whittingham K.

*Res Dev Disabil. 2016 Jun-Jul;53-54:279-86. doi: 10.1016/j.ridd.2016.02.013. Epub 2016 Mar 5.*

BACKGROUND: Children diagnosed with neurodevelopmental conditions such as cerebral palsy (CP) are at risk of experiencing restrictions in social activities negatively impacting their subsequent social functioning. Research has identified motor and communication ability as being unique determinants of social function capabilities in children with CP, to date, no research has investigated whether communication is a mediator of the relationship between motor ability and social functioning.
AIMS: To investigate whether early communication ability at 24 months corrected age (ca.) mediates the relationship between early motor ability at 24 months ca. and later social development at 60 months ca. in a cohort of children diagnosed with cerebral palsy (CP).
METHOD: A cohort of 71 children (43 male) diagnosed with CP (GMFCS I=24, 33.8%, II=9, 12.7%, III=12, 16.9%, IV=10, 14.1%, V=16, 22.5%) were assessed at 24 and 60 months ca. Assessments included the Gross Motor Function Measure (GMFM), the Communication and Symbolic Behaviour Scales-Developmental Profile (CSBS-DP) Infant-

Toddler Checklist and the Paediatric Evaluation of Disability Inventory (PEDI). A mediation model was examined using bootstrapping.
RESULTS: Early communication skills mediated the relationship between early motor abilities and later social functioning, b=0.24 (95% CI=0.08-0.43 and the mediation model was significant, F (2, 68)=32.77, p<0.001, R(2)=0.49.
CONCLUSIONS AND IMPLICATION: Early communication ability partially mediates the relationship between early motor ability and later social function in children with CP. This demonstrates the important role of early communication in ongoing social development. Early identification of communication delay and enriched language exposure is crucial in this population.

DOI: 10.1016/j.ridd.2016.02.013
PMID: 26955913 [PubMed - indexed for MEDLINE]

**Family quality of life among families with a child who has a severe neurodevelopmental disability: Impact of family and child socio-demographic factors.**
Schertz M, Karni-Visel Y, Tamir A, Genizi J, Roth D.
*Res Dev Disabil. 2016 Jun-Jul;53-54:95-106. doi: 10.1016/j.ridd.2015.11.028. Epub 2016 Feb 10.*

We aimed to examine family quality of life (FQOL) of Northern Israeli families
having a child with a severe neurodevelopmental disability and its relation to socio-demographics. The cohort included caregivers of 70 children ages (mean ± standard deviation) 5.36 ± 3.53 years. Families were two-parent (85.7%), lived in the periphery (67.1%) and included Jews (60%), Muslims (18.6%), Druze (14.3%) and Christians (7.1%). Religiosity included: secular (38.6%), traditional (31.4%), religious (30%). Children's diagnosis included autistic spectrum disorder (41.4%), intellectual disability (21.4%), cerebral palsy (17.1%), genetic syndromes (17.1%) and sensorineural hearing loss (2.9%). Degree of support (1-minimal,5-greatest) required by the child was 3.67 ± 1.28 for physical and 3.49 ± 1.36 for communication. Primary caregivers completed the FQOL Survey. Domain scores were highest for family relations and lowest for financial well-being. Dimension scores were highest for importance and lowest for opportunities. Overall FQOL approximated average. Jewish families and residents of a major urban area reported higher and more religious families reported lower overall FQOL. Regression analysis found ethnicity contributing to overall FQOL and domain scores with residence contributing to support from services. Ethnicity and child dependence contributed to dimension scores. Northern Israeli families having a child with a severe neurodevelopmental disability report average FQOL scores. However, family and child dependence characteristics affect FQOL scores. Professionals working with these families should consider FQOL information when making recommendations.

DOI: 10.1016/j.ridd.2015.11.028
PMID: 26871463 [PubMed - indexed for MEDLINE]

**Longitudinal changes in health-related quality of life in preschool children with cerebral palsy of different levels of motor severity.**
Lai CJ, Chen CY, Chen CL, Chan PS, Shen IH, Wu CY.
*Res Dev Disabil. 2017 Feb;61:11-18. doi: 10.1016/j.ridd.2016.11.013. Epub 2016 Dec 29.*

BACKGROUND: When setting goals for cerebral palsy (CP) interventions, health-related quality of life (HRQoL) is an important outcome.
AIMS: To compare longitudinal changes in HRQoL in children with CP of different levels of motor severity.
METHODS AND PROCEDURES: Seventy-three children with CP were collected and classified into three groups based on Gross Motor Function Classification System (GMFCS) levels. HRQoL was assessed by parent's proxy of the TNO-AZL Preschool Quality of Life (TAPQOL) at baseline and 6 months later.
OUTCOMES AND RESULTS: Children with GMFCS level V had a lower total TAPQOL score and scores in all domains than those with level I-IV (p<0.01), except for the non-motor subdomain of physical functioning at follow-up. With regards to longitudinal changes, the children with GMFCS level V had greater improvements in physical (p=0.016) and cognitive functioning (p=0.042), but greater deterioration in emotional functioning (p=0.008) than those with levels I-II at 6 months of follow-up.

CONCLUSIONS AND IMPLICATIONS: Motor severity was associated with TAPQOL scores in all domains and changes in some domains in children with CP. Clinicians should early identify children at risk of a poor HRQoL and plan timely treatment strategies to enhance the HRQoL of children with CP.

