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## Interventions and Management

### 1. Arch Phys Med Rehabil. 2012 Jul 27. [Epub ahead of print]

#### **Association between participation in life situations of children with cerebral palsy and their physical, social and attitudinal environment: a cross-sectional multi-centre European study.**

Colver A, Thyen U, Arnaud C, Beckung E, Fauconnier J, Marcelli M, McManus V, Michelsen SI, Parkes J, Parkinson K, Dickinson HO.

Institute of Health and Society, Newcastle University, Newcastle upon Tyne, UK.

**OBJECTIVE:** To evaluate how participation of children with cerebral palsy varied with their environment. **DESIGN:** Home visits to children. Administration of Life-H and European Child Environment Questionnaires. Structural equation modelling of putative associations between specific domains of participation and environment, while allowing for severity of child's impairments and pain. **SETTING:** European regions with population based registers of children with cerebral palsy. **PARTICIPANTS:** 1,174 children aged 8-12 years were randomly selected from eight population-based registers of children with cerebral palsy in six European countries. 743 (63%) agreed to participate; one further region recruited 75 children from multiple sources. Thus there were 818 children in the study. **INTERVENTIONS:** Not applicable. **MAIN OUTCOME MEASURE:** Participation in life situations. **RESULTS:** For the hypothesised associations, the models confirmed that higher participation was associated with better availability of environmental items. Higher participation in daily activities - mealtimes, health hygiene, personal care and home life - was significantly associated with a better physical environment at home ( $p < 0.01$ ). Mobility was associated with transport and the physical environment in the community. Participation in social roles (responsibilities, relationships, recreation) was associated with attitudes of classmates and social support at home. School participation was associated with attitudes of teachers and therapists. Environment explained between 14% and 52% of the variation in participation. **CONCLUSIONS:** The findings confirmed the social model of disability. The physical, social and attitudinal environment of disabled children influences their participation in everyday activities and social roles.

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[PMID: 22846455](https://pubmed.ncbi.nlm.nih.gov/22846455/) [PubMed - as supplied by publisher]

**2. Clin Rehabil. 2012 Jul 30. [Epub ahead of print]****Can a six-week exercise intervention improve gross motor function for non-ambulant children with cerebral palsy? A pilot randomized controlled trial.**

Bryant E, Pountney T, Williams H, Edelman N.

Chailey Heritage Clinical Services, Sussex Community NHS Trust, East Sussex, UK.

**Objective:** To determine the effect of a six-week exercise intervention on gross motor function for non-ambulant children with cerebral palsy. **Design:** A parallel arm randomized controlled trial. **Setting:** Four special schools. **Participants:** Thirty-five children aged 8-17 with bilateral cerebral palsy; Gross Motor Function Classification System levels IV-V. **Method:** Participants were randomly allocated to a static bike group, a treadmill group or control group. Participants in the bike and treadmill groups received exercise training sessions, three times weekly for six weeks. The control group received their usual care. Blinded assessments were performed at baseline and six weeks and followed up at 12 and 18 weeks. **Outcome measures:** Gross Motor Function Measures GMFM-66, GMFM-88D and GMFM-88E. **Results:** At six weeks significant differences were found in GMFM-88D scores between the bike group and the control group, and the treadmill group and the control group ( $P < 0.05$ ). The mean change (SD) in GMFM-88D score was 5.9 (6.8) for the bike group; 3.7 (4.4) for the treadmill group and 0.5 (1.9) for the control group. No significant differences were found for GMFM-66 or GMFM-88E scores between the bike group and control group, or the treadmill group and control group, although trends of improvement were observed for both exercise groups. The improvements observed declined during the follow-up period. **Conclusion:** This study provides preliminary evidence that exercising on a bike or treadmill may provide short-term improvements in gross motor function for non-ambulant children with cerebral palsy. This needs to be tested in a large-scale randomized trial.

[PMID: 22850757](#) [PubMed - as supplied by publisher]

**3. J Bone Joint Surg Br. 2012 Aug;94(8):1143-7****The Baumann procedure to correct equinus gait in children with diplegic cerebral palsy: Long-term results.**

Svehlík M, Kraus T, Steinwender G, Zwick EB, Saraph V, Linhart WE.

Medical University of Graz, Auenbruggerplatz 34, 8036 Graz, Austria.

