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Interventions and Management

1. *J Mot Behav.* 2016 Jan 5:1-10. [Epub ahead of print]

Anticipatory Postural Adjustments in Standing Reach Tasks Among Middle-Aged Adults With Diplegic Cerebral Palsy.

Su IY, Chow DH.

Previous studies reported that children with cerebral palsy (CP) exhibited premature anticipatory postural adjustments (APAs) with high variability and excessive activity in the frontal plane. To better understand the effects of gross motor functioning level on APAs over the life course, the authors examined the presence and consistency of APAs in 11 adults with diplegia at 2 functioning levels against 8 age-matched healthy adults during unilateral and bilateral reaching. Results revealed an anticipatory vertical torque (TZ) and an increased likelihood of APAs during bilateral reaching for the lower functioning group. It is postulated that APAs may first emerge in TZ in CP. Results also indicated an excessive premovement postural activity in the frontal plane in both CP groups.

[PMID: 26730748](#)

2. *Phys Occup Ther Pediatr.* 2016 Jan 6:1-12. [Epub ahead of print]

The Influence of Intense Combined Training on Upper Extremity Function in Children With Unilateral Cerebral Palsy: Does Initial Ability Matter?

Cohen-Hozler M, Sorek G, Kerem J, Schless S, Freedman R, Rotem H, Schweitzer M, Katz-Leurer M.

AIM: To examine whether level of manual ability modifies the response to an intensive program combining modified constraint and bimanual training on arm functioning children with unilateral cerebral palsy (UCP). **METHODS:** Thirty-four children aged 6-11 years, with Manual Ability Classification System (MACS) levels I-III (I:8, II:15, III:11), participated in a 2-week program, combining an hour of modified constraint with 5 hr of bimanual practice daily. The Assisting Hand Assessment (AHA) and the Jebsen-Taylor Test of Hand Function (JTTHF) were done pre-, post-, and 3-months post-intervention. **RESULTS:** Mean AHA logits unit scores increased overtime (F2;50 = 5, p = 0.01). There was no significant difference in AHA logits units change score between MACS levels (F4;56 = 1.4, p = 0.22). JTTHF scores did not change for either the affected or less-affected hand, although a significant interaction of time and MACS level was found in the less-affected side (F4;58 = 6.5, p < 0.01). Children in MACS levels I and II improved by similar degrees, in comparison to children at MACS level III who demonstrated significantly greater change over time. **CONCLUSION:** While a similar trend of improvement was

found in the bimanual abilities of children at all MACS levels, only children at MACS level III had improved performance in unilateral abilities in the less-affected side following intervention.

[PMID: 26734890](#)

3. Conf Proc IEEE Eng Med Biol Soc. 2015 Aug;2015:3590-3. doi: 10.1109/EMBC.2015.7319169.

An ecological evaluation of the metabolic benefits due to robot-assisted gait training.

Peri E, Biffi E, Maghini C, Marzorati M, Diella E, Pedrocchi A, Turconi AC, Reni G.

Cerebral palsy (CP), one of the most common neurological disorders in childhood, features affected individual's motor skills and muscle actions. This results in elevated heart rate and rate of oxygen uptake during sub-maximal exercise, thus indicating a mean energy expenditure higher than healthy subjects. Rehabilitation, currently involving also robot-based devices, may have an impact also on these aspects. In this study, an ecological setting has been proposed to evaluate the energy expenditure of 4 children with CP before and after a robot-assisted gait training. Even if the small sample size makes it difficult to give general indications, results presented here are promising. Indeed, children showed an increasing trend of the energy expenditure per minute and a decreasing trend of the energy expenditure per step, in accordance to the control group. These data suggest a metabolic benefit of the treatment that may increase the locomotion efficiency of disabled children.

[PMID: 26737069](#)

4. Bone Joint J. 2016 Jan;98-B(1):137-43. doi: 10.1302/0301-620X.98B1.35202.

Salvage procedures for the painful chronically dislocated hip in cerebral palsy.

Hwang JH, Varte L, Kim HW, Lee DH, Park H.