**Free Article**
DOI: 10.1016/j.ridd.2016.11.013
PMID: 28040642 [PubMed - in process]

**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 Jan 19. doi: 10.1111/dmcn.13392. [Epub ahead of print]*

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 α 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.

DOI: 10.1111/dmcn.13392
PMID: 28101883 [PubMed - as supplied by publisher]

**Predictors of parent-reported quality of life of adolescents with cerebral palsy: A longitudinal study.**
Rapp M, Eisemann N, Arnaud C, Ehlinger V, Fauconnier J, Marcelli M, Michelsen SI, Nystrand M, Colver A, Thyen U.
*Res Dev Disabil. 2017 Jan 19. pii: S0891-4222(16)30271-2. doi: 10.1016/j.ridd.2016.12.005. [Epub ahead of print]*

AIM: Parent-reporting is needed to examine Quality of Life (QoL) of children with cerebral palsy (CP) across all severities. This study examines whether QoL changes between childhood and adolescence, and what predicts adolescent QoL.
METHOD: SPARCLE is a European cohort study of children with CP, randomly sampled from population databases. Of 818 8-12-year-olds joining the study, 594 (73%) were revisited as 13-17-year-olds. The subject of this report is the 551 (316 boys, 235 girls) where the same parent reported QoL on both occasions using KIDSCREEN-52 (transformed Rasch scale, mean 50, SD 10 per domain). Associations were assessed using linear regression.
RESULTS: Between childhood and adolescence, average QoL reduced in six domains (1.3-3.8 points, $p<0.01$) and was stable in three (Physical wellbeing, Autonomy, Social acceptance). Socio-demographic factors had little predictive value. Childhood QoL was a strong predictor of all domains of adolescent QoL. Severe impairments of motor function, IQ or communication predicted higher adolescent QoL on some domains; except that severe motor impairment predicted lower adolescent QoL on the Autonomy domain. More psychological problems and higher parenting stress in childhood and their worsening by adolescence predicted lower QoL in five and eight domains respectively; contemporaneous pain in seven domains. The final model explained 30%-40% of variance in QoL, depending on domain.

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

DOI: 10.1016/j.ridd.2016.12.005
PMID: 28110883 [PubMed - as supplied by publisher]

**Strengths and challenges faced by school-aged children with unilateral CP described by the Five To Fifteen parental questionnaire.**
Forsman L, Eliasson AC.
*Dev Neurorehabil. 2016 Dec;19(6):380-388. Epub 2015 Apr 2.*

PURPOSE: The purpose of this study was to describe motor and non-motor (e.g. cognitive, social, and behavioral) challenges faced in daily life by children with unilateral cerebral palsy (UCP).
METHODS: In this cross-sectional study, parents completed the Five to Fifteen questionnaire and provided demographic information for 46 children aged 6-15 years (mean 11.01 ± 2.89 SD).
RESULTS: Most children were reported to have problems in both motor and non-motor domains, ranging from 20 to 92% depending on the domain. Perception and learning were the non-motor functions most commonly reported as challenging (63 and 65%, respectively). The total number of problems was significantly higher in age groups above 9 years. The correlation between all domains was high, but was consistently higher with the fine motor sub-domain, which could be used to predict executive function, perception, memory, and learning outcomes (R(2)=0.502, 0.642, 0.192, 0.192).
CONCLUSION: Most children with CP have everyday challenges beyond their primary motor deficiencies.
DOI: 10.3109/17518423.2015.1017662
PMID: 25837595 [PubMed - indexed for MEDLINE]

**Variability of total step activity in children with cerebral palsy: influence of definition of a day on participant retention within the study.**
Wilson NC, Mudge S, Stott NS.
*BMC Res Notes. 2016 Aug 20;9:411. doi: 10.1186/s13104-016-2218-9.*

BACKGROUND: Activity monitoring is important to establish accurate daily physical activity levels in children with cerebral palsy (CP). However, few studies address issues around inclusion or exclusion of step count data; in particular, how a valid day should be defined and what impact different lengths of monitoring have on retention of participant data within a study. This study assessed how different 'valid day' definitions influenced inclusion of participant data in final analyses and the subsequent variability of the data.
RESULTS: Sixty-nine children with CP were fitted with a StepWatch™ Activity Monitor and instructed to wear it for a week. Data analysis used two broad definitions of a day, based on either number of steps in a 24 h monitoring period or the number of hours of recorded activity in a 24 h monitoring period. Eight children either did not use the monitor, or used it for only 1 day. The remaining 61 children provided 2 valid days of monitoring defined as >100 recorded steps per 24 h period and 55 (90 %) completed 2 valid days of monitoring with ≥10 h recorded activity per 24 h period. Performance variability in daily step count was lower across 2 days of monitoring when a valid day was defined as ≥10 h recorded activity per 24 h period (ICC = 0.765) and, higher when the definition >100 recorded steps per 24 h period (ICC = 0.62). Only 46 participants (75 %) completed 5 days of monitoring with >100 recorded steps per 24 h period and only 23 (38 %) achieved 5 days of monitoring with ≥10 h recorded activity per 24 h period. Datasets of participants who functioned at GMFCS level II were differentially excluded when the criteria for inclusion in final analysis was 5 valid days of ≥10 h recorded activity per 24 h period, leaving datasets available for only 8 of 32 participant datasets retained in the study.
CONCLUSION: We conclude that changes in definition of a valid day have significant impacts on both inclusion of participant data in final analysis and measured variability of total step count.
DOI: 10.1186/s13104-016-2218-9
PMCID: PMC4992568
PMID: 27544209 [PubMed - indexed for MEDLINE]

