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## Interventions and Management

### **1. Protocol of Changes Induced by Early Hand-Arm Bimanual Intensive Therapy Including Lower Extremities (e-HABIT-ILE) in Pre-School Children With Bilateral Cerebral Palsy: A Multisite Randomized Controlled Trial**

Rodrigo Araneda, Stephane V Sizonenko, Christopher J Newman, Mickael Dinomais, Gregoire Le Gal, Daniela Ebner-Karestinos, Julie Paradis, Anne Klöcker, Geoffroy Saussez, Josselin Demas, Rodolphe Bailly, Sandra Bouvier, Emmanuel Nowak, Andrea Guzzetta, Inmaculada Riquelme, Sylvain Brochard, Yannick Bleyenheuff

BMC Neurol. 2020 Jun 12;20(1):243. doi: 10.1186/s12883-020-01820-2.

**Background:** Cerebral palsy (CP), which is the leading cause of motor disability during childhood, can produce sensory and cognitive impairments at different degrees. Most recent therapeutic interventions for these patients have solely focused on upper extremities (UE), although more than 60% of these patients present lower extremities (LE) deficits. Recently, a new therapeutic concept, Hand-arm Bimanual Intensive Therapy Including Lower Extremities (HABIT-ILE), has been proposed, involving the constant stimulation of UE and LE. Based on motor skill learning principles, HABIT-ILE is delivered in a day-camp setting, promoting voluntary movements for several hours per day during 10 consecutive week days. Interestingly, the effects of this intervention in a large scale of youngsters are yet to be observed. This is of interest due to the lack of knowledge on functional, neuroplastic and biomechanical changes in infants with bilateral CP. The aim of this randomized controlled study is to assess the effects of HABIT-ILE adapted for pre-school children with bilateral CP regarding functional, neuroplastic and biomechanical factors. **Methods:** This international, multicentric study will include 50 pre-school children with CP from 12 to 60 months of age, comparing the effect of 50 h (2 weeks) of HABIT-ILE versus regular motor activity and/or customary rehabilitation. HABIT-ILE presents structured activities and functional tasks with continuous increase in difficulty while the child evolves. Assessments will be performed at 3 period times: baseline, two weeks later and 3 months later. The primary outcome will be the Gross Motor Function Measure 66. Secondary outcomes will include Both Hands Assessment, Melbourne Assessment-2, Semmes-Weinstein Monofilament Test, algometry assessments, executive function tests, ACTIVLIM-CP questionnaire, Pediatric Evaluation of Disability Inventory (computer adaptive test), Young Children's Participation and Environment Measure, Measure of the Process of Care, Canadian Occupational Performance Measure, neuroimaging and kinematics. **Discussion:** The results of this study should highlight the impact of a motor, intensive, goal-directed therapy (HABIT-ILE) in pre-school children at a functional, neuroplastic and biomechanical level. In addition, this changes could demonstrated the impact of this intervention in the developmental curve of each child, improving functional ability, activity and participation in short-, mid- and long-term. **Name of the registry:** Evaluation of Functional, Neuroplastic and Biomechanical Changes Induced by an Intensive, Playful Early-morning Treatment Including Lower Limbs (EARLY-HABIT-ILE) in Preschool Children With Uni and Bilateral Cerebral Palsy (HABIT-ILE). **Trial registration:** NCT04017871 **REGISTRATION DATE:** July 12, 2019.

PMID: [32532249](https://pubmed.ncbi.nlm.nih.gov/32532249/)

### **2. [Effect of Biofeedback Combined With Task-oriented Training on Hand Function, Gesell Scale Score and Balance Ability in Children With Spastic Cerebral Palsy][Article in Chinese]**

Jin-Rong Huang, Feng Zhang, Fang-Fang Wen, Fu-Jian Chen, Ting-Ting Zhu

Sichuan Da Xue Xue Bao Yi Xue Ban. 2020 May;51(3):428-433. doi: 10.12182/20200360105.

**Objective:** To analyze the effects of biofeedback combined with task-oriented training on hand function, Gesell's infant development scale score (Gesell) and balance ability in children with spastic cerebral palsy (SCP). **Methods:** 66 children with SCP admitted to our hospital from January 2016 to June 2018 were randomly divided into the control group and the observation group. The control group (n=33) received conventional rehabilitation treatment, and the observation group (n=33) received biofeedback combined with task-oriented training based on the treatment of control group. After 6-month treatment, Modified Ashworth scale (MAS) score, Berg balance scale (BBS) score, standing and walking function score in gross motor function scale (GMFM), assisting hand assessment scales (AHA) score, Gesell scale score and satisfaction of the children's parents were compared between the two groups. **Results:** The MAS score after treatment was lower than that before treatment in both two groups (P<0.05), and the BBS score after treatment was higher than that before treatment in both two groups (P<0.05). After treatment, the MAS score in the observation group was lower than the control group, and the BBS score in the observation group was higher than the control group (P<0.05). The scores of standing and walking function after treatment were higher than that before treatment in both two groups (P<0.05). After treatment, the scores of standing and walking function in the observation group were higher than the control group (P<0.05). The AHA score and Gesell developmental quotient (DQ) score after treatment were higher than that before treatment in both two groups (P<0.05). After the treatment, the AHA score and Gesell DQ score in the observation group were higher than the control group (P<0.05). The satisfaction rate of rehabilitation treatment in the observation group was higher than the control group (90.91% vs. 60.61%, P<0.05). **Conclusion:** Biofeedback combined with task-oriented training can improve balance ability, spasm relieve, hand function, development level, standing and walking function in the children with spastic cerebral palsy and increase the treatment satisfaction degree of children's guardians.

