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Interventions and Management

1. Eur J Phys Rehabil Med. 2012 Jul 23. [Epub ahead of print]

The Locomotory Index in diplegic and hemiplegic children: the effects of age and speed on the energy cost of walking.

Marconi V, Carraro E, Trevisi E, Capelli C, Martinuzzi A, Zamparo P.

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BACKGROUND: The energy cost of locomotion (C) is a useful tool for quantifying the level of walking disability in the clinical evaluation of patients with cerebral palsy (CP). In addition to clinical condition, also age and velocity (v) can influence C, a fact that is often overlooked. **AIM:** To show: i) that C differs in the clinical subtypes of CP (hemiplegia or diplegia) and ii) that C should be measured at comparable speeds in CP patients and controls (of the same age). **DESIGN:** Controlled study. **SETTING:** Pediatric Rehabilitation Unit of "E. Medea" Scientific Institute (Conegliano, TV); Exercise Physiology Lab of University of Verona. **POPULATION:** Forty-three CP children (32 diplegic: Dg; 11 hemiplegic: Hg) and 20 healthy children (Cg) with an age range of 4-14 years. **METHODS:** C was measured as the ratio of net oxygen uptake to walking speed (at v from 1 to 6 km.h⁻¹). The Locomotory index (LI) was calculated as the ratio of C in Dg/Hg and Cg (of the same age) at the same speed. **RESULTS:** C decreases with increasing speed in all groups but evolves differently in Hg and Dg: in the former C decreases by increasing age, becoming similar to that of Cg at 12-14 years; in the latter C does not change as a function of age being always larger than in Cg. **CONCLUSION AND CLINICAL REHABILITATION IMPACT:** Our data highlight the reduction in C with increasing speed and suggest a better prognosis of locomotion for Hg compared to Dg.

[PMID: 22820823](https://pubmed.ncbi.nlm.nih.gov/22820823/) [PubMed - as supplied by publisher]

2. Gait Posture. 2012 Jul 18. [Epub ahead of print]

Single Event Multilevel Surgery in children with bilateral spastic cerebral palsy: A 5 year prospective cohort study.

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BACKGROUND: Single Event Multilevel Surgery (SEMLS) is considered the standard of care to improve gait and function in children with bilateral spastic cerebral palsy (BSCP). We have demonstrated in a randomized controlled trial (RCT) of SEMLS, that gait was improved at 12 months after surgery and gross motor function at 24 months after surgery. The question addressed in this study, was to determine if improvements in gait and function, would be maintained at 5 year follow-up. **METHODS:** Nineteen children with BSCP, GMFCS levels II (14 children) and III (5 children), mean age 9.7 years (range 7.7-12.2 years) participated in a prospective cohort study following participation in a RCT, with follow-up to 5 years. Outcome measures were Gait Profile Score (GPS), Gillette Gait Index (GGI), Gait Deviation Index (GDI), Gross Motor Function Measure (GMFM66) and Functional Mobility Scale (FMS). **RESULTS:** Eighteen children have completed follow-up, with interval analysis at 1, 2 and 5 years post SEMLS. One child was excluded because of neurological deterioration and his diagnosis was revised to Hereditary Spastic Paraparesis (HSP). GPS improved by 5.29° and GMFM66 by 3.3% at 5 years post SEMLS. Differences between outcome measures at 1 versus 5 years and 2 versus 5 years (except GMFM66) were not significant, indicating that improvements in gait and gross motor function were stable over time. **CONCLUSIONS:** SEMLS results in clinically and statistically significant improvements in gait and function, in children with BSCP, which were maintained at 5 years after surgery.

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3. Gait Posture. 2012 Jul 18. [Epub ahead of print]

Walking deterioration and gait analysis in adults with spastic bilateral cerebral palsy.

Opheim A, McGinley JL, Olsson E, Stanghelle JK, Jahnsen R.

