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Interventions and Management

1. Clin Biomech (Bristol, Avon). 2013 Feb 7. pii: S0268-0033(13)00003-X. doi: 10.1016/j.clinbiomech.2013.01.002. [Epub ahead of print]

The influence of gait speed on co-activation in unilateral spastic cerebral palsy children.

Gross R, Leboeuf F, Hardouin JB, Lempereur M, Perrouin-Verbe B, Remy-Neris O, Brochard S.

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BACKGROUND: Physiological co-activation of antagonistic muscles during gait allows stability of loaded joints. Excessive co-activation restrains motion and increases energy expenditure. Co-activation is increased by gait speed and in the case of upper motor neuron lesions. This study aimed to assess the pathological component of co-activation in children with unilateral cerebral palsy. **METHODS:** 10 children with unilateral cerebral palsy and 10 typically developing children walked at spontaneous, slow and fast speeds. The spatio-temporal parameters and electromyographic activity of the rectus femoris, vastus medialis, semi-tendinosus, tibialis anterior and soleus of both lower limbs were recorded. A co-activation index was computed from the EMG envelopes. A mixed linear model was used to assess the effect of walking speed on the index of the antagonistic muscle couples (rectus femoris/semi-tendinosus, vastus medialis/semi-tendinosus and tibialis anterior/soleus) in the different limbs. **FINDINGS:** A greater effect of walking speed on co-activation was found in the involved limbs of children with cerebral palsy for all muscle couples, compared with their uninvolved limbs and the limbs of typically developing children. In typically developing children, but not in children with cerebral palsy, the effect of gait speed on the co-activation index was lower in the rectus femoris/semi-tendinosus than in the other agonist/antagonist muscle couples. **INTERPRETATIONS:** In children with cerebral palsy, a pathological component of muscle activation might be responsible for the greater increase in co-activation with gait speed in the involved limb. Altered motor control could explain why the co-activation in the rectus femoris/semi-tendinosus couple becomes more sensitive to speed.

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2. Clin Rehabil. 2013 Feb 14. [Epub ahead of print]**Effect of whole body vibration training on mobility in children with cerebral palsy: a randomized controlled experimenter-blinded study.**

Lee BK, Chon SC.

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Objective: To evaluate ambulatory function and leg muscle thickness after whole body vibration training in children with cerebral palsy. **Design:** A block randomized controlled trial with two groups. **Setting:** Physical therapy department laboratory. **Subjects:** A total of 30 (15 experimental, mean (SD) age 10.0 (2.26) years and 15 control, 9.6 (2.58)) children with cerebral palsy, 15 males and 15 females. **Interventions:** The experimental group underwent whole body vibration training combined with conventional physical therapy training; the control group underwent conventional physical therapy training three days a week for eight weeks respectively. **Main outcome measures:** Three-dimensional gait analyses and ultrasonographic imaging of the leg muscles were measured at pre- and post-test of intervention for eight weeks. **Results:** Whole body vibration training resulted in significantly better gait speed ($P = 0.001$, from 0.37 (0.04) m/s to 0.48 (0.06)), stride length ($P = 0.001$, from 0.38 (0.18) m to 0.48 (0.18)) and cycle time ($P = 0.001$, from 0.85 (0.48) s to 0.58 (0.38)) in the experimental group compared with that in the control group. The ankle angle ($P = 0.019$, from 7.30 (4.02) degree to 13.58 (8.79)) also showed a remarkable increase in the experimental group, but not the hip ($P = 0.321$) and knee angle ($P = 0.102$). The thicknesses of the tibialis anterior ($P = 0.001$, 0.48 (0.08) mm to 0.63 (0.10)) and soleus ($P = 0.001$, 0.45 (0.04) mm to 0.63 (0.12)) muscles were significantly higher in the experimental group than in the control group. However, no significant effect was observed in the thickness of the gastrocnemius muscle ($P = 0.645$). **Conclusions:** These findings suggest that whole body vibration may improve mobility in children with cerebral palsy, probably through a positive effect on the leg muscles.

[PMID: 23411791](#) [PubMed - as supplied by publisher]

3. J Neurosurg Pediatr. 2013 Feb 8. [Epub ahead of print]**Functional outcomes of childhood dorsal rhizotomy in adults and adolescents with cerebral palsy.**

Hurvitz EA, Marciniak CM, Daunter AK, Haapala HJ, Stibb SM, McCormick SF, Muraszko KM, Gaebler-Spira D.

