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## Interventions and Management

### 1. Investigating the Effect of Leap Motion on Upper Extremity Rehabilitation in Children with Cerebral Palsy: A Randomized Controlled Trial

Mahla Daliri, Ali Moradi, Saeid Fatorehchy, Enayatollah Bakhshi, Ehsan Moradi, Sajad Sabbaghi

Dev Neurorehabil. 2023 Apr 25;1-9. doi: 10.1080/17518423.2023.2203210. Online ahead of print.

In this randomized clinical trial, we look for the following questions' answer: How does the integration of LMC affect (1) upper extremity (UE) function, (2) grip strength, and (3) lateral and palmar pinch strength in children with cerebral palsy (CP), in comparison with conventional rehabilitation methods? Twenty patients were randomly assigned to LMC (case) or conventional (control) groups. The grip, lateral and palmar pinch forces increased in case group patients more than control group both at the end of intervention ( $P < .001$  for all three), and at 20 weeks' follow-up ( $P$  values 0.035, 0.002, and 0.002). The Quality of Upper Extremity Skills Test (QUEST) score changes were similar between two groups, except for grasp score at the end of step 2 and 3 ( $P = .04$  and 0.01, respectively). The addition of LMC to the rehabilitation program of patients with CP may improve the UE motor function outcomes.

PMID: [37122098](https://pubmed.ncbi.nlm.nih.gov/37122098/)

### 2. Constraint-induced movement therapy versus bimanual intensive therapy in children with hemiplegia showing low/very low bimanual functional performance: A randomized clinical trial

Asunción Ferri-Morales, Rocío Palomo Carrión, Sara Ando-LaFuente, Rubén Arroyo Fernández, Jose Ignacio Calvo Arenillas, Virgilia Antón-Antón, Elisabeth Bravo Esteban

PM R. 2023 May 4. doi: 10.1002/pmrj.12990. Online ahead of print.

**Introduction:** Children with infantile hemiplegia with low or very low bimanual functional performance have great impediments to spontaneously use their affected upper limb, which affects their performance of day-to-day activities and their quality of life. **Objective:** The main objective of our study was to determine whether the order of application and the dose of modified Constraint Induced Movement Therapy within a combined (hybrid) protocol influences the results of bimanual functional performance of the affected upper limb and the quality of life of children with congenital hemiplegia (5-8 years old) with very low/low bimanual functional performance. **Design:** single-blinded randomized controlled trial. **Participants:** Twenty-one children with congenital hemiplegia (5-8 years old) were recruited from two public hospitals and an infantile hemiplegia association in Spain. **Interventions:** The experimental group ( $n = 11$ ) received 100 hours of intensive therapies for affected upper limb: 80 hours of modified Constraint Induced Movement Therapy and 20 hours of bimanual intensive therapy. The control group ( $n = 10$ ) received the same dose with 80 hours of bimanual intensive therapy and 20 hours of modified Constraint Induced Movement Therapy. The protocol was provided 2 hours per day, 5 days per week, for 10 weeks. **Outcome measures:** The primary outcome was bimanual functional performance, measured with the Assisting Hand Assessment, and the second outcome was quality of life, measured with the Pediatric Quality of Life Inventory Cerebral-Palsy module (PedsQL™ v. 3.0, CP module). Four assessments were performed: Week 0-4-8-10. **Results:** The experimental group obtained an increase of 22 AHA units at week 8 with the application of modified Constraint Induced Movement, in contrast with the

control group, who obtained an increase of 3.7 AHA units after Bimanual Intensive Therapy. At week 10, the control group showed its greatest increase in bimanual functional performance, with 10.6 AHA units after modified Constraint Induced Movement Therapy. Regarding quality of life, the greatest improvement occurred after modified Constraint Induced Movement, with 13.1 points in the experimental group (80 hours), and 6.3 points in the control group (20 hours). The protocol interaction was statistically significant for bimanual functional performance ( $p = 0.018$ ) and quality of life ( $p = 0.09$ ). Conclusions: modified Constraint Induced Movement Therapy is more beneficial than Bimanual Intensive Therapy to improve upper limb functioning and quality of life in children with congenital hemiplegia showing very low/low bimanual performance. This article is protected by copyright. All rights reserved.

PMID: [37139775](#)

### 3. Hip reconstruction in children with cerebral palsy: does magnitude of surgery influence complications and outcomes?

David E Westberry, Lisa Carson, Emily R Shull, Lauren C Hyer

J Pediatr Orthop B. 2023 May 1. doi: 10.1097/BPB.0000000000001091. Online ahead of print.