PMID: [32543155](#)

### **3. Selective Dorsal Rhizotomy and Energy Consumption in Children With Cerebral Palsy: The Importance of Publishing Unpopular Results**

Andrew Skalsky

Dev Med Child Neurol. 2020 Jun 16. doi: 10.1111/dmcn.14595. Online ahead of print.

PMID: [32543716](#)

### **4. Efficacy of Radial Extracorporeal Shock Wave Therapy Compared With Botulinum Toxin Type A Injection in Treatment of Lower Extremity Spasticity in Subjects With Cerebral Palsy: A Randomized, Controlled, Cross-Over Study**

Xavier Vidal, Joan Martí-Fàbregas, Olga Canet, Marta Roqué, Antoni Morral, Miriam Tur, Christoph Schmitz, Mercè Sitjà-Rabert

J Rehabil Med. 2020 Jun 11. doi: 10.2340/16501977-2703. Online ahead of print.

**Objectives:** To investigate whether botulinum toxin type A (BTX-A) injection is more effective than radial extracorporeal shock wave therapy in reducing plantar flexor muscle spasticity in subjects with cerebral palsy. **Methods:** A total of 68 subjects with cerebral palsy were randomly allocated to BTX-A injection (Group 1) or radial extracorporeal shock wave therapy (Group 2) (first experiment; E1). Outcome was evaluated using the Tardieu V1 and V3 stretches, at 3 weeks, 2 months (M2) and M3 after baseline. At M6 subjects in Group 1 received radial extracorporeal shock wave therapy and subjects in Group 2 received BTX-A injection (second experiment; E2); outcome was evaluated as in E1. Treatment success was defined as improvement in foot dorsiflexion  $\geq 10^\circ$  when performing the V3 stretch at M2 in both experiments. **Results:** In both experiments mean V1 and V3 significantly improved over time. In E1 both treatments resulted in similar treatment success. In E2 fewer subjects treated with BTX-A injection reached the criteria of treatment success than did subjects treated with radial extracorporeal shock wave therapy, which was due to a carry-over effect from E1. No significant complications were observed. **Conclusion:** BTX-A injection is not superior to radial extracorporeal shock wave therapy in the treatment of plantar flexor muscle spasticity in subjects with cerebral palsy.

PMID: [32556354](#)

### 5. Canonical Correlation Between Body-Posture Deviations and Gait Disorders in Children With Cerebral Palsy

Andrzej Szopa, Małgorzata Domagalska-Szopa, Andrzej Siwec, Ilona Kwiecień-Czerwieniec

PLoS One. 2020 Jun 16;15(6):e0234654. doi: 10.1371/journal.pone.0234654. eCollection 2020.

Children with Cerebral Palsy (CP) show the postural constraints while standing, and gait disorders, resulting from both primary and secondary impairments of brain injury. In our previous studies, several characteristic postural and gait patterns in children with unilateral as well as with bilateral CP were defined, and the relationship between these patterns was demonstrated. The purpose of present study was to identify which features of body posture deviation during standing were strongly related to gait deviations in independently ambulatory children with CP. For this aim we explored the cross-relationship between features of body posture while standing examined by surface topography and the selected gait parameters from three-dimensional instrumented gait analysis in one hundred twenty children with cerebral palsy, aged between 7 and 13 years, who were able to walk independently. First, our study documented that that sagittal misalignment of the spine curvature was significantly related to kinematic deviations such as deviations of pelvic tilt, inadequate swing phase and knee flexion, and peak dorsiflexion in stance. Second, the study shows that the static asymmetry of pelvis and trunk was significantly associated with kinematic deviations during gait cycle such as pelvic rotation, hip abduction in swing, ROM of knee flexion, peak dorsiflexion in stance. Based on obtained results and referring to our previous findings it can be assumed that the first model of the relationship between postural deviation and gait disturbances, called 'postural and gait complex of disorders in sagittal plane', is related to children with bilateral CP, whereas the second model 'postural and gait complex of disorders in coronal plane' to children with unilateral CP. The clinical applications of this study relate to the early recognition of particular features of postural deviation using surface topography, instead of more difficult and demanding expensive tools 3-D gait analysis.

PMID: [32544177](#)

### 6. Inter-rater and Intrarater Reliabilities of the Identification of a "Gothic Arch" in the Acetabulum of Children With Cerebral Palsy

Stacey Miller, Eva Habib, Jeffrey Bone, Emily Schaeffer, Brian W Yang, Jodie Shea, Ava Maleki, Benjamin J Shore, Kishore Mulpuri

J Pediatr Orthop. 2020 Jun 17. doi: 10.1097/BPO.0000000000001615. Online ahead of print.