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Walking deterioration occurs frequently in adults with spastic bilateral cerebral palsy (CP), but their gait characteristics are largely unknown. The study aims were (1) to compare selected gait analysis variables between those reporting and those not reporting walking deterioration, and (2) to characterise the overall gait deviations and classify the gait patterns. Participants (N=16) were recruited from a follow-up study, had spastic bilateral CP, <40 years in 2006, GMFCS levels I-III, and could walk at least 10m without support. Eight reported walking deterioration (cases) and eight did not (controls). A theoretical framework linking work of walking, fatigue and deterioration in walking was developed. It was hypothesised that higher energy requirements during gait and larger gait deviations would be associated with deterioration in walking. Three-dimensional gait analysis was used to obtain centre of mass work, mechanical joint work, lower limb kinematics, movement analysis profile (MAP), and gait profile scores (GPS). There were no differences between the cases and controls in centre of mass work, joint work, or in the GPS. The largest MAP deviations were seen in sagittal pelvis, hip, and knee angles and foot progression. Crouch and asymmetric gait were common patterns. Walking deterioration could not be explained by these work and kinematic variables. An individual's perception of deterioration in walking is subjective, and may be experienced and interpreted differently across people. Larger, longitudinal studies on the natural history of walking in spastic CP are needed. Qualitative studies on the subjective experiences of walking deterioration are also warranted.

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4. Ann Rehabil Med. 2012 Jun;36(3):400-3. Epub 2012 Jun 30.

The change of intrinsic stiffness in gastrocnemius after intensive rehabilitation with botulinum toxin a injection in spastic diplegic cerebral palsy.

Kwon DR, Park GY, Kwon JG.

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A recent study claimed that botulinum toxin A (BTX-A) injection into the calf muscle of cerebral palsy (CP) children did not change the intrinsic stiffness. Contrary to this recent report, in our case, decreased muscle spasticity, which was measured using a modified Ashworth scale, and increased Gross Motor Function Measure score were demonstrated at 4 weeks after intensive rehabilitation treatment (IRT) with BTX-A injection to the medial gastrocnemius muscle in a child with spastic CP. Additionally, we identified decreased muscle stiffness which was demonstrated by a decrease in the color-coded scale and shear velocity, and an increase in the strain ratio using dynamic sonoelastography.

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5. J Child Neurol. 2012 Jul 25. [Epub ahead of print]

Usefulness of the Tendon Reflex for Assessing Spasticity After Botulinum Toxin-A Injection in Children With Cerebral Palsy.

Jang DH, Sung IY, Kang YJ.

This study sought to investigate the relationships between clinical and neurophysiologic assessments of spasticity after injection of botulinum toxin-A in children with cerebral palsy. A total of 40 children were recruited. Clinical assessments included the modified Ashworth scale and modified Tardieu scale parameters R1, R2, and D. Neurophysiologic assessment included compound motor action potential, Hoffmann, and tendon reflex. Children showed significant decreases in modified Ashworth scale, R1, and R2 at 2, 4, and 12 weeks and in D at 2 and 4 weeks. Amplitude of compound motor action potential decreased at 2 weeks, Hoffmann reflex amplitude decreased at 4 weeks, and tendon reflex amplitude decreased at 2 and 4 weeks. At 12 weeks, none of the neurophysiologic parameters differed from baseline. The correlations among R2, D, and the amplitude of tendon reflex were significant. Neurophysiologic tests could be used to evaluate reduced spasticity after botulinum toxin-A injection. The amplitude of tendon reflex showed the highest correlation with severity of spasticity.

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6. Prosthet Orthot Int. 2012 Jul 24. [Epub ahead of print]

The effect of tuning ankle foot orthoses-footwear combination on the gait parameters of children with cerebral palsy.

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Background: There are a wide variety of ankle foot orthoses used in clinical practice which are characterised by their design, the material used and the stiffness of that material. Changing any of these three components will alter the effect of the ankle foot orthosis on gait. **Objectives:** The purpose of this article is to provide an overview on the available research on ankle foot orthosis-footwear combination tuning on the gait characteristics of children with cerebral palsy through a structured review. **Study Design:** Literature review. **Methods:** A thorough search of previous studies published in English was conducted within all major databases using relevant phrases without any limits for the dates. These searches were then supplemented by tracking all key references from the appropriate articles identified including hand searching of published books where relevant. **Results:** To date, there are 947 papers in the literature pertaining to the study of ankle foot orthosis. Of these, 153 investigated the use of ankle foot orthosis for children with cerebral palsy. All the studies included in this review were of a within-subjects design and the evidence levels were generally low. **Conclusions:** The overall results suggested that ankle foot orthosis-footwear combination tuning has the potential to improve the kinematics and kinetics of gait in children with cerebral palsy. However, the review highlights a lack of well-designed and adequately powered studies.