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Object: In this descriptive study the authors evaluated medical outcomes, interventions, satisfaction with life, and subjective impressions about selective dorsal rhizotomy (SDR) in older adolescents and adults who had undergone the procedure as children. **Methods:** A survey was administered to older adolescents (16-20 years old) and adults with CP who had undergone SDR between 1986 and 2000 at two academic centers. The patients or their caregivers participated in telephone or clinic interviews. Subjective impressions about the SDR and a history of post-SDR medical interventions were obtained. Current functional status, history and ratings of pain, educational achievement, living situation, and subjective health status were also recorded. The Diener Satisfaction with Life Scale (SWLS) was administered. **Results:** Eighty-eight participants, mean age 25.6 ± 4.8 years (mean \pm standard deviation), were interviewed at a mean of 19.6 ± 3.0 years after surgery. The distribution of current reported Gross Motor Function Classification System levels was as follows: I, 7%; II, 18%; III, 23%; IV, 36%; and V, 16%. Moreover, 56% of respondents were living with parents and 25% were living alone. Thirty-five percent were employed, and 39% were still in school. The mean overall SWLS score was 26.0 ± 7.3 , indicating a high level of satisfaction with life. According to 65% of the patients, the SDR was helpful; 31% were uncertain about the procedure's efficacy. Sixty-five percent would recommend the procedure to others. Fifty-eight percent reported excellent to very good health. Forty-four percent reported pain in the past week. Fifty-one percent reported chronic back pain in general. Logistic regression analysis suggested that an increased satisfaction with life was a predictor ($p = 0.01$) of an affirmative response to the question about recommending the procedure to others and that better overall health showed a trend toward being such a predictor ($p = 0.08$). Additional interventions were frequently performed after the SDR. Seventy-four percent of participants underwent orthopedic surgery. Thirty-eight percent were currently taking oral medications for tone, and 53% had received botulinum toxin injections for spasticity treatment. Thirteen patients (15%) had an intrathecal baclofen pump placed. **Conclusions:** The majority of adults who had undergone SDR as children would recommend the procedure to others. Very few reported negative

impressions of the procedure. Levels of satisfaction with life were generally high. Pain prevalence was similar to what has been reported in the literature for adults with cerebral palsy. Despite the SDR, further interventions, both surgical and nonsurgical, were used in the majority of patients.

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4. Res Dev Disabil. 2013 Feb 2;34(4):1198-1203. doi: 10.1016/j.ridd.2012.12.018. [Epub ahead of print]

The influence of hip abductor weakness on frontal plane motion of the trunk and pelvis in patients with cerebral palsy.

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Trendelenburg walking pattern is a common finding in various disorders, including cerebral palsy (CP), where it is seen in children and adults. Clinically, this deviation is viewed as a consequence of hip abductor weakness resulting in pelvic obliquity. Trunk lean to the ipsilateral side is a common compensatory mechanism to counteract pelvic obliquity and to maintain gait stability. However, no published investigations objectively address pelvic and trunk motions in the frontal plane or examine the correlation with hip abductor weakness in patients with CP. We selected 375 ambulatory (GMFCS I-III) patients with spastic bilateral CP and 24 healthy controls from our gait laboratory database. They had all undergone a standardized three-dimensional analysis of gait, including trunk motion, and a clinical examination including hip abductor strength testing. Selected frontal plane kinematic and kinetic parameters were investigated and statistically tested for correlation (Spearman rank) with hip abductor strength. Only a weak ($r=0.278$) yet highly significant correlation between trunk lean and hip abductor strength was found. Hip abductor weakness was accompanied by decreased hip abduction moment. However, no significant differences in pelvic position were found between the different strength groups, indicating that the pelvis remained stable regardless of the patients' strength. Our findings indicate that weak hip abductors in patients with CP are accompanied by increased trunk lean to the ipsilateral side while pelvic position is preserved by this compensatory mechanism. However, since this correlation is weak, other factors influencing lateral trunk lean should be considered. In patients with severe weakness of the hip abductors compensatory trunk lean is no longer fully able to stabilize the pelvis, and frontal pelvic kinematics differs from normal during loading response. The results indicate that the stable pelvic position seems to be of greater importance than trunk position for patients with CP. Further studies are needed to investigate other factors influencing lateral trunk lean.