Children with cerebral palsy (CP) and neuromuscular hip dysplasia (NMHD) frequently require hip reconstruction including femoral and pelvic osteotomies. Outcomes and complications in CP patients with NMHD who underwent varying degrees of hip reconstruction surgeries were examined. Ninety-nine patients with a diagnosis of CP who underwent surgical management of NMHD over a 15-year period (2005-2020) were reviewed. Three patient cohorts with varying degrees of surgery were analyzed including: (1) unilateral femoral osteotomy with pelvic osteotomy; (2) bilateral femoral osteotomy with unilateral pelvic osteotomy; and (3) simultaneous bilateral femoral osteotomy and bilateral pelvic osteotomy. Data points included operative (OR) time, length of stay (LOS), estimated blood loss (EBL), and transfusion requirement. Complications during the perioperative and postoperative periods were identified and graded by severity. Increased EBL, need for transfusion, OR time, and LOS were observed more frequently in patients undergoing bilateral reconstruction. Complication rates were high for all three cohorts, with 87% of cases in the bilateral pelvic osteotomy cohort experiencing  $\geq 1$  complication. However, 90% of these were considered grade I or II and required no or minimal intervention. The average postoperative migration index at final follow-up for treated hips was significantly less in bilateral pelvic osteotomy cases. Patients with CP and bilateral NMHD can be safely managed with bilateral simultaneous comprehensive reconstruction. The data presented in this study can help both surgeons and families anticipate a more accurate postoperative course. Level of evidence: III.

PMID: [37129017](#)

### 4. Conventional versus locked plates for hip dislocation in cerebral palsy: a matched cohort analysis

Frederico Coutinho de Moura Vallim, Marcello Henrique Nogueira-Barbosa, Henrique Abreu da Cruz, Vitor Moreira Viana, Marwan Volotão Ferzeli, João Antonio Matheus Guimarães

Eur J Orthop Surg Traumatol. 2023 May 6. doi: 10.1007/s00590-023-03568-0. Online ahead of print.

Purpose: Bone quality of non-ambulatory patients with cerebral palsy (CP) is a matter of concern for proximal femoral varus derotational osteotomies (VDRO). Locking plates (LCP) have been designed to compensate this biological downfall. Little data exist comparing the LCP with the conventional femoral blade plate. Methods: We retrospectively studied 32 patients submitted to VDRO (40 hips), operated with blade plates or LCP. Groups were matched, and the minimal follow-up was 36 months. Clinical (age at surgery, sex, GMFCS class, CP patterns) and radiological characteristics (neck shaft angle [NSA], acetabular index [AI], Reimers migration index [MP] and time until bone healing), as well as postoperative complications and the cost of treatment, were evaluated. Results: Preoperative clinical characteristics and radiographic measurements were comparable, except for a higher AI in the BP group ( $p < 0.01$ ). Mean follow-up was longer in the LCP group (57.35 vs 34.6 months). Mean NSA, AI and MP had comparable correction with surgery ( $p < 0.01$ ). At final follow-up, dislocation recurrence speed was higher in BP group although not statistically significant (0.56% vs 0.35%/month;  $p = 0.29$ ). The complication rate was similar in both groups ( $p > 0.05$ ). Finally, the cost of the treatment was 62% higher in the LCP group ( $p = 0.01$ ). Conclusion: Our cohorts showed LCP or BP equivalence clinically and radiographically in mid-term follow-up, with the former increasing the cost of treatment by a mean of 62%. This may raise a question on the real necessity of locked implants for these operations.

PMID: [37147534](#)

### 5. HipScreen mobile app for the measurement of hip migration percentage in children with cerebral palsy: Accuracy, reliability, and discriminatory ability

Vedant A Kulkarni, Nina Q Cung-Shahlaie, Anita M Bagley, Nuen-Tsang Yang, Sandra L Taylor, Jon R Davids

Dev Med Child Neurol. 2023 May 4. doi: 10.1111/dmcn.15612. Online ahead of print.