[PMID: 22833518](#) [PubMed - as supplied by publisher]

7. Phys Ther. 2012 Jul 19. [Epub ahead of print]**Factors Associated With Physical Therapy Services Received for Individuals With Cerebral Palsy in an Outpatient Pediatric Medical Setting.**

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A.F. Bailes, PT, MS, PCS, Department of Occupational Therapy and Physical Therapy, Cincinnati Children's Hospital Medical Center, MLC 4007, 3333 Burnet Ave, Cincinnati, OH 45229 (USA).

BACKGROUND: Limited information is available regarding physical therapy (PT) use for individuals with cerebral palsy (CP). **OBJECTIVES:** The purpose of this study was to evaluate the association of GMFCS level, age, race, gender and type of insurance with the total physical therapy units received over a one year period for individuals with CP in this outpatient pediatric medical setting. **DESIGN:** This was a cross sectional study. **METHODS:** Four hundred and twenty five individuals with CP (GMFCS Level I 36%, Level II 15%, Level III 13%, Level IV 19% and Level V 17%) were identified retrospectively through the electronic medical records. One-way analyses of variance (ANOVA) were performed for each explanatory variable followed by a multiway ANOVA that adjusted for other variables to find the best model to explain total PT units received. **RESULTS:** A significant difference in total therapy units received was found among GMFCS levels ($F=6.91$; $df=4, 420$; $p<0.0001$), age groups ($F=4.76$; $df=3, 421$; $p=0.0028$) and type of insurance ($F=8.09$; $df=2, 422$; $p=0.0004$). No significant difference in PT received was found for the factors of gender and race. The final multi-factorial model indicates a significant main effect of insurance and a GMFCS by age interaction accounting for 19% of the variability ($F=4.45$; $df=21, 403$; $p<0.001$). **LIMITATIONS:** This study is cross sectional and examines physical therapy services received in a pediatric medical setting in one geographic region of the United States. **CONCLUSIONS:** The results of this study provide insight into how therapy received varies for individuals with CP. Future studies should evaluate additional variables that may affect physical therapy services received.

[PMID: 22822238](#) [PubMed - as supplied by publisher]**8. J Hand Surg Am. 2012 Aug;37(8):1665-71.****Early results of surgical intervention for elbow deformity in cerebral palsy based on degree of contracture.**

Carlson MG, Hearn KA, Inkellis E, Leach ME.

Hospital for Special Surgery, New York, NY.

PURPOSE: Elbow flexion posture, caused by spasticity of the muscles on the anterior surface of the elbow, is the most common elbow deformity seen in patients with cerebral palsy. This study retrospectively evaluated early results of 2 surgical interventions for elbow flexion deformities based on degree of contracture. We hypothesized that by guiding surgical treatment to degree of preoperative contracture, elbow extension and flexion posture angle at ambulation could be improved while preserving maximum flexion. **METHODS:** Eighty-six patients (90 elbows) were treated for elbow spasticity due to cerebral palsy. Seventy-one patients (74 elbows) were available for follow-up. Fifty-seven patients with fixed elbow contractures less than 45° were surgically treated with a partial elbow muscle lengthening, which included partial lengthening of the biceps and brachialis and proximal release of the brachioradialis. Fourteen patients (17 elbows) with fixed elbow contractures $\geq 45^\circ$ had a more extensive full elbow release, with biceps z-lengthening, partial brachialis myotomy, and brachioradialis proximal release. **RESULTS:** Age at surgery averaged 10 years (range, 3-20 y) for partial lengthening and 14 years (range, 5-20 y) for full elbow release. Follow-up averaged 22 months (range, 7-144 mo) for partial lengthening and 18 months (range, 6-51 mo) for full elbow release. Both groups achieved meaningful improvement in flexion posture angle at ambulation, active and passive extension, and total range of motion. Elbow flexion posture angle at ambulation improved by 57° and active extension increased 17° in the partial lengthening group, with a 4° loss of active flexion. In the full elbow release group, elbow flexion posture angle at ambulation improved 51° and active extension improved 38°, with a loss of 19° of active flexion. **CONCLUSIONS:** Surgical treatment of spastic elbow flexion in cerebral palsy can improve deformity. We obtained excellent results by guiding the surgical intervention by the amount of preoperative elbow contracture. **TYPE OF STUDY/LEVEL OF EVIDENCE:** Therapeutic IV.