The aims of this study were to report functional outcomes of salvage procedures for patients with cerebral palsy (CP) who have chronic dislocation of the hip using validated scoring systems, and to compare the results of three surgical techniques. We reviewed 37 patients retrospectively. The mean age at the time of surgery was 12.2 years (8 to 22) and the mean follow-up was 56 months (24 to 114). Patients were divided into three groups: 14 who underwent proximal femoral resection arthroplasty (PFRA group 1), ten who underwent subtrochanteric valgus osteotomy (SVO group 2), and 13 who underwent subtrochanteric valgus osteotomy with resection of the femoral head (SVO with FHR group 3). All patients were evaluated using the Caregiver Priorities and Child Health Index of Life with Disabilities (CPCHILD) and the Pediatric Quality of Life Inventory (PedsQL). Significant improvements occurred in most CPOCHILD and PedsQL subsection scores following surgery in all patients, without significant differences between the groups. There were 12 post-operative complications. Less severe complications were seen in group 1 than in groups 2 and 3. Salvage surgery appears to provide pain relief in patients with CP who have painful chronic dislocation of the hip. The three salvage procedures produced similar results, however, we recommend the use of PFRA as the complications are less severe. TAKE HOME MESSAGE: Salvage surgery can be of benefit to patients with CP with chronic painful hip dislocation, but should be limited to selected patients considering complications. Cite this article: Bone Joint J 2016;98-B:137-43.

[PMID: 26733527](#)

5. Conf Proc IEEE Eng Med Biol Soc. 2015 Aug;2015:4562-5. doi: 10.1109/EMBC.2015.7319409.

Motor control investigation of dystonic cerebral palsy: A pilot study of passive knee trajectory.

Androwis GJ, Michael PA, Jewaid D, Nolan KJ, Strongwater A, Foulds RA.

The purpose of this study is to better understand dystonia in CP and be able to objectively distinguish between individuals who experience spasticity, dystonia, or a combination of these conditions while evaluating the effect of 2Hz vestibular stimulation. Selected outcome measures included knee ROM, angular velocity and acceleration and all measures increased post vestibular stimulation; these results are indications of a possible reduction in the level of disability. The current investigation also identified an unexpected and unique behavior of the knee in children with

dystonic cerebral palsy (CP) that was noticed while administering the Pendulum Knee Drop test (PKD) at approximately 0.4 rad (a mid-angle between full extension and zero vertical). There was a catch-like phenomenon at the described mid-angle in dystonic individuals. These results may suggest that dystonia is not a velocity dependent hypersensitivity of reflexes, but may include position dependent muscle reflexes and co-contractions. This reinforces the need for a more precise objective measure or perhaps a modified measure such as a mid-angle PKD test. Furthermore, based on the results obtained through the modified technique, beneficial alterations can be made to the form of treatment such as: robotic therapy or physical therapy that specifically accommodates the unique motor control disorder in individuals with dystonic CP.

[PMID: 26737309](#)

6. Conf Proc IEEE Eng Med Biol Soc. 2015 Aug;2015:3432-5. doi: 10.1109/EMBC.2015.7319130.

Therapeutic effects of functional electrical stimulation on motor cortex in children with spastic Cerebral Palsy.

Mukhopadhyay R, Mahadevappa M, Lenka PK, Biswas A.

In the present study we have evaluated the electroencephalogram (EEG) signal recorded during ankle dorsal and plantar flexion in children with spastic Cerebral Palsy (CP) after Functional Electrical Stimulation (FES) of the Tibialis Anterior (TA) muscles. The intervention group had 10 children with spastic diplegic/hemiplegic CP within the age group of 5 to 14 years of age who received both FES for 30 minutes and the conventional physiotherapy for 30 minutes a day, while the control group had 5 children who received only conventional physiotherapy for 60(30 + 30) minutes a day only. Both groups were treated for 5 days a week, up to 12 weeks. The EEG data were analyzed for Peak Alpha Frequency (PAF), sensorimotor rhythm (SMR), mu wave suppression and power spectral density (PSD) of all the bands. The results showed a decrease in SMR and mu wave suppression in the intervention group as compared to the control group, indicating a positive/greater improvement in performance of motor activities. Therefore, from this study we could conclude that FES combined with conventional physiotherapy improves the motor activity in children with spastic CP.

[PMID: 26737030](#)

7. Conf Proc IEEE Eng Med Biol Soc. 2015 Aug;2015:5509-12. doi: 10.1109/EMBC.2015.7319639.

The effects of an ankle foot orthosis on cerebral palsy gait: A multiple regression analysis.

Wahid F, Begg R, Sangeux M, Halgamuge S, Ackland DC.