Although equinus gait is the most common abnormality in children with spastic cerebral palsy (CP) there is no consistency in recommendations for treatment, and evidence for best practice is lacking. The Baumann procedure allows selective fractional lengthening of the gastrocnemii and soleus muscles but the long-term outcome is not known. We followed a group of 18 children (21 limbs) with diplegic CP for ten years using three-dimensional instrumented gait analysis. The kinematic parameters of the ankle joint improved significantly following this procedure and were maintained until the end of follow-up. We observed a normalisation of the timing of the key kinematic and kinetic parameters, and an increase in the maximum generation of power of the ankle. There was a low rate of overcorrection (9.5%,  $n = 2$ ), and a rate of recurrent equinus similar to that found with other techniques (23.8%,  $n = 5$ ). As the procedure does not impair the muscle architecture, and allows for selective correction of the contracted gastrocnemii and soleus, it may be recommended as the preferred method for correction of a mild fixed equinus deformity.

[PMID: 22844059](#) [PubMed - in process]

**4. J Child Orthop. 2011 Aug;5(4):289-296. Epub 2011 Jun 24.****Recurrence after surgery for equinus foot deformity in children with cerebral palsy: assessment of predisposing factors for recurrence in a long-term follow-up study.**

Joo SY, Knowtharapu DN, Rogers KJ, Holmes L Jr, Miller F.

**BACKGROUND:** Despite the large number of studies on the recurrence after surgery for equinus foot deformity in cerebral palsy (CP) patients, only a few investigations have reported long-term recurrence rates. Furthermore, little

is known on the interval between the recurrent surgeries and the factors that lead to early recurrence. This study aimed to assess the overall recurrence after surgery for equinus foot deformity in patients with CP and to assess the factors associated with recurrence. We also aimed to determine the predisposing factors for early recurrence. **METHODS:** The medical records of 186 patients (308 feet) were reviewed in order to determine the recurrence after surgery for equinus foot deformity. The type of CP, type of surgery, age at surgery, functional mobility, passive dorsiflexion of the ankle at the last follow-up visit, and subsequent treatment were recorded. Kaplan-Meier survival analysis was employed, with the end point defined as reoperation. **RESULTS:** The mean age at surgery was  $6.8 \pm 2.5$  years (range, 2.2-13.1). With the mean follow-up period of 11.3 years (range, 7.2-17.7), the overall recurrence rate was 43.8%. The recurrence rate was highest among patients with hemiplegia (62.5%). The Kaplan-Meier survival without repeat surgery estimate was shown to be 88.6% at 5 years and 59.6% at 10 years. Among children with hemiplegia and diplegia, the younger children ( $\leq 8$  years of age) showed a higher rate of recurrence compared with the older children ( $P = 0.04$  and  $P = 0.01$ , respectively). In 41 feet (30.4%), reoperations were performed within 5 years after the primary surgery. Early recurrence was most prevalent among children with hemiplegia (50.0%). In children with diplegia and quadriplegia, the younger children underwent the secondary operation later than the older children ( $P = 0.04$  and  $P = 0.02$ , respectively). **CONCLUSION:** Recurrence after surgery for equinus foot deformity is common and the age at surgery has a significant influence on recurrence. Recurrence can occur at any age while the child is still growing; therefore, it is advised to follow those patients until they reach skeletal maturity.

**LEVEL OF EVIDENCE:** Level III, therapeutic study.

[PMID: 22852035](#) [PubMed - as supplied by publisher] [PMCID: PMC3234889](#)

## **5. Curr Treat Options Neurol. 2012 Aug 2. [Epub ahead of print]**

### **Updates in the Treatment of Spasticity Associated With Cerebral Palsy.**

Benini R, Shevell MI.

Division of Pediatric Neurology, Montreal Children's Hospital-McGill University Health Center, McGill University, Montreal, Quebec, Canada.

**OPINION STATEMENT:** Spasticity affects up to 80 % of patients with cerebral palsy (CP) and often plays a significant role in limiting the child's ability to function and participate in daily activities. The treatment of spasticity involves a multifaceted approach that includes pharmacological treatment with antispasmodics, physical therapy to maintain range of motion and prevent contractures, as well as a variety of orthopedic and neurosurgical interventions. Pharmacological agents currently used in clinical practice to treat spasticity in children have existed for almost two decades and continue to be used despite lack of solid evidence for their efficacy. Studies detailing safety profiles and optimal dosing in the pediatric population are greatly warranted. Intramuscular injection of botulinum neurotoxin is becoming increasingly popular for the treatment of segmental spasticity and current literature suggests it is safe and effective (Level A). Constraint-induced movement therapy (CIMT) and repetitive transcranial magnetic stimulation (rTMS) are emerging as effective interventions in improving motor function in hemiplegic CP. However, the role of these as of yet >interventions in reducing spasticity remains to be clarified.