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9. Rev Neurol. 2012 Aug 1;55(3):137-47.

Dichotic listening in Spanish-speaking children: validation of a set of dichotic lists of Spanish words and syllables [Article in Spanish]

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INTRODUCTION. Dichotic listening test can estimate hemispheric dominance for language. **AIM.** To study the usefulness of a new set of dichotic pairs of Spanish stimuli in middle childhood. **SUBJECTS AND METHODS.** The stratified control group comprised 40 healthy, right-handed children, aged 3.5- 7.5 years, of both sexes, with average ability at speaking Spanish. The clinical sample comprised 12 children with right spastic hemi-paretic cerebral palsy, average general intelligence and sentence repetition index over $-2z$. Each listening series is composed of 20 age-appropriate dichotic pairs: one syllable, word, or number; or trains of two or three syllables or numbers. Voice onset time, duration and stress of stimuli were balanced. Hemispheric dominance index (HDI) for language was calculated using a formula with the scores of stimuli from right or left ears. Statistical analysis evaluated the age-related accuracy and discriminant power of each HDI. **RESULTS.** In the non-forced attention paradigm, the range of HDI is 0-200. Values of HDI ≥ 112 indicate left hemisphere dominance for language, whereas values of HDI ≤ 88 indicate right hemisphere dominance. All 40 typical subjects showed left HDI for language, without influence of age and sex. In contrast, ten out of twelve (83%) right hemiparetic children had right HDI. **CONCLUSIONS.** The results show that this new set of dichotic pairs is useful in the initial assessment of cerebral dominance for language and valid for use in Spanish speaking children aged 3.5 years or more.

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10. J Autism Dev Disord. 2012 Jul 25. [Epub ahead of print]

Syndrome Specificity and Mother-Child Interactions: Examining Positive and Negative Parenting Across Contexts and Time.

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This study examined the extent to which child syndromes and observation context related to mothers' parenting behaviors. Longitudinal observations were conducted of parenting behavior across ages 3, 4, and 5 years during structured and unstructured activities. The 183 participants included mothers of children with autism spectrum disorders, cerebral palsy, Down syndrome, undifferentiated developmental delay, or typical cognitive development. Negative parenting behaviors were higher in structured activities and higher in mothers of children in all developmentally delayed groups. Positive parenting was higher in unstructured activities and especially high for mothers of children with Down syndrome. Despite differences found through direct observation of parenting children in different diagnostic groups, they are not as strong as syndrome-group differences found through more commonly used self-report questionnaires assessing domains like parenting stress.

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Prevention and Cure

11. Clin Obstet Gynecol. 2012 Sep;55(3):810-28.

Headache and neurological disease in pregnancy.

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A review of the approach in pregnancy to a very commonly encountered neurological disorder (headache), along with less commonly encountered neurological entities that none the less deserve the obstetrician's attention. Definitions of specific disorders and differential diagnoses are reviewed, along with treatment options and pregnancy-associated morbidities. Headache is reviewed first including the common primary headaches migraine and tension-type headache. The disabling neurological disorders-multiple sclerosis, cerebral palsy, and spinal cord injury are grouped due to common morbidities affecting pregnancy. Finally, Bell palsy is also reviewed.

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12. Exp Neurol. 2012 Jul 23. [Epub ahead of print]

Antenatal Insults Modify Newborn Olfactory Function By Nitric Oxide Produced From Neuronal Nitric Oxide Synthase.

Drobyshevsky A, Yu L, Yang Y, Khalid S, Luo K, Jiang R, Ji H, Derrick M, Kay L, Silverman RB, Tan S.