The aim of this study was twofold. Firstly, to develop a multiple regression normalization (MR) strategy to decorrelate physical properties and walking speed from spatiotemporal gait data in healthy children; and secondly, to use this MR approach to identify the effect of a solid ankle foot orthosis (AFO) on gait in children with cerebral palsy (CP). Spatiotemporal gait data during self-selected walking were obtained from 51 children with diplegic CP and 34 age-matched healthy controls. Data were normalized using standard dimensionless equations (DS) and a MR approach. Stride length, stance time, swing time, and double support time were significantly different between children with CP and healthy controls using DS ($p < 0.05$); however, only stride length and swing time were significantly different when children with CP walked with and without an AFO. Normalizing gait data using DS demonstrated significant differences in cadence and step time in children with CP when wearing an AFO compared to the controls ($p < 0.05$). In contrast, MR normalization revealed significant differences in all spatiotemporal parameters between children with CP with and without an AFO, except double support time. After MR normalization, spatiotemporal parameters in children wearing an AFO became closer to those of the controls, except for double support time. The MR approach presented will assist in evaluating the effectiveness of conservative interventions such as AFOs in children with CP, as well as in surgery, and may be useful in gait classification using machine learning.

[PMID: 26737539](#)

8. *Pediatr Phys Ther.* 2016 Jan 7. [Epub ahead of print]**Lower Extremity Handheld Dynamometry Strength Measurement in Children With Cerebral Palsy.**

Mulder-Brouwer AN, Rameckers EA, Bastiaenen CH.

PURPOSE: The purpose of this study was to evaluate the evidence on reliability of handheld dynamometry protocols to quantify maximal isometric strength of the muscles of the lower extremities of children with cerebral palsy. **METHODS:** A systematic search of Cochrane, MEDLINE, CINAHL, and PubMed up to December 2013 and best-evidence synthesis were performed. **RESULTS:** Seven eligible studies were identified. Best-evidence synthesis revealed "unknown" to "moderate" evidence. Intraclass correlation coefficient values were "positive" for most muscle groups for intrarater reliability and showed mixed results for interrater reliability. **CONCLUSIONS:** Because of small sample sizes (10-25) in all included studies, the final level of evidence remains "unknown." Reliability data obtained in the included studies of handheld dynamometry in children with cerebral palsy are promising, despite low levels of evidence. When these protocols are applied very carefully, they may prove relevant to different clinical settings.

[PMID: 26744991](#)

9. *Disabil Health J.* 2015 Dec 1. pii: S1936-6574(15)00173-9. doi: 10.1016/j.dhjo.2015.11.003. [Epub ahead of print]**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.

BACKGROUND: This is the first study that quantified the anaerobic performance in football players with cerebral palsy (CP). **OBJECTIVE/HYPOTHESIS:** 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 players with 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.

[PMID: 26723466](#)

10. *Br J Ophthalmol.* 2016 Jan 4. pii: bjophthalmol-2015-307296. doi: 10.1136/bjophthalmol-2015-307296. [Epub ahead of print]**Perceptual visual dysfunction, physical impairment and quality of life in Bangladeshi children with cerebral palsy.**

Mitry D, Williams C, Northstone K, Akter A, Jewel J, Khan N, Muhit M, Gilbert CE, Bowman R.

BACKGROUND: Cerebral palsy (CP) is the most common cause of motor disability in children and is often accompanied by sensory and/or cognitive impairment. The aim of this study was to characterise visual acuity impairment, perceptual visual dysfunction (PVD) and physical disability in a community-based sample of Bangladeshi children with CP and to assess the impact of these factors on the quality of life of the children. **METHODS:** A key informant study was used to recruit children with CP from Sirajganj district. Gross Motor Function Classification System (GMFCS) levels and visual impairment were assessed by a physiotherapist and an optometrist, respectively. Assessments of visual perception were performed and standardised questionnaires were administered to each child's main carer to elicit indicators of PVD and parent-reported health-related quality of life.

A generalised linear regression analysis was conducted to assess the determinants of the quality of life scores. RESULTS: 180 children were recruited. The median age was 8 years (IQR: 6-11 years); 112 (62%) were male; 57 (32%) had visual acuity impairment and 95 (53%) had some parent-reported PVD. In analyses adjusted for age, sex, GMFCS and acuity impairment, visual attention ($p < 0.001$) and recognition/navigation ($p < 0.001$) were associated with total health-related quality of life, and there were similar trends for total PVD score ($p = 0.006$) and visual search ($p = 0.020$). CONCLUSIONS: PVD is an important contributor in reducing quality of life in children with CP, independent of motor disability and acuity impairment. Better characterisation of PVD is important to help design interventions for affected children, which may improve their quality of life. Published by the BMJ Publishing Group Limited.