Background: Progressive hip displacement in children with cerebral palsy (CP) is monitored by measuring migration percentage (MP) on anteroposterior (AP) pelvis radiographs. Accurate measurement of MP requires the lateral margin of the ossified acetabulum to be identified for the placement of Perkin's line. It has been suggested that when there is an erosion of the acetabular rim, described as a gothic arch, the midpoint of the arch be used for the placement of Perkin's line. However, this requires that there be agreement on what constitutes a gothic arch. The purpose of this study was to evaluate the inter-rater and intrarater reliabilities of identifying a gothic arch on pelvis radiographs. Methods: An online survey with 100 AP pelvis images (200 hips) of children with CP was sent to international experts. Participants were asked to identify which hip(s) had a gothic arch (left, right, both, and neither). The Fleiss  $\kappa$  statistic for inter-rater reliability was calculated. Eight weeks later, the images were shuffled and redistributed to calculate intrarater reliability. Results: The initial survey was completed by 10 participants with 9 participants completing the second survey. The average inter-rater  $\kappa$  value was 0.18 [95% confidence interval (CI), 0.14-0.23] and 0.19 (95% CI, 0.14-0.24) for the 2 surveys, respectively. Among the pediatric orthopaedic surgeons subgroup, the  $\kappa$  values were 0.06 (95% CI, 0.02-0.1) and 0.08 (95% CI, 0.03-0.13). The average intrarater reliability  $\kappa$  value was 0.61 (95% CI, 0.2-1), ranging from 0.32 to 0.86. Conclusions: There were poor inter-rater and moderate intrarater reliabilities in identifying a gothic arch on AP pelvis radiographs in children with CP. Further characterization and clarification of what constitutes a gothic arch are required. The lack of agreement on the identification of a gothic arch may negatively impact the measurement of MP and referrals to a pediatric orthopaedic surgeon.

PMID: [32558745](#)

### 7. RESULTS OF ORTHOSES USED ON AMBULATORY PATIENTS WITH BILATERAL CEREBRAL PALSY

Alessandro Giurizzatto Melanda, Ana Carolina Pauleto, Dielise Debona Lucksch, Rodrigo Fauz Munhoz DA Cunha, Suhaila Mahmoud Smaili

Acta Ortop Bras. May-Jun 2020;28(3):137-141. doi: 10.1590/1413-785220202803228922.

**Objective:** To investigate the impact of ankle-foot orthoses (AFO) on subjects diagnosed with bilateral cerebral palsy (CP) using the gait index and temporal data parameters. **Methods:** Twenty-four subjects, 14 male and 10 female, with a mean age of 11 (5-17 years old), underwent a comprehensive gait analysis under both barefoot (BF) and braced walking conditions. All children had been wearing the orthoses for at least 2 months before the gait analysis. **Results:** The overall values for the left and right Gait Profile Scores (GPS) did not show statistically significant variations when comparing the same individuals with and without orthoses. Gait velocity increased by 19.5% ( $p < 0.001$ ), while the cadence decreased by 4% with use of orthosis, although it was not statistically significant ( $p > 0.05$ ). The stride and the step lengths on both the right and left sides, however, resulted in statistically significant increases, when wearing AFO. **Conclusion:** AFO, prescribed for assistance by professionals without using gait data, did not significantly affect the gait index (GPS), but improved temporal data. The determination of quantitative clinical parameters for the prescription of orthotics in patients with bilateral CP, as well as orthotics that meet the specific requirements are points to be addressed in the future to obtain more significant effects. Level of evidence III, Case control study.

PMID: [32536795](https://pubmed.ncbi.nlm.nih.gov/32536795/)

### **8. The Split Transfer of Tibialis Anterior Tendon to Peroneus Tertius Tendon for Equinovarus Foot in Children With Cerebral Palsy**

İlker Abdullah Sarıkaya, Sema Ertan Birsnel, Ali Şeker, Ozan Ali Erdal, Barış Görgün, Muharrem İnan

Acta Orthop Traumatol Turc. 2020 May;54(3):262-268. doi: 10.5152/j.aott.2020.03.571.

**Objective:** The aim of this study was to analyze the results of the split anterior tibialis tendon transfer (SPLATT) to peroneus tertius (PT) for equinovarus foot deformity in children with cerebral palsy (CP). **Methods:** The medical records of 25 ambulatory CP patients (mean age:  $8.7 \pm 3.2$  years, range: 4-16 years) with equinovarus foot (33 feet), who underwent SPLATT to PT surgery between 2014 and 2016, were retrospectively reviewed. A senior surgeon performed all the surgical procedures. SPLATT was performed as part of a single-event multilevel surgery for the lower limb, and the concomitant procedures on the same extremity were recorded. The patients who required any additional foot or ankle surgery that could affect the clinical outcome (except heel cord lengthening) were excluded from the study. The Kling's College Criteria were used to evaluate the procedural outcome of the foot position and gait, and the associated complications were recorded. **Results:** The mean follow-up time was  $28.8 \pm 5$  months (range: 24-42 months). The postoperative Kling scores were excellent for 27 feet of the patients who had a plantigrade foot, without fixed or postural deformity, in a regular shoe, having no calluses; good for 5 cases for those who walked with less than  $5^\circ$  varus, valgus, or equinus posture of the hind foot, wearing regular shoes, having no callosities; and fair for 1 case for those who had recurrence of the deformity. There was only one wound detachment, which was treated with wound care and dressing. None of the patients had overcorrection, infection, or bone fracture. **Conclusion:** The dynamic SPLATT to PT surgery for the management of the equinovarus foot deformities in the CP patients is a safe and less complicated surgical alternative with a good functional outcome. It is a safe and effective treatment method for the management of equinovarus foot deformities in CP. Level of evidence: Level IV, Therapeutic study.

PMID: [32544062](https://pubmed.ncbi.nlm.nih.gov/32544062/)

### **9. Ultrasonographic Measurement of Talar Cartilage Thickness in Patient With Cerebral Palsy**

Berke Aras, Serdar Kesikburun, Volkan Yılmaz, Emine Yeliz Gümüş Demirtaş, Evren Yaşar

Am J Phys Med Rehabil. 2020 Jun 10. doi: 10.1097/PHM.0000000000001499. Online ahead of print.