**Work participation among middle-aged persons with cerebral palsy or spina bifida--a longitudinal study.**

Törnbom M, Jonsson U, Sunnerhagen KS
*Disabil Health J. 2014 Apr;7(2):251-5. doi: 10.1016/j.dhjo.2013.06.005. Epub 2013 Aug 20.*

BACKGROUND: Most studies of work participation among persons with cerebral palsy (CP) or spina bifida (SB) have focused on young adults, little is known about older adults.
OBJECTIVE: The aim of this study was to compare work participation in 2009 with 1997 (98).
METHODS: Two groups of persons with CP or SB in Gothenburg, Sweden with an IQ above 70 were interviewed using a structured questionnaire regarding work participation. Group (A) was studied in 1983 (n = 55), in 1997 (n = 42) and in 2009 (n = 28). Group (B) was studied in 1998 (n = 30) and in 2009 (n = 25). In this study, the persons interviewed in 2009 were compared with their own data from 1997 (8), with a non-parametric test.
RESULTS: Work participation had significantly decreased ($p < 0.004$) since 1997 (8); more persons worked part time or had stopped working. Thirty-eight percent had continued their education during 1997 (8)-2009, most of them worked. Of 34 persons working in 2009, 56% had wage subsidies, an increase from 42% in 1997 (8). Of the persons who worked and had continued their education, 37.5% had wage subsidies while, among persons without continued education, 72% had this support. Transportation to work functioned but not as well as in 1997 (8). More persons used transportation for people with a disability in 2009 than in 1997 (8) and criticism was expressed about the transportation system.
CONCLUSIONS: Results showed that work participation for middle-aged persons with CP or SB without intellectual disability decreased with age but continued education and wage subsidies facilitated work participation.

DOI: 10.1016/j.dhjo.2013.06.005
PMID: 24680055 [PubMed - indexed for MEDLINE]

## Activité physique

**An aerobic exercise program for young people with cerebral palsy in specialist schools: A phase I randomized controlled trial.**
Cleary SL, Taylor NF, Dodd KJ, Shields N
*Dev Neurorehabil. 2017 Jan 3:1-8. doi: 10.1080/17518423.2016.1265602. [Epub ahead of print]*

PURPOSE: To evaluate the safety, adherence, and estimates of effect of an aerobic exercise program in specialist schools for young people with cerebral palsy.
METHODS: Nineteen students with cerebral palsy were randomly allocated to an intervention group who completed an aerobic exercise program (27 sessions over nine weeks) or a control group who completed social/art activities over the same time.
RESULTS: There were no serious adverse events and the exercise program was completed with high rates of attendance (77%) and adherence to target heart rate zones (79%). Effect sizes favored the intervention group for measures of cardiovascular performance (sub-maximal treadmill test, effect size d = 0.7; muscle power sprint test, d = 0.9) and participation (Preference for Active-Physical Activities, d = 0.6).
CONCLUSIONS: An aerobic exercise program in specialist schools for young people with cerebral palsy, that may improve measures of cardiovascular performance, can be completed safely, with moderately high levels of adherence.
DOI: 10.1080/17518423.2016.1265602
PMID: 28045554 [PubMed - as supplied by publisher]

**Decision Trees for Detection of Activity Intensity in Youth with Cerebral Palsy.**
Trost SG, Fragala-Pinkham M, Lennon N, O'Neil ME.
*Med Sci Sports Exerc. 2016 May;48(5):958-66. doi: 10.1249/MSS.0000000000000842.*

PURPOSE: To develop and test decision tree (DT) models to classify physical activity (PA) intensity from accelerometer output and Gross Motor Function Classification System (GMFCS) classification level in ambulatory youth with cerebral palsy (CP) and compare the classification accuracy of the new DT models to that achieved by previously published cut points for youth with CP.
METHODS: Youth with CP (GMFCS levels I-III) (N = 51) completed seven activity trials with increasing PA intensity while wearing a portable metabolic system and ActiGraph GT3X accelerometers. DT models were used to identify

vertical axis (VA) and vector magnitude (VM) count thresholds corresponding to sedentary (SED) (<1.5 METs), light-intensity PA (LPA) (≥1.5 and <3 METs) and moderate-to-vigorous PA (MVPA) (≥3 METs). Models were trained and cross-validated using the "rpart" and "caret" packages within R.
RESULTS: For the VA (VA_DT) and VM DT (VM_DT), a single threshold differentiated LPA from SED, whereas the threshold for differentiating MVPA from LPA decreased as the level of impairment increased. The average cross-validation accuracies for the VC_DT were 81.1%, 76.7%, and 82.9% for GMFCS levels I, II, and III. The corresponding cross-validation accuracies for the VM_DT were 80.5%, 75.6%, and 84.2%. Within each GMFCS level, the DT models achieved better PA intensity recognition than previously published cut points. The accuracy differential was greatest among GMFCS level III participants, in whom the previously published cut points misclassified 40% of the MVPA activity trials.
CONCLUSIONS: The GMFCS-specific cut points provide more accurate assessments of MVPA levels in youth with CP across the full spectrum of ambulatory ability.
DOI: 10.1249/MSS.0000000000000842
PMCID: PMC4833604 [Available on 2017-05-01]
PMID: 26673127 [PubMed - indexed for MEDLINE]