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5. Mov Disord. 2013 Feb 13. doi: 10.1002/mds.25339. [Epub ahead of print]

Effects of Deep Brain Stimulation in Dyskinetic Cerebral Palsy: A Meta-analysis.

Koy A, Hellmich M, Pauls KA, Marks W, Lin JP, Fricke O, Timmermann L.

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Secondary dystonia encompasses a heterogeneous group with different etiologies. Cerebral palsy is the most common cause. Pharmacological treatment is often unsatisfactory. There are only limited data on the therapeutic outcomes of deep brain stimulation in dyskinetic cerebral palsy. The published literature regarding deep brain stimulation and secondary dystonia was reviewed in a meta-analysis to reevaluate the effect on cerebral palsy. The Burke-Fahn-Marsden Dystonia Rating Scale movement score was chosen as the primary outcome measure. Outcome over time was evaluated and summarized by mixed-model repeated-measures analysis, paired Student *t* test, and Pearson's correlation coefficient. Twenty articles comprising 68 patients with cerebral palsy undergoing deep brain stimulation assessed by the Burke-Fahn-Marsden Dystonia Rating Scale were identified. Most articles were case reports reflecting great variability in the score and duration of follow-up. The mean Burke-Fahn-Marsden

Dystonia Rating Scale movement score was 64.94 ± 25.40 preoperatively and dropped to 50.5 ± 26.77 postoperatively, with a mean improvement of 23.6% ($P < .001$) at a median follow-up of 12 months. The mean Burke-Fahn-Marsden Dystonia Rating Scale disability score was 18.54 ± 6.15 preoperatively and 16.83 ± 6.42 postoperatively, with a mean improvement of 9.2% ($P < .001$). There was a significant negative correlation between severity of dystonia and clinical outcome ($P < .05$). Deep brain stimulation can be an effective treatment option for dyskinesic cerebral palsy. In view of the heterogeneous data, a prospective study with a large cohort of patients in a standardized setting with a multidisciplinary approach would be helpful in further evaluating the role of deep brain stimulation in cerebral palsy. © 2013 Movement Disorder Society.

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6. Stud Health Technol Inform. 2013;184:349-55.

Virtual Reality Aided Training of Combined Arm and Leg Movements of Children with CP.

Riener R, Dislaki E, Keller U, Koenig A, Van Hedel H, Nagle A.

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Cerebral palsy (CP) occurs in over 2 out of 1000 live births and can impair motor control and cognition. Our goal was to create a robotic rehabilitation environment that mimics real-life situations by allowing simultaneous exercise of upper and lower limbs. We chose to use the Lokomat as a gait robot and added a novel removable arm robot, called PASCAL (pediatric arm support robot for combined arm and leg training), that was integrated into the Lokomat environment. We also added a virtual reality (VR) environment that enables the subject to perform motivating game-like scenarios incorporating combined arm and leg movements. In this paper we summarize the design of PASCAL and present the novel virtual environment including first experimental results. The next step will be to test whether a combined application of the virtual environment and the two simultaneously working robots is feasible in healthy participants, and finally to clinically evaluate the entire system on children with CP.

[PMID: 23400183](#) [PubMed - in process]

7. Isr Med Assoc J. 2012 Dec;14(12):737-41.

Intensive intermittent physical therapy in infants with cerebral palsy: a randomized controlled pilot study.

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BACKGROUND: The effectiveness of intensive versus standard physical therapy for motor progress in children with cerebral palsy is controversial. Sitting acquisition is considered an important developmental milestone.

OBJECTIVES: To assess the acquisition of sitting and gross motor progress in infants with cerebral palsy treated with intermittent intensive physical therapy as compared to a matched group treated with a standard physical therapy regimen. **METHODS:** We conducted a randomized controlled crossover study in 10 infants aged 12-22 months with cerebral palsy; 5 were assigned to the intensive intermittent therapy group and 5 to the control group. After 4 weeks of baseline intervention, the intervention program was administered to the experimental group for 8 weeks and the regularly scheduled weekly program to the comparison group, targeting sitting as the treatment goal. Thereafter the comparison group crossed over. The Gross Motor Function Measure 66 and 88 (GMFM 66 and 88) were used at 4 week intervals. **RESULTS:** The intermittent intensive regimen yielded a mean improvement of 7.8% as compared to 1.2% with the standard treatment. However, these results were attributed to infants with a low functional level only ($P < 0.01$). **CONCLUSIONS:** Goal-directed intensive intermittent regimen could possibly be beneficial in infants with a low functional level.