[PMID: 22851256](#) [PubMed - as supplied by publisher]

## **6. J Child Orthop. 2011 Aug;5(4):315. Epub 2011 Jan 25.**

### **RETRACTED ARTICLE: Reconstruction of acute closed traumatic extensor hallucis longus tendon rupture in adolescents with spastic cerebral palsy.**

Bishay SN.

[PMID: 22852038](#) [PubMed - as supplied by publisher] [PMCID: PMC3234896](#)

**7. J Neurosci. 2012 May 23;32(21):7384-91****Muscle coordination is habitual rather than optimal**

de Rugy A, Loeb GE, Carroll TJ.

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When sharing load among multiple muscles, humans appear to select an optimal pattern of activation that minimizes costs such as the effort or variability of movement. How the nervous system achieves this behavior, however, is unknown. Here we show that contrary to predictions from optimal control theory, habitual muscle activation patterns are surprisingly robust to changes in limb biomechanics. We first developed a method to simulate joint forces in real time from electromyographic recordings of the wrist muscles. When the model was altered to simulate the effects of paralyzing a muscle, the subjects simply increased the recruitment of all muscles to accomplish the task, rather than recruiting only the useful muscles. When the model was altered to make the force output of one muscle unusually noisy, the subjects again persisted in recruiting all muscles rather than eliminating the noisy one. Such habitual coordination patterns were also unaffected by real modifications of biomechanics produced by selectively damaging a muscle without affecting sensory feedback. Subjects naturally use different patterns of muscle contraction to produce the same forces in different pronation-supination postures, but when the simulation was based on a posture different from the actual posture, the recruitment patterns tended to agree with the actual rather than the simulated posture. The results appear inconsistent with computation of motor programs by an optimal controller in the brain. Rather, the brain may learn and recall command programs that result in muscle coordination patterns generated by lower sensorimotor circuitry that are functionally "good-enough."

[PMID: 22623684](#) [PubMed - indexed for MEDLINE]

**8. No To Hattatsu. 2012 Jul;44(4):327-32.****Studies on bone mineral status with bone quantitative ultrasonography in severely handicapped school children--correlations with gross motor function and dietary status [Article in Japanese]**

Watanabe S, Inakazu E, Yano M, Endo Y, Okumura Y, Hirano K, Aiba H.

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**OBJECTIVE:** Severely handicapped children and adolescents have reduced bone mineral density and high prevalence of pathological fractures. Bone quantitative ultrasonography (QUS) is a radiation-free method for assessing bone density. It is portable and easy to use in subjects with severe bodily deformities. **METHODS:** We evaluated 166 students (age 6-20 years) at a school for disabled children for bone mineral density using the osteo-sono-assessment index (OSI) calculated by measuring the velocity of ultrasound waves, the speed of sound (SOS) and the transmission index (TI), at the calcaneus. All examinations were performed using an AOS-100 analyzer (ALOKA Ltd., Tokyo, Japan). The Gross Motor Function Classification System (GMFCS) for cerebral palsy was also applied. We assessed OSI for dietary texture modifications and methods of feeding. **RESULTS:** Those with pathological fractures tended to have lower OSI than other students. Such fractures were individually unrelated to age, sex and GMFCS. OSI was significantly higher at GMFCS level I than level II. OSI in levels I to III was equally significantly higher than that in levels IV and V. As to feeding methods, the tube feeding group tended to have lower OSI than the oral ingestion group. In the oral ingestion group, those receiving a regular diet had significantly higher OSI than the mixed-minced diet group. However, students with a gastrostomy tended to have higher OSI than those receiving gastro-nasal tube feeding. **CONCLUSIONS:** Gross motor function (applied GMFCS) is a major factor affecting bone mineral density. Tube feeding reduces bone mineral density. However, forced oral intake may also reduce it. In the tube feeding group, a modified diet of appropriate texture delivered via gastrostomy may be the key to improving bone mineral density.

[PMID: 22844766](#) [PubMed - in process]

**9. Res Dev Disabil. 2012 Jul 30;33(6):2308-2316. [Epub ahead of print]****Knee muscle strength at varying angular velocities and associations with gross motor function in ambulatory children with cerebral palsy.**

Hong WH, Chen HC, Shen IH, Chen CY, Chen CL, Chung CY.

Department of Sports Medicine, China Medical University, 91 Hsueh-Shih Road, Taichung 40402, Taiwan.