**Inverse Dynamics Modelling of Paralympic Wheelchair Curling.**
Laschowski B, Mehrabi N, McPhee J.
*J Appl Biomech. 2017 Jan 13:1-19. doi: 10.1123/jab.2016-0143. [Epub ahead of print]*

Paralympic wheelchair curling is an adapted version of Olympic curling played by individuals with spinal cord injuries, cerebral palsy, multiple sclerosis, and lower extremity amputations. To the best of the authors' knowledge, there has been no experimental or computational research published regarding the biomechanics of wheelchair curling. Accordingly, the objective of this research was to quantify the angular joint kinematics and dynamics of a Paralympicwheelchair curler throughout the delivery. The angular joint kinematics of the upper extremity were experimentally measured using an inertial measurement unit system; the translational kinematics of the curling stone were additionally evaluated with optical motion capture. The experimental kinematics were optimized to satisfy the kinematic constraints of a subject-specific multibody biomechanical model. The optimized kinematics were subsequently used to compute the resultant joint moments via inverse dynamics analysis. The main biomechanical demands throughout the delivery (i.e., in terms of both kinematic and dynamic variables) were about the hip and shoulder joints, followed sequentially by the elbow and wrist. The implications of these findings are discussed in relation to wheelchair curling delivery technique, musculoskeletal modelling, and forward dynamic simulations.
DOI: 10.1123/jab.2016-0143
PMID: 28084864 [PubMed - as supplied by publisher]

**Muscle strength and anaerobic performance in football players with cerebral palsy.**
Yanci J, Castagna C, Los Arcos A, Santalla A, Grande I, Figueroa J, Camara J.
*Disabil Health J. 2016 Apr;9(2):313-9. doi: 10.1016/j.dhjo.2015.11.003. Epub 2015 Dec 1.*

BACKGROUND: This is the first study that quantified the anaerobic performance in football players with cerebral palsy (CP).
OBJECTIVE: This study aimed to examine anaerobic fitness in a population of football players with CP using vertical jumping (VJ) and Wingate tests.
METHODS: Twelve players (age 26.8 ± 4.8 yr, body mass 66.2 ± 4.8 kg, height 173.7 ± 6.4 cm, body mass index 22.2 ± 1.9 kg m(-2)) from the Spanish National Football Team with CP which had 9.4 ± 3.7 years of playing experience performed the VJ and Wingate anaerobic tests.
RESULTS: Vertical jump height was 20.0 ± 1.2 cm for squat jump (HSJ) and 23.9 ± 5.4 cm for countermovement jump (HCMJ). Wingate test peak power (PPOW) was 490.6 ± 125.8 W (7.35 ± 1.53 W kg(-1)). HCMJ was largely (r = -0.631, p = 0.028) and very-largely (r = -0.710, p = 0.01) associated with PPOW (W kg(-1)) and mean power output (MPOW) (W kg(-1)), respectively. Squat jump test peak power (W)showed a large association (r = -0.656, p = 0.021) with MPOW (W and W kg(-1)).The CMJ height resulted 19.5% higher than SJ.
CONCLUSIONS: Results showed low VJ and anaerobic capacity of football playerswith CP compared to national players without CP and the general population. In football players with CP the difference (19.5%) between VJ with or

without countermovement (CMJ-SJ) was higher than reported for national players without CP. Further studies examining the effect of football practice on neuromuscular performance in subjects with CP are warranted.

DOI: 10.1016/j.dhjo.2015.11.003
PMID: 26723466 [PubMed - indexed for MEDLINE]

**Physical Activity Among Adolescents with Cerebral Palsy: An Integrative Review.**
Koldoff EA, Holtzclaw BJ.
*J Pediatr Nurs. 2015 Sep-Oct;30(5):e105-17. doi: 10.1016/j.pedn.2015.05.027. Epub 2015 Jul 18.*

PROBLEM: Physical activity is necessary for optimum physical and psychosocial health in the general population. It is even more important for adolescents who struggle with impairments that limit motor function. Recommendations for best practice are needed as adolescents transition into adulthood.
PURPOSE: An integrative review was performed to determine the state of the science regarding 1) what factors impact physical activity in adolescents with cerebral palsy, and 2) how the needs of this population have been addressed regarding physical activity.
SEARCH STRATEGY: A literature search of MEDLINE, CINAHL, and PubMed was conducted using the terms cerebral palsy, mobility or activity, and adolescents. Exclusion criteria were surgical or pharmacological interventions.
RESULTS OF THE LITERATURE SEARCH: Descriptive and intervention studies were included and evaluated for purpose, design, and key findings.
SYNTHESIS OF EVIDENCE: Correcting the decline of physical activity in adolescents with CP may carry benefits over into adulthood. There are few studies that adapt physical activity to age and level of impairment. Several studies support approaching physical activity from a social model, focusing on participation of the person in the context of environment. There is a lack of research incorporating family-centered care. Many study designs are shallow and lack the proper instruments for assessing outcomes.
IMPLICATIONS FOR PRACTICE: Home and community based interventions need to be developed that are individualized. More studies are needed with stronger research designs and better instruments in order to generalize results for practice.