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Newborn feeding, maternal, bonding, growth and wellbeing depend upon intact odor recognition in the early postnatal period. Antenatal stress may affect postnatal odor recognition. We investigated the exact role of a neurotransmitter, nitric oxide (NO), in newborn olfactory function. We hypothesized that olfactory neuron activity depended on NO generated by neuronal NO synthase (NOS). Utilizing in vivo functional manganese enhanced MRI (MEMRI) in a rabbit model of cerebral palsy we had shown previously that in utero hypoxia ischemia (H-I) at E22 (70% gestation) resulted in impaired postnatal response to odorants and poor feeding. With the same antenatal insult, we manipulated NO levels in the olfactory neuron in postnatal day 1 (P1) kits by administration of intranasal NO donors or a highly selective nNOS inhibitor. Olfactory function was quantitatively measured by the response to amyl acetate stimulation by MEMRI. The relevance of nNOS to normal olfactory development was confirmed by the increase of nNOS gene expression from fetal ages to P1 in olfactory epithelium and bulbs. In control kits, nNOS inhibition decreased NO production in the olfactory system and increased MEMRI slope enhancement. In H-I kits the MEMRI slope did not increase, implicating modification of endogenous NO-mediated olfactory function by the antenatal insult. NO donors as a source of exogenous NO did not significantly change function in either group. In conclusion, olfactory epithelium nNOS in newborn rabbits probably modulates olfactory signal transduction. Antenatal H-I injury remote from delivery may affect early functional development of the olfactory system by decreasing NO-dependent signal transduction.

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13. Hum Mutat. 2012 Jul 26. doi: 10.1002/humu.22173. [Epub ahead of print]

Joint analysis of SNPs and proteins identifies regulatory IL18 gene variations decreasing the chance of spastic cerebral palsy.

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Cerebral palsy (CP) is a permanent disorder, affecting 2-3 per 1,000 live born children, disturbing movement and posture. Spastic limbs affects about 70-80% of the CP children, and this group is the target of our study. CP is considered a multi-factorial condition believed to be provoked by e.g. preterm birth, infection during pregnancy, neural disorders, and genetics, to mention some. Interestingly, the cytokine network is believed to be involved in many of these disorders. In this study, including 203 spastic CP cases and 167 controls, we measured the levels of 25 cytokine proteins, and genotyped 159 SNPs in their gene loci. Using logistic regression we estimated the genetic association of SNP genotypes to spastic CP. In addition, fitting a Tobit regression model for each protein and each SNP in the respective gene loci, we estimated three regression coefficients corresponding three different effects of the genetic variation on the protein level. Intriguingly, two IL18 loci SNPs (rs549908:A>C and rs1290349:C>A) showed a protective effect against spastic CP, and interestingly both were associated to a decreased epidemiological expression of IL-18 protein. By joining protein data to genetic information we have provided new data suggesting IL18's involvement in the pathogenesis of spastic CP.

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14. Stroke. 2012 Jul 24. [Epub ahead of print]

Near-Term Fetal Hypoxia-Ischemia in Rabbits: MRI Can Predict Muscle Tone Abnormalities and Deep Brain Injury.

Drobyshevsky A, Derrick M, Luo K, Zhang LQ, Wu YN, Takada SH, Yu L, Tan S.

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BACKGROUND AND PURPOSE: The pattern of antenatal brain injury varies with gestational age at the time of insult. Deep brain nuclei are often injured at older gestational ages. Having previously shown postnatal hypertonia after preterm fetal rabbit hypoxia-ischemia, the objective of this study was to investigate the causal relationship between the dynamic regional pattern of brain injury on MRI and the evolution of muscle tone in the near-term rabbit fetus. **METHODS:** Serial MRI was performed on New Zealand white rabbit fetuses to determine equipotency of fetal hypoxia-ischemia during uterine ischemia comparing 29 days gestation (E29, 92% gestation) with E22 and E25. E29 postnatal kits at 4, 24, and 72 hours after hypoxia-ischemia underwent T2- and diffusion-weighted imaging. Quantitative assessments of tone were made serially using a torque apparatus in addition to clinical assessments. **RESULTS:** Based on the brain apparent diffusion coefficient, 32 minutes of uterine ischemia was selected for E29 fetuses. At E30, 58% of the survivors manifested hind limb hypotonia. By E32, 71% of the hypotonic kits developed dystonic hypertonia. Marked and persistent apparent diffusion coefficient reduction in the basal ganglia, thalamus, and brain stem was predictive of these motor deficits. **CONCLUSIONS:** MRI observation of deep brain injury 6 to 24 hours after near-term hypoxia-ischemia predicts dystonic hypertonia postnatally. Torque-displacement measurements indicate that motor deficits in rabbits progressed from initial hypotonia to hypertonia, similar to human cerebral palsy, but in a compressed timeframe. The presence of deep brain injury and quantitative shift from hypo- to hypertonia may identify patients at risk for developing cerebral palsy.

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