**Objective:** Foot deformities are one of the most common musculoskeletal problems in children with cerebral palsy (CP). These deformities affect the walking ability and function of the patients. Talar cartilage is the hyaline joint cartilage of the tibiotalar joint which plantarflexes and dorsiflexes of the ankle. The aim of this study was to determine whether talar cartilage thickness was affected in children with ambulant diplegic cerebral palsy. **Design:** 40 patients with diplegic CP (19 males, 21 females) and 40 age, gender, and weight-matched healthy control subjects (20 males, 20 females) were included in the study. The demographic and clinical characteristics of the patients including age, sex and body mass index (BMI) were recorded. Patients were classified using the GMFCS. A 12 MHz linear probe was used for ultrasonographic cartilage measurements at the tibiotalar joint according to EURO-MUSCULUS/ USPRM scanning protocols. **Results:** Mean talar cartilage thickness was

significantly decreased in the cerebral palsy group compared to the healthy control group ( $p < 0.001$ ). There was a significant negative correlation between GMFCS levels and talar cartilage thickness measurements ( $p < 0.001$ ,  $\tau = -0.695$ ). Conclusion: This study demonstrates that patients with CP have a thinner talar cartilage compared to healthy control subjects.

PMID: [32541350](#)

### 10. Spastic Cerebral Palsy Pain Improvement With Propofol: A Case Report

Valéria Martinez, Thibaud Lansaman, Leah Guichard

A A Pract. 2020 May;14(7):e01217. doi: 10.1213/XAA.0000000000001217.

Propofol is a sedative and a hypnotic agent used in the induction and maintenance of general anesthesia. Propofol also relaxes skeletal muscles. It has been used successfully to treat local or diffuse muscular rigidity from various etiologies. Propofol also provides modulation of pain processing and perception. Our case report describes a 25-year-old patient with painful spastic cerebral palsy, who experienced prolonged improvement of his symptoms after treatment with propofol. The patient has received 13 administrations of propofol with similar efficacy each time.

PMID: [32539269](#)

### 11. Communication Behaviours of Children With Cerebral Palsy Who Are Minimally Verbal

Cristina Mei, Bethany Fern, Sheena Reilly, Madeleine Hodgson, Dinah Reddihough, Fiona Mensah, Angela Morgan

Child Care Health Dev. 2020 Jun 17. doi: 10.1111/cch.12792. Online ahead of print.

Background: There is a lack of population-based studies exploring the communicative behaviours of minimally verbal children with cerebral palsy (CP), with factors associated with superior and poorer communication outcomes unknown. This study aimed to examine the communication behaviours of minimally verbal children with CP recruited from a representative community sample, and to identify factors associated with communication outcomes. Methods: Twenty minimally verbal children aged 5-6 years, recruited through the Victorian Cerebral Palsy Register, completed the Communication and Symbolic Behaviour Scales-Developmental Profile (CSBS-DP). Linear regressions examined child-related and environmental factors associated with communication outcomes. Results: CSBS-DP total raw scores ranged from 0-113. Strengths were the use of conventional gestures and understanding of language. Challenges were noted in using sequential action schemes during play. Communication typically served to regulate the behaviour of others. All participants demonstrated reduced functional communication (Communication Function Classification System levels III-IV). In the multivariable regression model adjusted for cognition, poorer communication skills were associated with Manual Ability Classification System levels IV-V ( $p = 0.004$ ). Conclusions: Whilst some children with CP who are minimally verbal use a variety of communication functions, significant functional limitations may be apparent. Severe upper limb impairment may provide an early indication of greater communication difficulties.

PMID: [32557737](#)

### 12. Validity, Reliability and Responsiveness to Change of the French Version of the Drooling Impact Scale

Rachel Bard-Pondarré, Fabienne Roumenoff, Christell Julien, Gwen Grguric, Mélanie Porte, Christophe Boulay, Véronique Bourg, Emmanuelle Chaléat-Valayer

Disabil Rehabil. 2020 Jun 17;1-7. doi: 10.1080/09638288.2020.1777471. Online ahead of print.

Background: work still needs to be done to measure the impact of sialorrhea on quality of life and define the efficacy of different therapies. The Drooling Impact Scale showed good validity and sensitivity to change, especially after botulinum toxin injection. The aim of this study is to present its French translation and to explore its validity, reliability and responsiveness to change in a group of children with Cerebral Palsy. Methods: multicentre study at six rehabilitation centres in France. Children

with Cerebral Palsy aged 4-18 years with sialorrhea problems were included (n = 55), either in a control group (n = 33) or in the intervention group (n = 22, with 3 drug treatment and 19 botulinum toxin injections). The French Drooling Impact Scale was administered twice, 1 month apart. Results: The French Drooling Impact Scale total score at inclusion was meanly 53.9 (Standard Deviation 11.9) in the stable control group and 66.0 (16.1) in the intervention group (p = 0.0058). The validity of the scale was established, as well as an adequate internal consistency (Cronbach's  $\alpha = 0.71$ ); correlations between each item and the total score were found between 0.5 and 0.71 except for item 5 (r = 0.38) and item 7 (0.41). The test-retest reliability in stable children was good (Lin coefficient = 0.83, bias correction factor = 0.92 and Pearson correlation coefficient = 0.89). There was a high responsiveness to change, mean change was -40.0 in the intervention group and -3.6 in the stable group (p < 0.0001), with Standard Error of Measurement = 2.6. Conclusion: the French Drooling Impact Scale has shown sufficient clinometric properties to be used now by clinicians or researchers. IMPLICATIONS FOR REHABILITATION The Drooling Impact scale has now its French version. The French version of the Drooling Impact Scale has shown its validity and a good test-retest reliability. The responsiveness to change was explored in a group of children undergoing saliva-control interventions and the scale was able to show a big change. The authors recommend to use this questionnaire in a semi-directed interview conducted by a health professional.