DOI: 10.1016/j.pedn.2015.05.027
PMID: 26195302 [PubMed - indexed for MEDLINE]

## Vieillisssement – Passage à l'âge adulte

**Health Care Transition Experiences of Young Adults With Cerebral Palsy.**
Carroll EM(1).
*J Pediatr Nurs. 2015 Sep-Oct;30(5):e157-64. doi: 10.1016/j.pedn.2015.05.018. Epub 2015 Jun 30.*

Health care transition (HCT) describes the purposeful, planned movement of adolescents from child to adult-orientated care. The purpose of this qualitative study is to uncover the meaning of transition to adult-centered care as experienced by young adults with cerebral palsy (YA-CP) through the research question: What are the lived experiences of young adults with cerebral palsy transitioning from pediatric to adult healthcare? Six females and 3 males, aged 19-25 years of age, who identified as carrying the diagnosis of cerebral palsy without cognitive impairment, were interviewed. Giorgi's (1985) method for analysis of phenomenology was the framework for the study and guided the phenomenological reduction. The meaning of the lived experiences of YA-CPs transition to adult health care is expert novices with evidence and experience-based expectations, negotiating new systems interdependently and accepting less than was expected. More information and support is needed for the YA-CP during transition to ensure a well-organized move to appropriate adult-oriented health care that is considerate of the lifelong impact of the disorder. The nurses' role as advocate, mentor and guide can optimize the individual's response to the transition process.

DOI: 10.1016/j.pedn.2015.05.018
PMID: 26142160 [PubMed - indexed for MEDLINE]

**Multimorbidity in Middle-Aged Adults with Cerebral Palsy.**
Cremer N Hurvitz EA, Peterson MD
*Am J Med. 2017 Jan 5. pii: S0002-9343(16)31304-3. doi: 10.1016/j.amjmed.2016.11.044. [Epub ahead of print]*

BACKGROUND: Individuals with cerebral palsy have less lean body mass, greater relative adiposity, and lower fitness and physical activity participation; and yet, the prevalence of age-related multimorbidity in this population has yet to be established.
PURPOSE: To examine the prevalence of lifestyle-related chronic conditions and multimorbidity in a sample of middle-aged adults with cerebral palsy.
METHODS: A clinic-based sample of middle-aged adults with cerebral palsy was examined using Electronic Medical Records Search Engine (EMERSE) software. Our cohort included n= 435 individuals aged 40-60 years old, with an ICD-9/10-CM Diagnosis Code for cerebral palsy. Prevalence of 12 chronic conditions were evaluated, including existing diagnoses or historical record of: osteopenia/osteoporosis, myocardial infarction, stroke, coronary artery disease, impaired glucose tolerance/type 2 diabetes, other cardiovascular conditions, rheumatoid arthritis, osteoarthritis, asthma, emphysema, pre-hypertension/hypertension, and hyperlipidemia. Multivariate logistic models were used to estimate adjusted mulitmorbidity (i.e., ≥2 chronic conditions), adjusting for age, sex, smoking status, obesity, and Gross Motor Function Classification System (GMFCS).
RESULTS: There were 137 unique multimorbidity combinations. Multimorbidity was significantly more prevalent among obese versus non-obese individuals for both GMFCS I-III (75.8% vs. 53.6%) and GMFCS IV-V (79.0% vs 64.2%), but was also significantly higher in non-obese individuals with GMFCS IV-V (64.2%) compared to individuals with non-obese individuals with GMFCS I-III (53.6%). Both obesity status (OR: 2.20; 95% CI 1.32-2.79) and the GMFCS IV-V category (OR: 1.81; 95% CI 1.32-3.68) were independently associated with multimorbidity. CONCLUSION: Middle-aged adults with cerebral palsy have high estimates of multimorbidity, and both obesity and higher GMFCS levels are independently associated with greater risk.

DOI: 10.1016/j.amjmed.2016.11.044
PMID: 28065772 [PubMed - as supplied by publisher]

## Prise en charge et Accompagnant/Accompagnement

**Burnout of Formal Caregivers of Children with Cerebral Palsy.**
Vicentic S, Sapic R, Damjanovic A, Vekic B, Loncar Z, Dimitrijevic I, Ilankovic A, Jovanovic AA.
*Isr J Psychiatry Relat Sci. 2016;53(2):10-15.*

BACKGROUND: Burnout syndrome is under-researched within caregivers (CGs) of children with cerebral palsy. The primary aim was to determine the burnout level of formal CGs of children with cerebral palsy (G1) and to compare it with a control group (G2) of professional pediatric nurses, and second, to correlate the level of depression and anxiety with the burnout level.
METHOD: In a total sample of 60 CGs, the Maslach Burnout Inventory Human Services Survey (MBI-HSS), consisting of three structural units - emotional exhaustion (MBIEE) subscale, depersonalization (MBI-DP) subscale and personal accomplishment (MBI-PA) subscale - was used to measure burnout. The Beck Anxiety Inventory (BAI) was used for the assessment of anxiety, and the Beck Depression Inventory (BDI) for depression.
RESULTS: A significant difference was shown on the MBI-EE subscale and on the BDI test ($p<0.05$), in both cases higher scores were obtained by G1. High burnout was observed in all subscales, on the MBI-EE subscale registered 50% of CGs in G1, and 17% in control G2. Correlation of the MBI-EE subscale with BDI and BAI tests was highly significant ($p<0.01$).
CONCLUSIONS: These findings indicate the need for future research aimed at formulating preventive strategies for caregivers' mental health. Better care for caregivers would provide them with better professional satisfaction, and consequently would lead to better care for patients.
PMID: 28079032 [PubMed - in process]