[PMID: 23393711](#) [PubMed - in process]

8. J Oral Pathol Med. 2013 Feb 12. doi: 10.1111/jop.12047. [Epub ahead of print]**Increased salivary immunoglobulin A and reduced α -amylase activity in whole saliva from spastic cerebral palsy individuals.**

Leite MF, Aznar LC, Ferreira MC, Guaré RO, Santos MT.

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BACKGROUND: Salivary immunoglobulin A (SIgA) together with innate defenses such as α -amylase, provides the 'first line of defense' against pathogens present at mucosal surfaces. This study aimed to evaluate salivary α -amylase and immunoglobulin A (IgA) in whole saliva of spastic cerebral palsy (CP) individuals. **METHODS:** Whole saliva was collected from 22 CP and 24 sibling volunteers with no neurological damage control groups (CG) (aged 7-14 years). The salivary flow rate, total protein and SIgA concentrations, and α -amylase activity were determined. **RESULTS:** The CP group presented higher salivary flow rate (35%) and lower total protein concentration (18%) compared with the CG ($P \leq 0.05$). CPG had higher absolute (68%, $\mu\text{g SIgA/ml}$) and relative (55%, $\mu\text{g SIgA/mg prot}$ and 108%, $\mu\text{g SIgA/min}$) concentrations of IgA compared with the CG ($P \leq 0.05$). CPG had lower relative α -amylase activity (15% mg malt/mg prot and 33%, mg malt/min) compared with the CG ($P \leq 0.05$). **CONCLUSION:** This study concluded that CP individuals presented alterations in the profile of salivary proteins involved in the defense system of the oral cavity.

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9. Int J Qual Stud Health Well-being. 2013 Feb 6;8:1-10. doi: 10.3402/qhw.v8i0.20007.**At the edge of vulnerability-lived experience of parents of children with cerebral palsy going through surgery.**

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This study explored the experiences of parents of children with cerebral palsy undergoing surgery as they describe them from a lived experience perspective. When children undergo surgical procedures, they have to stay at hospital for a long time, which represents a great challenge for the children as well as their parents. We collected data by using open-ended interviews with 12 parents of 9 children and analyzed these data in accordance with Max van Manen's methodological themes. Based on the parents' stories, the essential theme is: At the edge of vulnerability-being parents at hospital to a child with CP undergoing surgery, which consisted of three subthemes: establishing trust, awareness of a child who cannot speak, and sensing bodily reactions. Parents experienced demanding challenges as they entered the hospital, in a situation that meant both familiarity and unfamiliarity. Judgments about how to care for the child relied on what they normally did. Sitting bedside for hours and days, thoughts about the legitimacy of letting their child go through the suffering surgery were tormenting the parents. They felt vulnerable and very much dependent on health care workers' competence and at the same time doubting them in seeing and taking care of their child's specific needs. It was experienced as an ambivalent situation, and even more so for the parents of a child without speech. The findings indicate that establishing trust implies being met at an existential level and a deeply felt need for health care workers that are really engaged in taking care of their child and their parents.

[PMID: 23395108](#) [PubMed - in process]

10. J Pediatr Nurs. 2013 Feb 8. pii: S0882-5963(13)00006-7. doi: 10.1016/j.pedn.2013.01.001. [Epub ahead of print]

A Different Life: Caring for an Adolescent or Young Adult With Severe Cerebral Palsy.

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Mothers of children with severe functional disabilities often assume roles that exceed the normative activities of parenting in relation to the intensity, complexity, and temporal nature of the family caregiver experience. This phenomenologic inquiry explored the lived experience of caregiving among mothers caring for an adolescent or young adult with severe cerebral palsy. Data were collected through semi-structured interviews with 11 mothers and analyzed using van Manen's approach. Analyses revealed four interrelated essential themes related to managing an unexpected life, balancing caregiver demands, assuming advocacy roles, and facing an uncertain future. Findings suggest the need for improved supports and services to optimize family caregiving during this transitional period of family life.

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11. Rev Gaucha Enferm. 2012 Sep;33(3):73-80.

Family's abilities and difficulties in caring for children with cerebral palsy [Article in Portuguese]

Dantas MS, Pontes JF, de Assis WD, Collet N.