PMID: [32552097](#)

### 13. Caregivers' Perceptions Regarding Oral Health Status of Children and Adolescents With Cerebral Palsy

Cristiana Pereira Malta, Gabriele Groehs Guerreiro, Natali Marchezan Dornelles, Clandio Timm Marques, Juliana Saibt Martins, Leticia Westphalen Bento

J Clin Pediatr Dent. 2020 Jun 17. doi: 10.17796/1053-4625-44.3.5. Online ahead of print.

Objectives: The aim of the present study was to compare the perception of caregivers regarding the oral health status of children and adolescents with cerebral palsy (CP) and those with typical development. Study Design: Study group (SG) was composed of 35 children and adolescents with a clinical diagnosis of CP and their caregivers. Control group (CG) was composed of 35 individuals with typical development (matched with the SG for age, sex and caries activity) and their caregivers. Questionnaire was administered to caregivers addressing the oral health of individuals under their care. Caries activity, dmft/DMFT index, visible plaque index (VPI) and occlusal characteristics were determined. Results: Statistically significant differences were found in the perceptions of dental problems (p = 0.004) and gingival bleeding (p = 0.013). Individuals in SG whose caregivers perceived dental problems had a higher mean VPI (50.84 ± 5.11%) than those in CG (27.97 ± 6.50%). The mean dmft/DMFT in the SG was 2.77 ± 3.20. Class II molar relationship, overjet and anterior open bite were more prevalent in the SG. Conclusion: Caregivers of children/adolescents with CP perceive more oral problems, such as visible plaque, gingival bleeding and malocclusion, than caregivers of children/adolescents with typical development.

PMID: [32552449](#)

### 14. Progression of Motor Disability in Cerebral Palsy: The Role of Concomitant Epilepsy

Tomoyuki Takano, Anri Hayashi, Yuki Harada

Seizure. 2020 Jun 9;80:81-85. doi: 10.1016/j.seizure.2020.06.014. Online ahead of print.

Purpose: The aim of this study is to investigate the clinical characteristics of epilepsy affecting the progression of motor disabilities in cerebral palsy (CP). Methods: CP patients were retrospectively followed for 15 years from January 2005 to January 2020, and the following items were collected from the medical records: sex, age, etiology, and the clinical features of epilepsy. All patients were divided into two groups of unchanging CP and worsening CP based on whether or not they showed progression of motor disabilities during 15 years' hospitalization, respectively. Results: In total, we evaluated 65 CP cases who had been continuously hospitalized for more than 15 years. Twenty-eight patients had unchanging CP, showing no changes in motor disabilities for 15 years, while 37 had worsening CP, showing a worsening of the motor disabilities over 15 years. Most epilepsy patients with unchanging CP showed their first seizure onset during the first year of life (62.5 %), while the epilepsy patients with worsening CP showed the onset from 1 year of age (70.8 %) (p = 0.03). Daily or weekly seizure frequency was significantly more apparent in cases of worsening CP (25.0 %) than in cases of unchanging CP (p = 0.03). Conclusion: The younger the age at the time of seizure onset, the less severe the consequences appear to be. Furthermore, increased seizure frequency seems to be directly related to reduced functional connections involving the whole brain. These two factors result in progressive motor disabilities, including intellectual, sensory and behavioral difficulties in CP patients.

PMID: [32544658](#)

### 15. Bone Health Impairment in Patients With Cerebral Palsy

José Miguel Martínez de Zabarte Fernández, Ignacio Ros Arnal, José Luis Peña Segura, Ruth García Romero, Gerardo Rodríguez Martínez

Arch Osteoporos. 2020 Jun 18;15(1):91. doi: 10.1007/s11657-020-00753-0.

Bone health problems may be related to the nutritional deficit in pediatric patients with cerebral palsy. It is common to find asymptomatic vertebral fractures when they have low bone mineral density. Fat mass deficit could be related to a lower bone mineral density and a higher risk of vertebral fractures. Objectives: To study the bone health of patients with CP and its relationship with neurological and nutritional status. Purpose: Cerebral palsy (CP) is the most common cause of motor disability in pediatric age. Methods: Cross-sectional, observational, descriptive, and analytical study in which patients with CP between 4 and 5 years with Gross Motor Function Classification System (GMFCS) grades III-IV-V were included. It was carried out: survey, anthropometric study, bioimpedanciometry (BIA), and bone densitometry. Patients with low bone mineral density (BMD Z score less than - 2.0) underwent lumbar radiography looking for vertebral fractures to be diagnosed with osteoporosis. Results: Total sample: 51 patients (51.0% women). Mean age:  $11.0 \pm 0.5$  years. BMD Z score average: - 2.1 (95% CI - 2.5, - 1.7). BMD Z score according to GMFCS: grade III - 1.6 (- 2.2; - 1.), grade IV - 1.6 (- 2.4; - 0.9), grade V - 3.1 (- 3.9, - 2.2) ( $p = 0.013$ ). Bone health classification according to the International Society for Clinical Densitometry was: 47.1% normal, 52.9% low BMD. Relationship between low BMD and low fat mass ( $p = 0.030$ ) and low cell mass ( $p = 0.040$ ) was found. Prevalence of vertebral fractures in lumbar radiography: 25.9%, increasing as the degree of neurological involvement. Vertebral fractures were found in 5/13 GMFCS grade V, 2/6 GMFCS grade IV, and 0/10 GMFCS grade III. Conclusions: Bone health in the pediatric population with CP is compromised in relation to the degree of neurological involvement and nutritional status. Those patients with moderate-severe cerebral palsy and low BMD seem to present an increased risk of fracture.