**Factors associated with caregiver experience in families with a child with cerebral palsy.**
Lowes L, Clark TS, Noritz G.
*J Pediatr Rehabil Med. 2016;9(1):65-72. doi: 10.3233/PRM-160362.*

PURPOSE: Managing the stresses of parenting a child with cerebral palsy (CP) can be challenging. This study sought to identify factors that are associated with higher levels of caregiver stress.
METHODS: A retrospective review of data from the Learn From Every Patient™ project conducted in an interdisciplinary CP clinic were used to compare caregiver responses on 2 subsets (financial and time/emotional) of the Assessment of Caregiver Experience in Neuromuscular Disorders (ACEND) and physical and medical characteristics of the child.
RESULTS: The range of scores in both the financial and emotional subset was large. The presence of behavior problems, seizures, and severity of CP showed the strongest associations with emotional stress and accounted for 14% of the variance in scaled scores ($r= 0.392$, adj $R2= 14.3$, $p< 0.01$). The child's age was not significantly related to parental stress. The most highly reported areas of stress were worry about the child's pain, and the financial impact of lost wages.
CONCLUSION: Caregiver experience varied widely and is associated with a range of factors among families caring for a child with CP. Further research is needed to test whether interventions to minimize the areas of greatest stress could make a meaningful difference in family functioning.
DOI: 10.3233/PRM-160362
PMID: 26966802 [PubMed - indexed for MEDLINE]

**Family adaptation to cerebral palsy in adolescents: A European multicenter study.**
Guyard A, Michelsen SI, Arnaud C, Fauconnier J.
*Res Dev Disabil. 2017 Feb;61:138-150. doi: 10.1016/j.ridd.2016.11.010. Epub 2017 Jan 10.*

BACKGROUND AND AIM: Factors promoting family adaptation to child's disability are poorly studied together. The aim of the study was to describe the family adaptation to disability and to identify determinants associated with using a global theoretical model.
MATERIALS AND METHODS: 286 families of teenagers [13-17 years] with cerebral palsy (CP) from 4 European disability registers were included and visited at home. Face to face interviews were performed in order to measure parental distress, perceived impact in various dimensions of family life, family resources and stressors. Relationships were modelled with structural equations. RESULTS: 31.8% of parents living with an adolescent with CP showed clinically significant high stress requiring professional assistance. The main stressors were the level of motor impairment and behavioural disorders in adolescent. A good family functioning was the best protective factor. Respite in care and a parents' positive attitude were significantly related to less parental distress. Material support, socioeconomical level, marital status or parental qualifications did not appear to be significant protector factors.
CONCLUSIONS: Particular attention must be paid not only on physical condition but also on adolescent psychological problems to improve family adaptation. Families at risk of experiencing severe distress should be targeted early and proactive caregiver interventions on the whole family should be performed.
WHAT THIS PAPER ADDS: Family is a dynamic system: facing disability, it tries to recover its balance with available resources and its perception of the situation. Literature highlights potential stressors and protecting factors that could affect the disabled child's family adaptation but few papers study a global model including most of these factors. This study validated a global theoretical model of family adaptation to disability at adolescence. It identified behaviour disorders and motor impairment level as main stressors, family functioning as the largest protecting factors, and equipment and financial support as non significant protective factors.

DOI: 10.1016/j.ridd.2016.11.010
PMID: 28087202 [PubMed - in process]

**Functional priorities reported by parents of children with cerebral palsy: contribution to the pediatric rehabilitation process. [Article in English, Portuguese]**
Brandão MB, Oliveira RH, Mancini MC.
*Braz J Phys Ther. 2014 Nov-Dec;18(6):563-71. doi: 10.1590/bjpt-rbf.2014.0064. Epub 2015 Jan 9.*

BACKGROUND: Collaborative actions between family and therapist are essential to the rehabilitation process, and they can be a catalyst mechanism to the positive outcomes in children with cerebral palsy (CP).
OBJECTIVES: To describe functional priorities established by caregivers of CP children by level of severity and age, and to assess changes on performance and satisfaction on functional priorities reported by caregivers, in 6-month interval.

METHOD: 75 CP children, weekly assisted at Associação Mineira de Reabilitação, on physical and occupational therapy services. The following information was collected: gross motor function (Gross Motor Function Classification System-GMFCS) and functional priorities established by caregivers (Canadian Occupational Performance Measure-COPM). Data were collected in two moments, with a 6-month interval.
RESULTS: The main functional demands presented by caregivers were related to self-care activities (48.2%). Parents of children with severe motor impairment (GMFCS V) pointed higher number of demands related to play (p=0.0036), compared to the other severity levels. Parents of younger children reported higher number of demands in mobility (p=0.025) and play (p=0.007), compared to other age groups. After 6 months, there were significant increase on COPM performance (p=0.0001) and satisfaction scores (p=0.0001).
CONCLUSIONS: Parents of CP children identified functional priorities in similar performance domains, by level of severity and age. Orienting the pediatric rehabilitation process to promote changes in functional priorities indentified by caregivers can contribute to the reinforcement of the parent-therapist collaboration.
**Free PMC Article**
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PMCID: PMC4311601
PMID: 25590449 [PubMed - indexed for MEDLINE]