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This is a qualitative research and exploratory-descriptive study aimed at finding out the family's abilities and difficulties in caring for children with cerebral palsy. Data was collected from seven families, between March and April 2009, through semi-structured interviews. The analysis followed the principles of thematic interpretation. The difficulties are more evident than the abilities and bring repercussions to daily life activities. Dealing with difficulties to control seizures, spasticity, changes in postural tone, occurrence of primitive reflexes, result in the complexity to perform simple tasks like feeding, bathing, locomotion, because children become increasingly dependent on caregivers. Over time, the difficulties give way to the routine and adaptation to the child's daily life. Strengthening relationships with families by improving their bonds and developing quality and comprehensive actions, promotes the welfare of the family/child with cerebral palsy.

[PMID: 23405811](#) [PubMed - in process]

Prevention and Cure

12. Acta Paediatr. 2013 Feb 7. doi: 10.1111/apa.12191. [Epub ahead of print]

Predictive value of neonatal brain MRI on the neurodevelopmental outcome of preterm infants by 5 years of age.

Setänen S, Haataja L, Parkkola R, Lind A, Lehtonen L; The PIPARI Study Group.

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AIM: To study the prognostic value of MRI in preterm infants at term equivalent age for cognitive development at 5

years of age. **METHODS:** A total of 217 very low birth weight/very low gestational age infants who all received brain MRI at term equivalent age were categorized into 4 groups based on the brain MRI findings. Cognitive development was assessed at 5 years of chronological age by using a short form of Wechsler Preschool and Primary Scale of Intelligence - Revised. This information was combined with neurosensory diagnoses by 2 years of corrected age. **RESULTS:** Of all infants 31 (17.0%) had Full Scale Intelligence Quotient (FSIQ) <85, 14 (6.5%) had cerebral palsy and 4 (1.8%) had severe hearing impairment. A total of 41 (22.0%) infants had some neurodevelopmental impairment at 5 years of age. Considering cognitive outcome (FSIQ <85), the positive predictive value of several major MRI pathologies was 43.8%, and the negative predictive value of normal finding or minor pathologies was 92.0% and 85.7%, respectively. **CONCLUSION:** The MRI of the brain at term equivalent age may be valuable in predicting neurodevelopmental outcome in preterm infants by 5 years of age. The findings should always be interpreted alongside the clinical information of the infant. Furthermore, MRI should not replace a long-term clinical follow-up for very preterm infants. ©2013 The Author(s)/Acta Paediatrica ©2013 Foundation Acta Paediatrica.

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13. Dev Med Child Neurol. 2013 Feb 9. doi: 10.1111/j.1469-8749.2012.04429.x. [Epub ahead of print]

Long-term survival of children with cerebral palsy in Okinawa, Japan.

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Aim: The aim of this study was to describe the survival prognosis of children with cerebral palsy (CP) in Okinawa, Japan. **Method** A cohort study was conducted on all children with CP born between 1988 and 2005 in Okinawa, Japan. Survival proportions were determined with a life table and Kaplan-Meier survival curves were plotted. The effect of each predictor variable was estimated using Cox regression analysis. **Results** This study included 580 children with CP (332 males, 248 females). In the cohort, 119 (20.5%) children were classified in Gross Motor Function Classification System (GMFCS) level I, 65 (11.2%) were classified in level II, 40 (6.9%) in level III, 189 (32.6%) in level IV, 166 (28.6%) in level V and GMFCS level was unknown for one. Of the 34 children who died, 29 were classified in GMFCS level V and GMFCS level was unknown for one. Mean age at start of follow-up was 24.5 months (SD 2.6mo); mean length of follow-up was 8 years 8 months (standard error of the mean 0.214y). The 5 year- and 18-year survival percentages of the entire cohort were 98% and 89% respectively. In children with CP, significantly lower survival rates were associated with multiple factors, including a birthweight of at least 2500g ($p=0.009$), a gestational age of at least 37 weeks ($p=0.004$), and the most severe gross motor limitation, GMFCS level V ($p<0.001$). However, multivariate analysis showed GMFCS level V was the only significant predictor variable ($p<0.001$) for survival of CP. **Interpretation** This study is the first to describe survival of children with CP in Japan. Our results are similar to those previously reported in other countries. These results are important in planning adequate provision of social and medical services for individuals with CP.

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