The aim of this study was to evaluate the relationships of muscle strength at different angular velocities and gross motor functions in ambulatory children with cerebral palsy (CP). This study included 33 ambulatory children with spastic CP aged 6-15 years and 15 children with normal development. Children with CP were categorized into level I (n=17) or level II (n=16) according to Gross Motor Function Classification System (GMFCS) levels. All children underwent curl-up test and isokinetic tests of the knee extensor and flexor muscle. Children with CP underwent the gross motor function assessments, including the Gross Motor Function Measure (GMFM-66) and the gross motor subtests of Bruininks-Oseretsky Test of Motor Proficiency (BOTMP). The hamstring-quadriceps ratio (HQ ratio) was calculated as  $100\% \times (\text{isokinetic peak torque of hamstring (knee flexor)} / \text{isokinetic peak torque of quadriceps (knee extensor)})$ . Children with GMFCS level II had lower BOTMP and GMFM-66 scores, curl-up scores, HQ ratio, and knee muscle strength, especially knee flexor, compared to those with GMFCS level I. The regression analysis showed that knee flexor torques at 60 and 90°/s are mainly related to balance ( $r(2)=0.167$ ,  $p=0.011$ ) and strength ( $r(2)=0.243$ ,  $p=0.002$ ) while knee flexor torques at 120°/s mainly contribute to running speed and agility ( $r(2)=0.372$ ,  $p<0.001$ ). These findings suggest that children with CP had knee strength deficits, especially knee flexor. Postural muscle (knee flexor) strength dominated gross motor function than antigravity muscle strength (knee extensor). The knee flexor strength at different angular velocities was associated with various gross motor tasks. The HQ ratio may be used as a potential biomarker to probe the therapeutic effectiveness for muscle strengthening in these children. These data may allow clinician for formulating effective muscle strengthening strategies for these children.

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**10. Dev Med Child Neurol. 2012 Jul 31. doi: 10.1111/j.1469-8749.2012.04368.x. [Epub ahead of print]****Construct validity of the Quality of Upper Extremity Skills Test for children with cerebral palsy.**

Thorley M, Lannin N, Cusick A, Novak I, Boyd R.

The Rehabilitation Studies Unit, University of Sydney and Queensland Cerebral Palsy Health Service, Royal Children's Hospital, Brisbane Occupational Therapy Department, Alfred Health and Faculty of Health Sciences, La Trobe University, Melbourne; School of Health Sciences, University of Wollongong, NSW; Cerebral Palsy Alliance Research Institute, Sydney; Queensland Cerebral Palsy and Rehabilitation Research Centre, The University of Queensland, Brisbane, Qld, Australia.

**Aim:** The aim of the study was to investigate the construct validity of the Quality of Upper Extremity Skills Test (QUEST) in children with cerebral palsy (CP). **Method:** A total of 170 QUEST assessments from a convenience sample of 94 children with CP involved in clinical and research treatment programmes (54 males, 40 females; mean age 6y 10mo, SD 2y 11mo, range 2-16y; Gross Motor Function Classification System levels I-V) were reviewed. **Results:** The QUEST was not unidimensional; many items demonstrated poor fit when total scores were analysed; goodness of fit improved when domains were considered independently and limbs separately examined. QUEST items involving elbow flexion and/or forearm in pronation were easily achieved, thus reducing test sensitivity. Postures items in the grasp domain behaved erratically, with little total score relationship. **Interpretation:** Calculating total scores is discouraged. Reporting QUEST results separately for domains and each limb is recommended. Posture items in the grasp domain had little relationship with total scores and it is recommended that they be removed from the test.

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**11. Dev Med Child Neurol. 2012 Jul 31. doi: 10.1111/j.1469-8749.2012.04391.x. [Epub ahead of print]****Gastrostomy tube feeding of children with cerebral palsy: variation across six European countries.**

Dahlseng MO, Andersen GL, DA Graca Andrada M, Arnaud C, Balu R, DE LA Cruz J, Folha T, Himmelmann K, Horridge K, Júlíusson P, Páhlman M, Rackauskaite G, Sigurdardottir S, Uldall P, Vik T; on behalf of the Surveillance of Cerebral Palsy in Europe Network

Department of Laboratory Medicine, Children's and Women's Health, Faculty of Medicine, Norwegian University of Science and Technology, Trondheim, Norway The Cerebral Palsy Registry of Norway, Vestfold Hospital Trust, Tønsberg, Norway The Cerebral Palsy Registry of Portugal, Federação das Associações Portuguesas de Paralisia Cerebral, Lisbon, Portugal Inserm, UMR 1027, Toulouse, France Paediatric Department, Sunderland Royal Hospital, Sunderland, UK Clinical Research Unit, Imas12-Ciberesp, Hospital 12 Octubre, Madrid, Spain Calouste Gulbenkian Cerebral Palsy Rehabilitation Centre, Lisbon, Portugal Department of Pediatrics, Institute of Clinical Sciences, Queen Silvia Children's Hospital, Sahlgrenska Academy at the University of Gothenburg, Göteborg, Sweden City Hospitals Sunderland NHS Foundation Trust, and North of England Collaborative Cerebral Palsy Survey, Sunderland, UK Department of Paediatrics, Haukeland University Hospital, Bergen, Norway Department of Paediatrics, Aarhus University Hospital, Aarhus, Denmark State Diagnostic, Counselling Centre, Kopavogur, Iceland Child Department, Righospitalet, Copenhagen University, Copenhagen, Denmark.