PMID: [32556612](#)

### 16. Machine Learning for Monitoring and Evaluating Physical Activity in Cerebral Palsy

Carlo M Bertonecchi, Federico Solla

Dev Med Child Neurol. 2020 Jun 16. doi: 10.1111/dmcn.14596. Online ahead of print.

PMID: [32543715](#)

### 17. The Effectiveness of Virtual Reality Exercise on Individual's Physiological, Psychological and Rehabilitative Outcomes: A Systematic Review

Jiali Qian, Daniel J McDonough, Zan Gao

Review Int J Environ Res Public Health. 2020 Jun 10;17(11):E4133. doi: 10.3390/ijerph17114133.

Objective purpose: This review synthesized the literature examining the effects of virtual reality (VR)-based exercise on physiological, psychological, and rehabilitative outcomes in various populations. Design: A systematic review. Data sources: 246 articles were retrieved using key words, such as "VR", "exercise intervention", "physiological", "psychology", and "rehabilitation" through nine databases including Academic Search Premier and PubMed. Eligibility criteria for selecting studies: 15 articles which met the following criteria were included in the review: (1) peer-reviewed; (2) published in English; (3) randomized controlled trials (RCTs), controlled trials or causal-comparative design; (4) interventions using VR devices; and (5) examined effects on physiological, psychological, and/or rehabilitative outcomes. Descriptive and thematic analyses were used. Results: Of the 12 articles examining physiological outcomes, eight showed a positive effect on physical fitness, muscle strength, balance, and extremity function. Only four articles examined the effects on psychological outcomes, three showed positive effects such that VR exercise could ease fatigue, tension, and depression and induce calmness and enhance quality of life. Nine articles investigated the effects of VR-based exercise on rehabilitative outcomes with physiological and/or psychological outcomes, and six observed significant positive changes. In detail, patients who suffered from chronic stroke, hemodialysis, spinal-cord injury, cerebral palsy in early ages, and cognitive decline usually saw better improvements using VR

-based exercise. Conclusion: The findings suggest that VR exercise has the potential to exert a positive impact on individual's physiological, psychological, and rehabilitative outcomes compared with traditional exercise. However, the quality, quantity, and sample size of existing studies are far from ideal. Therefore, more rigorous studies are needed to confirm the observed positive effects.

PMID: [32531906](#)

### 18. Classification of Facial Expressions for Intended Display of Emotions Using Brain-Computer Interfaces

E Salari, Z V Freudenburg, M J Vansteensel, N F Ramsey

Ann Neurol. 2020 Jun 17. doi: 10.1002/ana.25821. Online ahead of print.

Facial expressions are important for intentional display of emotions in social interaction. For people with severe paralysis, the ability to intentionally display emotions can be impaired. Current brain-computer interfaces (BCIs) allow for linguistic communication but are cumbersome for expressing emotions. Here, we investigated the feasibility of a BCI to display emotions by decoding facial expressions. We used electrocorticographic recordings from the sensorimotor cortex of people with refractory epilepsy and classified 5 facial expressions, based on neural activity. The mean classification accuracy was 72%. This approach could be a promising avenue for development of BCI-based solutions for fast communication of emotions.

PMID: [32548859](#)

### 19. Estimated Prevalence of Asthma in US Children With Developmental Disabilities

Luyu Xie, Andrew Gelfand, George L Delclos, Folefac D Atem, Harold W Kohl 3rd, Sarah E Messiah

JAMA Netw Open. 2020 Jun 1;3(6):e207728. doi: 10.1001/jamanetworkopen.2020.7728.

Importance: The prevalence of asthma in US children with various developmental disabilities and delays is unclear, including how estimates vary by ethnic group. Objective: To report asthma prevalence estimates by various disability categories and developmental delays in a diverse sample of the US pediatric population. Design, setting, and participants: This population-based cross-sectional study encompassed a total of 71 811 families with children or adolescents aged 0 to 17 years (hereinafter referred to as children) who participated in the 2016 and 2017 National Survey of Children's Health. Data were collected from June 10, 2016, to February 10, 2017, for the 2016 survey and from August 10, 2017, to February 10, 2018, for the 2017 survey. Data were analyzed from September 20, 2019, to April 5, 2020. Exposures: Developmental disability, including attention-deficit/hyperactivity disorder, autism spectrum disorder, cerebral palsy, seizure, intellectual and/or learning disability, and vision, hearing, and/or speech delay. Delay was defined as not meeting growth milestones with unknown cause. Main outcomes and measures: Weighted asthma prevalence estimates and 95% CIs were generated for children with and without disabilities. Results: A total of 71 811 participants (mean [SE] age, 8.6 [0.1] years; 36 800 boys [51.1%; 95% CI, 50.2%-52.0%]; 50 219 non-Hispanic white [51.4%; 95% CI, 50.6%-52.3%]) were included in our final analytical sample, of whom 5687 (7.9%; 95% CI, 7.5%-8.4%) had asthma and 11 426 (15.3%; 95% CI, 14.7%-16.0%) had at least 1 disability. Overall asthma prevalence estimates were 10 percentage points higher in children with a disability (16.1%; 95% CI, 14.3%-17.8%) vs children without a disability (6.5%; 95% CI, 6.0%-6.9%). The odds of asthma were significantly higher in children with a disability (odds ratio [OR], 2.77; 95% CI, 2.39-3.21) or delay (OR, 2.22; 95% CI, 1.78-2.77) vs typically growing children. Adjusted models remained significant for all disability categories (overall adjusted OR, 2.21; 95% CI, 1.87-2.62). Subgroup analyses showed ethnic minorities had a higher prevalence of concurrent asthma and developmental disabilities vs non-Hispanic whites (19.8% [95% CI, 16.6%-23.0%] vs 12.6% [95% CI, 11.1%-14.0%];  $P < .001$ ). Conclusions and relevance: These results suggest that US children with various developmental disabilities or delay may have higher odds for developing asthma vs their typically developing peers. These findings support asthma screening in pediatric health care settings among patients with developmental disabilities and delays, particularly among those from ethnic minority backgrounds. In addition, very young children with asthma should be screened for disabilities and delays, because temporality cannot be determined by the current data source and analytical approach.