[PMID: 26729766](#)

11. Int J Paediatr Dent. 2016 Jan 4. doi: 10.1111/ipd.12220. [Epub ahead of print]

Gingivitis and salivary osmolality in children with cerebral palsy.

Santos MT, Ferreira MC, Guaré RO, Diniz MB, Rösing CK, Rodrigues JA, Duarte DA.

AIM: To investigate the influence of salivary osmolality on the occurrence of gingivitis in children with cerebral palsy (CP). DESIGN: A total of 82 children with spastic CP were included in this cross-sectional study. Oral motor performance and gingival conditions were evaluated. Unstimulated saliva was collected using cotton swabs, and salivary osmolality was measured using a freezing point depression osmometer. Spearman's coefficient, receiver operating characteristic (ROC), and multiple logistic regression analyses were performed. RESULTS: Strong correlation ($r > 0.7$) was determined among salivary osmolality, salivary flow rate, visible plaque, dental calculus, and the occurrence of gingivitis. The area under the ROC to predict the influence of salivary osmolality on the occurrence of gingivitis was 0.88 (95% CI 0.81-0.96; $P < 0.001$). The cutoff value of 84.5 for salivary osmolality presented good sensitivity and specificity, both higher than 77%. The proportion of children presenting salivary osmolality ≤ 84.5 mOsm/kgH₂O and gingivitis was 22.5%, whereas for the group presenting osmolality > 84.5 mOsm/kgH₂O, the proportion of children with gingivitis was 77.5%. Salivary osmolality above 84.5 increased the likelihood of gingivitis fivefold, whereas each additional 0.1 mL of salivary flow reduced the likelihood of gingivitis by 97%. CONCLUSION: Gingivitis occurs more frequently in children with CP showing increased values of salivary osmolality.

[PMID: 26726753](#)

12. Res Dev Disabil. 2015 Dec 28;49-50:247-257. doi: 10.1016/j.ridd.2015.11.025. [Epub ahead of print]

Differences in autonomic functions as related to induced stress between children with and without cerebral palsy while performing a virtual meal-making task.

Kirshner S, Weiss PL, Tirosh E.

BACKGROUND: Efforts to improve the participation and performance of children with cerebral palsy (CP) are often related to the adaptation of environmental conditions to meet their cognitive and motor abilities. However, the influence of affective stimuli within the environment on emotion and performance, and their ability to improve or impede the children's participation has not been investigated in any systematic way although the emerging evidence suggests that it affects the individuals in many levels. OBJECTIVES: (1) To measure autonomic responses to affective stimuli during a simulated Meal-Maker task in children with CP in comparison to children who are typically developing, and (2) to examine the interactions between autonomic functions, subjective reports of stress, and task performance among children with and without CP. METHODS: Fifteen children with CP and 19 typically developing peers (6 to 12 years) participated. After completing behavioral questionnaires (e.g., State and Trait Anxiety Inventories), children prepared meals within a camera tracking virtual Meal-Maker environment. Either a negative, positive, or neutral visual stimulus was displayed, selected from the International Affective Picture System. Children also passively viewed the same pictures while rating their valence and arousal levels. Heart rate (HR) and skin conductance were recorded synchronously with stimulus onset. RESULTS: Significant differences in autonomic functions were found between groups, i.e., a higher "low frequency" to "high frequency" (LF:HF) ratio in the children with CP during the meals associated with a negative stimulus ($p = 0.011$). Only children with CP had significant positive correlations between trait anxiety and LF:HF ratio during virtual meal-making associated with positive ($p = 0.049$) and negative stimuli ($p = 0.003$) but not during neutral stimuli. For children with CP the amplitude

of skin conductance response during passive picture viewing was significantly higher for negative than for positive stimuli ($p=0.017$) but there were no significant changes in autonomic responses during virtual Meal-Maker task. Significant correlations between trait anxiety, autonomic activity during the calm state and Meal-Maker performance outcomes were found only for children with CP. CONCLUSIONS: In general, the Meal-Maker virtual environment was shown to be a feasible platform for the investigation of the effect of emotionally loaded stimuli on the balance of autonomic functions in children with and without CP. Anxiety level appears to play a significant role in children with CP and should be considered as a potentially important factor during clinical evaluation and intervention. Further studies are needed to develop additional measurements of emotional responses and to refine the types of affective interference.