**Aim:** To compare the prevalence of gastrostomy tube feeding (GTF) of children with cerebral palsy (CP) in six European countries. **Method:** Data on 1295 children (754 males, 541 females; mean age 5y 11mo, range 11y 2mo, min 6mo, max 11y 8mo) with CP born from 1999 to 2001 were collected from geographically defined areas in six European countries; four of the areas covered the whole country. Distribution of CP was unilateral 37%, bilateral 51%, dyskinetic 8%, and ataxic 4%. Sixty children were classified in Gross Motor Function Classification System (GMFCS) levels I and II, 6 in level III and 34 in levels IV and V. Outcome measures were GTF, age at placement, feeding difficulties and the children's height and weight for age standard deviation scores (z-scores). **Results:** The use of GTF among all children with CP was highest in western Sweden (22%, 95% confidence interval [CI] 16-29), and lowest in Portugal (6%, 95% CI 3-10), northern England (6%, 95% CI 3-9) and in Iceland (3%, 95% CI 0-13;  $p < 0.001$ ). The difference between areas was greater among children in GMFCS levels IV and V (non-ambulant); in this group, lower height z-scores were more prevalent in the areas with lower prevalence of GTF. The children's age at placement of gastrostomy also varied between areas ( $p < 0.002$ ). **Interpretation:** The observed differences in the use of GTF may reflect differences in access to treatment or clinical practice, or both. Our results suggest that the use of GTF may improve growth in height and weight among children with more severely affected gross motor function - the group most likely to have associated feeding difficulties.

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**12. Dev Med Child Neurol. 2012 Jul 31. doi: 10.1111/j.1469-8749.2012.04390.x. [Epub ahead of print]****Gastrostomy tube feeding of children with cerebral palsy.**

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## Prevention and Cure

13. *J Obstet Gynaecol Res.* 2012 Jul 29. doi: 10.1111/j.1447-0756.2012.01945.x. [Epub ahead of print]

### Fetal heart rate patterns related to neonatal brain damage and neonatal death in placental abruption.

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Department of Obstetrics & Gynecology, Faculty of Medicine, University of Miyazaki Department of Obstetrics & Gynecology, Miyazaki Medical Association Hospital, Miyazaki, Japan.

**Aim:** The aim of this study was to determine the correlation between non-reassuring fetal heart rate (NRFHR) patterns and poor neonatal outcome in placental abruption. **Material and Methods:** A retrospective study was performed involving 83 placental abruptions with a live fetus at one tertiary and one secondary hospital in Miyazaki prefecture, Japan. We examined the correlation among NRFHR, umbilical arterial blood gas status, and neonatal poor outcomes, including neonatal death (ND) and cerebral palsy (CP). **Results:** A total of 83 cases were divided into bradycardia ( $n = 27$ ), recurrent late deceleration (rLD,  $n = 29$ ), severe variable deceleration or prolonged deceleration (sVD/PD,  $n = 8$ ), and other cases ( $n = 19$ ). In the bradycardia group, the incidence of low umbilical artery (UA) pH ( $<7.0$ ) was 59% and the average UA pH was  $6.96 \pm 0.22$ . Among these cases, 10 showed severe bradycardia (less than 80 b.p.m.) and an average UA pH of  $6.85 \pm 0.24$ , and four cases resulted in poor outcome (three CP and one ND). In the rLD group, the incidence of low UA pH ( $<7.0$ ) was 7% and the average UA pH was  $7.24 \pm 0.12$ . In this group, a 40-week-old fetus with umbilical phlebitis had a lower UA pH (6.92) and developed CP. In the sVD/PD group, there were no cases of a low UA pH ( $<7.0$ ) and the average UA pH was  $7.30 \pm 0.04$ . In this group, a 31-week-old boy with a UA pH of 7.36 developed CP (PVL). The remaining 19 cases had no CP. **Conclusion:** Poor neonatal outcome of placental abruption is closely related to NRFHR, especially the degree of bradycardia. In the rLD and sVD/PD groups, risk factors, such as prematurity and fetal inflammation, co-existed.

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