PMID: [32543699](#)

## 20. Definition and Diagnosis of Cerebral Palsy in Genetic Studies: A Systematic Review

Ryan Pham, Ben W Mol, Jozef Gecz, Alastair H MacLennan, Suzanna C MacLennan, Mark A Corbett, Clare L van Eyk, Dani L Webber, Lyle J Palmer, Jesia G Berry

Review Dev Med Child Neurol. 2020 Jun 15. doi: 10.1111/dmcn.14585. Online ahead of print.

**Aim:** To conduct a systematic review of phenotypic definition and case ascertainment in published genetic studies of cerebral palsy (CP) to inform guidelines for the reporting of such studies. **Method:** Inclusion criteria comprised genetic studies of candidate genes, with CP as the outcome, published between 1990 and 2019 in the PubMed, Embase, and BIOSIS Citation Index databases. **Results:** Fifty-seven studies met the inclusion criteria. We appraised how CP was defined, the quality of information on case ascertainment, and compliance with international consensus guidelines. Seven studies (12%) were poorly described, 33 studies (58%) gave incomplete information, and 17 studies (30%) were well described. Missing key information precluded determining how many studies complied with the definition by Rosenbaum et al. Only 18 out of 57 studies (32%) were compliant with the Surveillance of Cerebral Palsy in Europe (SCPE) international guidelines on defining CP. **Interpretation:** Limited compliance with international consensus guidelines on phenotypic definition and mediocre reporting of CP case ascertainment hinders the comparison of results among genetic studies of CP (including meta-analyses), thereby limiting the quality, interpretability, and generalizability of study findings. Compliance with the SCPE guidelines is important for ongoing gene discovery efforts in CP, given the potential for misclassification of unrelated neurological conditions as CP.

PMID: [32542675](#)

## 21. Neurophysiological Mechanisms of Hypertonia and Hypotonia in Children With Spastic Cerebral Palsy: Surgical Implications

M Sindou, A Joud, G Georgoulis

Childs Nerv Syst. 2020 Jun 16. doi: 10.1007/s00381-020-04732-1. Online ahead of print.

Mechanism of hypertonia in cerebral palsy children is dual: a neural component due to spasticity (velocity dependent) and a biomechanical component linked to soft tissue changes. Their differentiation-which might be clinically difficult-is however crucial, as only the first component will respond to anti-spastic treatments, the second to physiotherapy. Furthermore, spasticity is frequently associated with dystonia, which is a sustained hypertonic state induced by attempts at voluntary motion. Spasticity and dystonia have to be carefully distinguished as dorsal rhizotomy will not significantly influence the dystonic component. Spasticity, which by definition opposes to muscle stretching and lengthening, has two important consequences. First, the muscles tend to remain in a shortened position, which in turn results in soft tissue changes and contracture. The second is that movements are restricted. Thus, both hypertonia and lack of mobilization create a vicious circle leading to severe locomotor disability linked to irreducible musculotendinous retraction and joint ankylosis/bone deformities. These evolving consequences should be highly considered during the child's assessment for decision-making. The hypotonic effects of lumbosacral dorsal rhizotomy, which are not only segmental on the lower limbs but also supra-segmental through the reticular formation, are finally discussed.

PMID: [32548670](#)

## 22. Participation in Leisure Activities by Portuguese Children With Cerebral Palsy

Fabio Vila-Nova, Raul Oliveira, Rita Cordovil

Percept Mot Skills. 2020 Jun 17;31512520931639. doi: 10.1177/0031512520931639. Online ahead of print.

Leisure participation contributes to the health and wellbeing of children with and without physical disabilities. In the present cross-sectional study, we aimed to assess the influence of child and family factors on leisure activity participation of children with cerebral palsy (CP) aged 8-18 years. A convenience sample of 69 participants with CP (M age = 12.75 years, SD = 2.95; 45 males) responded to the Children's Assessment of Participation and Enjoyment questionnaire to report participation diversity, frequency, companies, environment and enjoyment in leisure activities. From these questionnaires, we used descriptive statistics to summarize overall participation, two activity domains (formal and informal) and five activity types (recreational, social, active physical, skill-based, and self-improvement). Regression analysis assessed child and family factors'

influence on participation. On average, children with CP were involved in 21 leisure activities in the last four months. Within activity types, social and recreational activities were the most frequently reported. Participation in physical and skill-based activities was low. Overall children with CP experienced high enjoyment with engagement in leisure activities. Collectively, factors of age, cognitive function, gross motor function, and mother's education level predicted 33% of activity diversity and 30% of activity frequency. We concluded that children with CP show diverse leisure activity participation and high leisure activity enjoyment. Health, education and sports professionals should consider the child's functional profile and family context when promoting participation.