[PMID: 26735708](#)

13. Conf Proc IEEE Eng Med Biol Soc. 2015 Aug;2015:5187-90. doi: 10.1109/EMBC.2015.7319560.

Frequency-based features for early cerebral palsy prediction.

Rahmati H, Martens H, Aamo OM, Stavdahl O, Stoen R, Adde L.

In this paper we aim at predicting cerebral palsy, the most serious and lifelong motor function disorder in children, at an early age by analysing infants' motion data. An essential step for doing so is to extract informative features with high class separability. We propose a set of features derived from frequency analysis of the motion data. Then, we evaluate the practicality of our features on one of the richest data sets collected to study this disease. In this data set, the motion data are extracted from both electromagnetic sensors as well as video camera. The proposed features are used for classifying both data sets. Using these features, we manage to achieve promising classification performance. Classification accuracy of 91% for the sensor data and 88% for the video-derived data show not only the advantage of employing these features for predicting cerebral palsy, but also that replacing electromagnetic sensors with a video camera is feasible.

[PMID: 26737460](#)

14. Epilepsy Behav Case Rep. 2014 Feb 12;4:104-7. doi: 10.1016/j.ebcr.2014.01.005. eCollection 2015.

Lateralized, nonepileptic convulsions in an adult with cerebral palsy: Case report and review of the literature.

Gale S, Safar L, Robbins J, Daffner K.

The authors report a case of unilateral functional neurological symptoms (nonepileptic convulsions) in a 38-year-old man with mild, motor-predominant cerebral palsy. His convulsions are all lateralized to the same side as his paretic limbs. His episodes significantly decreased after several months of weekly psychodynamic-oriented psychotherapy. Functional neurological disorders have been rarely reported in children or adults with cerebral palsy. Among patients with brain injury, right-hemispheric brain disease may be more helpful than either handedness or the side of symptoms in clinically profiling patients with suspected functional disorders. This case raises biomechanistic questions about brain injury, the development of functional disorders, and the lateralization of functional symptoms.

[PMID: 26744693](#)

Prevention and Cure

15. Am J Obstet Gynecol. 2015 Dec 23. pii: S0002-9378(15)02579-X. doi: 10.1016/j.ajog.2015.12.031. [Epub ahead of print]

Prolonged Latency of Preterm Premature Rupture of Membranes and Risk of Neonatal Sepsis.

Drassinower D, Friedman AM, Običan SG, Levin H, Gyamfi-Bannerman C.

BACKGROUND: Preterm premature rupture of membranes (PPROM) is associated with inflammation and infection,

and it may involve the loss of a barrier to ascending infection from the vagina, it is possible that prolonged PPROM could be an independent risk factor for neonatal sepsis. **OBJECTIVE:** To determine whether prolonged latency after PPROM is associated with an increased risk of neonatal sepsis. **STUDY DESIGN:** This secondary analysis of the randomized controlled trial of magnesium sulfate for the prevention of cerebral palsy evaluated whether the time interval between diagnosis of PPROM and delivery was associated with increased risk of neonatal sepsis. Latency time was categorized by weeks of latency (0 weeks - ≥ 4 weeks). The primary outcome was confirmed neonatal sepsis. Logistic regression was used to control for confounders. **RESULTS:** 1596 patients with PPROM were analyzed, of whom 1390 had a < 4 week interval and 206 had an interval of ≥ 4 weeks. Confirmed neonatal sepsis occurred in 15.5% of patients in the cohort. In the univariate analysis, patients in the prolonged PPROM group were less likely to have neonatal sepsis (6.8% vs 17.2%, RR 0.40 95% confidence interval 0.24-0.66). This relationship was retained in the multivariable model; patients with prolonged PPROM ≥ 4 weeks had an adjusted odds ratio of 0.21 (95% CI 0.10-0.41) for neonatal sepsis. Neonatal sepsis was also significantly associated with earlier gestational age at rupture of membranes. **CONCLUSION:** Prolonged exposure to an intrauterine environment of PPROM does not increase the risk of neonatal sepsis; prolonged PPROM ≥ 4 weeks was associated with decreased risk of neonatal sepsis.

[PMID: 26723194](#)