**Hospital admissions in children with cerebral palsy: a data linkage study.**
Meehan E, Reid SM, Williams K, Freed GL, Sewell JR, Vidmar S, Donath S Reddihough DS.
*Dev Med Child Neurol. 2016 Nov 30. doi: 10.1111/dmcn.13350. [Epub ahead of print]*

AIM: The overall aim was to investigate the feasibility and utility of linking a cerebral palsy (CP) register to an administrative data set for health services research purposes. We sought to compare CP hospital admissions to general childhood population admissions, and identify factors associated with type and frequency of admissions in a CP cohort.
METHOD: The CP register for Victoria, Australia was linked to the state's hospital admissions database. Data pertaining to the admissions of a CP cohort (n=1748) that took place between 2007 and 2014 were extracted. Population data were also obtained.
RESULTS: Overall, 80% of the CP cohort (n=1401) had at least admission between 2007 and 2014, accounting for 11 012 admissions or 1.5% of all admissions in their age group. Compared to general population admissions, CP admissions were more costly and more likely to be elective (66% vs 57%; p<0.001), medical (71% vs 57%; p<0.001), and to take place in metropolitan hospitals (92% vs 78%; p<0.001). Increased CP severity and complexity were associated with having more admissions and a higher proportion of admissions attributable to respiratory illness.
INTERPRETATION: By linking with administrative data sets, CP registers may be useful for health services research and inform health service delivery.

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**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(4):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.
DOI: 10.3233/WOR-162456
PMID: 28059821 [PubMed - in process]

**Long-time sickness absence among parents of pre-school children with cerebral palsy, spina bifida and down syndrome: a longitudinal study.**
Brekke I, Früh EA, Kvarme LG, Holmstrøm H
*BMC Pediatr. 2017 Jan 18;17(1):26. doi: 10.1186/s12887-016-0774-8.*

BACKGROUND: Taking care of a child with special needs can be draining and difficult and require a lot of parental time and resources. The present study investigated the long-term sickness absence of parents who have children with Spina bifida, cerebral palsy and Down syndrome compared to that of parents without a child with special needs.
METHODS: The sample consisted of primiparae women who gave birth between 2001 and 2005 and the fathers of the children (N = 202,593). Data were obtained from the Medical Birth Registry of Norway (MBRN), which is linked to the Central Population Register, education and income registries and Historical Event Database (FD-Trygd) of Statistics Norway (SSB). The linkage data provide longitudinal data, together with annual updates on children and their parents. Statistical analyses were performed using difference-in-difference (DD) study design.
RESULTS: Caring for a child with special needs affected maternal sickness absence, particularly in the first year after the birth. The level of sickness absence of mothers caring for a child with spina bifida and cerebral palsy was greater than that of mothers caring for a child with Down syndrome. In contrast, the sickness absence of fathers caring for a child with special needs was, on average, comparable to that of fathers without a special-needs child in the post-birth period.
CONCLUSIONS: Caring for a child with special needs affected the long-term sickness absence of mothers but not fathers. The findings indicate that the burden of care in the case of children with special needs falls especially on the mother.
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PMCID: PMC5242016
PMID: 28100193 [PubMed - in process]

**Parents' Experiences of Health and Needs When Supporting Their Adolescents With Cerebral Palsy During Transition to Adulthood.**
Björquist E, Nordmark E, Hallström I.
*Phys Occup Ther Pediatr. 2016;36(2):204-16. doi: 10.3109/01942638.2015.1101041. Epub 2015 Dec 7.*

AIMS: Parents are the primary support providers for adolescents with disabilities, their health and wellbeing is therefore of great importance when planning for youths' transition into adulthood. The aim of this study was to gain a deeper understanding of how parents of adolescents with cerebral palsy (CP) experience their own health and wellbeing and their needs for support during the adolescent's transition to adulthood.
METHODS: An inductive qualitative approach was used, including interviews with 15 mothers and fathers to 10 adolescents with CP aged 17-18 years. Latent content analysis was used for analyzing the data.
RESULTS: The main theme "Friction blisters chafing and healing during transition" illustrates the parents' experiences. Five sub-themes formed the parents' experiences of concerns along with sorrow and stress in life, worries about what was to come, their need for support, strategies for coping, and experiences of cohesion.
CONCLUSIONS: Knowledge of parents' experiences of their health, wellbeing, and needs provide valuable information for the planning of transition for adolescents with disabilities. Help with parents' sorrow, stress, and worry in daily life might be facilitated and parental health safeguarded by a navigator who can both guide and give hands-on support.
DOI: 10.3109/01942638.2015.1101041
PMID: 26642865 [PubMed - indexed for MEDLINE]

**Participatory design in the development of an early therapy intervention for perinatal stroke.**
Basu AP, Pearse JE, Baggaley J, Watson RM, Rapley T.