PMID: [32552484](#)

### **23. Aquatic Therapy in Contemporary Neurorehabilitation: An Update**

Bruce E Becker

Review PM R. 2020 Jun 14. doi: 10.1002/pmrj.12435. Online ahead of print.

Aquatic therapy has been used extensively in a number of neurologic diseases and pathologies. This review will describe disease-specific rehabilitative applications for this population. Recent research has offered scientific support for use in common neurological diseases that are part of rehabilitative practice, and very recent findings may create even firmer support for its use in these as well as other conditions. Stroke, Parkinsonism, and multiple sclerosis are areas that have recently received a significant number of published studies. Dementia is another area that has been more recently studied and received basic science support. Cerebral palsy has also had recent supportive evidence published. Available literature is reviewed to create a more evidence-based support for the use of aquatic therapy in neurorehabilitation. This article is protected by copyright. All rights reserved.

PMID: [32536028](#)

### **24. Association Between Sensory Processing and Activity Performance in Children With Cerebral Palsy Levels I-II on the Gross Motor Function Classification System**

Silvia Leticia Pavão, Camila Resende Gâmbaro Lima, Nelci Adriana Cicuto Ferreira Rocha

Braz J Phys Ther. 2020 May 29;S1413-3555(19)30445-9. doi: 10.1016/j.bjpt.2020.05.007. Online ahead of print.

Background: Investigating the influence of sensory processing disorders on the level of function of children with cerebral palsy (CP) may help therapists identify specific impairments that impact activity and participation in these children. This may provide direction on selection of interventions to improve function and quality of life. Objectives: To investigate if sensory processing disorders in children with CP levels I and II on the Gross Motor Function Classification System (GMFCS) are associated with activity performance. Methods: Sensory processing and activity performance of 28 children with CP between 5 and 15 years (mean  $\pm$  standard deviation;  $9.9 \pm 3.2$  years) were evaluated using the Sensory Profile (SP) and Pediatric Evaluation of Disability Inventory (PEDI), respectively. Associations between the components of the SP and PEDI were assessed with Spearman correlation coefficients. Multiple linear regression analysis using backward stepwise method was used to determine the variables of sensory processing that are associated with activity performance on the PEDI. Results: The category of Behavioral Outcomes of Sensory Processing was the only variable associated with Functional Abilities in self-care and social function ( $r^2 = 0.30$  and  $r^2 = 0.39$ , respectively) and Caregiver Assistance ( $r^2 = 0.36$  and  $r^2 = 0.37$ , respectively), ( $p < 0.05$ ). Conclusion: Sensory processing in children with CP levels I-II on the GMFCS is associated with their ability to perform daily living activities and in their social interaction with the environment.

PMID: [32540329](#)

### **25. A Systematic Review of Magnesium Sulfate for Perinatal Neuroprotection: What Have We Learnt From the Past Decade?**

Robert Galinsky, Justin M Dean, Ingran Lingam, Nicola J Robertson, Carina Mallard, Laura Bennet, Alistair J Gunn

Front Neurol. 2020 May 27;11:449. doi: 10.3389/fneur.2020.00449. eCollection 2020.

There is an important unmet need to improve long term outcomes of encephalopathy for preterm and term infants. Meta-analyses of large controlled trials suggest that maternal treatment with magnesium sulfate (MgSO<sub>4</sub>) is associated with a reduced risk of cerebral palsy and gross motor dysfunction after premature birth. However, to date, follow up to school age has found an apparent lack of long-term clinical benefit. Because of this inconsistency, it remains controversial whether MgSO<sub>4</sub> offers sustained neuroprotection. We systematically reviewed preclinical and clinical studies reported from January 1 2010, to January 31 2020 to evaluate the most recent advances and knowledge gaps relating to the efficacy of MgSO<sub>4</sub> for the treatment of perinatal brain injury. The outcomes of MgSO<sub>4</sub> in preterm and term-equivalent animal models of perinatal encephalopathy were highly inconsistent between studies. None of the perinatal rodent studies that suggested benefit directly controlled body or brain temperature. The majority of the studies did not control for sex, study long term histological and functional outcomes or use pragmatic treatment regimens and many did not report controlling for potential study bias. Finally, most of the recent preterm or term human studies that tested the potential of MgSO<sub>4</sub> for perinatal neuroprotection were relatively underpowered, but nevertheless, suggest that any improvements in neurodevelopment were at best modest or absent. On balance, these data suggest that further rigorous testing in translational preclinical models of perinatal encephalopathy is essential to ensure safety and best regimens for optimal preterm neuroprotection, and before further clinical trials of MgSO<sub>4</sub> for perinatal encephalopathy at term are undertaken.

PMID: [32536903](#)

## **26. Acquired Os Odontoideum Due to Cervical Dystonia in a Child With Dyskinetic Cerebral Palsy**

Benjamin M Carpenter, Kendl M Sankary, Kelly Pham

PM R. 2020 Jun 15. doi: 10.1002/pmrj.12437. Online ahead of print.

PMID: [32543019](#)