*BMC Pediatr. 2017 Jan 23;17(1):33. doi: 10.1186/s12887-017-0797-9.*

BACKGROUND: Perinatal stroke is the leading cause of unilateral (hemiparetic) cerebral palsy, with life-long personal, social and financial consequences. Translational research findings indicate that early therapy intervention has the potential for significant improvements in long-term outcome in terms of motor function. By involving families and health professionals in the development and design stage, we aimed to produce a therapy intervention which they would engage with.
METHODS: Nine parents of children with hemiparesis and fourteen health professionals involved in the care of infants with perinatal stroke took part in peer review and focus groups to discuss evolving therapy materials, with revisions made iteratively. The materials and approach were also discussed at a meeting of the London Child Stroke Research Reference Group. Focus group data were coded using Normalisation Process Theory constructs to explore potential barriers and facilitators to routine uptake of the intervention.
RESULTS: We developed the Early Therapy in Perinatal Stroke (eTIPS) program – a parent-delivered, home-based complex intervention addressing a current gap in practice for infants in the first 6 months of life after unilateral perinatal stroke and with the aim of improving motor outcome. Parents and health professionals saw the intervention as different from usual practice, and valuable (high coherence). They were keen to engage (high cognitive participation). They considered the tasks for parents to be achievable (high collective action). They demonstrated trust in the approach and felt that parents would undertake the recommended activities (high collective action). They saw the approach as flexible and adaptable (high reflexive monitoring). Following suggestions made, we added a section on involving the extended family, and obtained funding for a website and videos to supplement written materials.
CONCLUSIONS: Focus groups with parents and health professionals provided meaningful feedback to iteratively improve the intervention materials prior to embarking on a pilot study. The intervention has a high potential to normalize and become a routine part of parents' interactions with their child following unilateral perinatal stroke.
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**Service use and family-centred care in young people with severe cerebral palsy: a population-based, cross-sectional clinical survey.**

McDowell BC, Duffy C, Parkes J
*Disabil Rehabil. 2015;37(25):2324-9. doi: 10.3109/09638288.2015.1019649. Epub 2015 Mar 4.*

PURPOSE: To assess healthcare use and family perception of family-centred care in children and young adults with severe cerebral palsy (CP) within a geographical region of the UK.
METHOD: Young people (4-27years) with severe forms of CP; Gross Motor Function Classification System levels IV and V, were recruited via an established case register. Data were collected in the participant's home using a standardised background proforma and validated questionnaires. The Measure of Processes of Care was used to assess the family's perception of family-centred care.
RESULTS: One-hundred and twenty-three children, young people and their families/guardians participated. Results showed high accessing of specialist services in childhood with a considerable decrease in young adults. Use of generalist services remained relatively constant. The reported use of formal respite services and support groups/youth clubs was relatively poor. Family-centred care was poor in the area of "providing general information"(2.8 ± 1.73) but more moderate in the areas of "providing specific information about the young person" (4.2 ± 1.94), "enabling and partnership" (4.2 ± 1.9), "co-ordinated and comprehensive care" (4.3 ± 1.95) and "respectful and supportive care" (4.7 ± 1.75).
CONCLUSIONS: The accessing of specialist services and respite care notably decreases amongst adolescents with severe forms of CP and the perception of family-centred care amongst families was fair at best. In particular, the results highlight the need for families to be provided with more general information and advice. Implications for Rehabilitation In a quest to enhance the rehabilitation process in young people with severe forms of cerebral palsy: Commissioners and service providers need to a adopt a more rationalised, needs led approach to service provision across the lifespan of people with severe forms of cerebral palsy, to include an effective and efficient transitional period. Habilitation specialists working with young adults need to continue to recognise the importance of family-centred care in managing this complex and chronic condition. Professionals working within the healthcare system

must provide better communication and improve their dissemination of information to the families of children and young people with complex needs.
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PMID: 25738910 [PubMed - indexed for MEDLINE]

**Social, Psychological and Financial Burden on Caregivers of Children with Chronic Illness: A Cross-sectional Study.**
Khanna AK, Prabhakaran A, Patel P, Ganjiwale JD, Nimbalkar SM
*Indian J Pediatr. 2015 Nov;82(11):1006-11. doi: 10.1007/s12098-015-1762-y. Epub 2015 May 15.*

OBJECTIVES: To explore social, psychological and financial burden on caregivers of chronically diseased children.
METHODS: Participants were recruited from ambulatory and hospital areas in pediatrics department following informed consent. Parents who were caregivers of children 18 y or below in age with chronic illness were included. Socio-demographic details were collected using a semi structured questionnaire, adapted from Family Burden Interview Schedule (FBIS). The psychological well-being of caregivers was assessed using Patient Health Questionnaire (PHQ-9) and Generalized Anxiety Disorder (GAD-7). Descriptive analysis and ANOVA was done for comparing mean scores of responses to analyze financial, psychological and social burden across different diagnosis.
RESULTS: A total of 204 (89 females:115 males) participated. Only 27% were receiving some benefits from government or hospital side. No depressive symptoms were reported by 25% caregivers, while 37% reported mild and 38% moderate to severe depressive symptoms. No anxiety symptoms were reported by 33%, while 50% reported mild and 17% moderate to severe anxiety symptoms. No association was seen between gender of the caregiver and depressive or anxiety symptoms. Significantly higher financial and social burden was seen in cerebral palsy and cancer groups vis-a-vis other diseases, being least in thalassemia. Disruption of routine life was highest in cancer group caregivers followed by those in cerebral palsy group.
CONCLUSIONS: Most caregivers reported moderate depressive symptoms and mild to
moderate anxiety symptoms. Cerebral palsy caused more social and financial burdenon family vis-a-vis thalassemia. Social and financial burden on families of remaining diseases was comparable.
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