Aim: To assess the accuracy, reliability, and discriminatory ability of a mobile app for measurement of migration percentage in

hip surveillance radiographs of children with cerebral palsy (CP). Method: The free mobile app HipScreen ([www.hipscreen.org](http://www.hipscreen.org)) was utilized by a diverse group of users to measure the migration percentage of 40 hips at two time points after completing an online tutorial and competency test. The mean absolute error (MAE) was calculated against the reference standard obtained on a radiology workstation. Statistical analyses included linear regression, intraclass correlation coefficient (ICC), and area under receiver-operating characteristic curve (AUC). Results: Thirty-seven users completed the study, with 30 having a healthcare professional background, but only 15 with x-ray interpretation expertise. The overall MAE of migration percentage measurement using the HipScreen app was 5.72% (95% confidence interval [CI]: 5.38-6.06), with good reliability between time points (ICC = 0.83). With a migration percentage less than 30% considered as a positive case, the HipScreen app had a sensitivity of 94% (95% CI: 87-97), specificity of 66% (95% CI: 61-77), and an AUC of 0.92 (95% CI: 0.88-0.96). Interpretation: Users from a broad range of backgrounds can utilize the HipScreen app to measure hip surveillance radiographs with clinically acceptable accuracy, reliability, and discriminatory ability.

PMID: [37143284](https://pubmed.ncbi.nlm.nih.gov/37143284/)

## **6. The efficacy of split tibial tendon transfers on functional gait outcomes for children and youth with cerebral palsy and spastic equinovarus foot deformities**

Jennifer Hochstetter-Owen, Susan Stott, Sian A Williams

Bone Jt Open. 2023 May 1;4(5):283-298. doi: 10.1302/2633-1462.45.BJO-2023-0005.R1.

To systematically review the efficacy of split tendon transfer surgery on gait-related outcomes for children and adolescents with cerebral palsy (CP) and spastic equinovarus foot deformity. Five databases (CENTRAL, CINAHL, PubMed, Embase, Web of Science) were systematically screened for studies investigating split tibialis anterior or split tibialis posterior tendon transfer for spastic equinovarus foot deformity, with gait-related outcomes (published pre-September 2022). Study quality and evidence were assessed using the Methodological Index for Non-Randomized Studies, the Risk of Bias In Non-Randomized Studies of Interventions, and the Grading of Recommendations Assessment, Development and Evaluation. Overall, 17 studies (566 feet) were included: 13 studies used clinical grading criteria to report a postoperative 'success' of 87% (75% to 100%), 14 reported on orthotic use with 88% reduced postoperative use, and one study reported on ankle kinematics improvements. Ten studies reported post-surgical complications at a rate of 11/390 feet (2.8%), but 84 feet (14.8%) had recurrent varus (68 feet, 12%) or occurrence of valgus (16 feet, 2.8%). Only one study included a patient-reported outcome measure (pain). Split tendon transfers are an effective treatment for children and youth with CP and spastic equinovarus foot deformities. Clinical data presented can be used for future study designs; a more standardized functional and patient-focused approach to evaluating outcomes of surgical intervention of gait may be warranted.

PMID: [37121581](https://pubmed.ncbi.nlm.nih.gov/37121581/)

## **7. The Role of Child Neurologists in the Management of Motor Disability in Cerebral Palsy: Establishing the Path Forward**

Rose Gelineau-Morel, Young-Min Kim, Jennifer A O'Malley, Jenny L Wilson, Bhooma R Aravamathan

Pediatr Neurol. 2023 Apr 5;144:33-38. doi: 10.1016/j.pediatrneurol.2023.03.018. Online ahead of print.

Background: Cerebral palsy (CP) is the most common motor disability of childhood, and yet the role of child neurologists and neurodevelopmentalists (CN/NDDs) in the management of children with CP is unclear. Although previous surveys showed that CN/NDDs believe they are uniquely expert in CP motor phenotyping and should be involved in CP management, others have demonstrated that training in CP management among CN/NDD residency programs is inadequate. Methods: In this article, we surveyed a group of CN/NDDs at the Child Neurology Society Cerebral Palsy Special Interest Group meeting on January 27, 2022. Questions addressed provider comfort with CP tone management including motor phenotyping, pharmacologic and surgical management, barriers and solutions to improving practice, and the use of systems-based care. Results: Responses from 42 participants demonstrated that CN/NDDs lack experience with CP tone management, with 48% and 58% of respondents reporting little to no experience in pharmacologic or surgical management, respectively. Primary barriers identified to improving comfort with CP tone management included lack of knowledge and ineffective treatment options, while most solutions centered on improving collaborations between CN/NDDs and other specialties. Only 50% of respondents reported currently using systems-based care in the management of patients with CP. Conclusions: An interdisciplinary, systems-based care model would allow for collaboration and knowledge sharing between involved specialties and provide high-value goal-directed care to maximize the functional outcomes for every individual with CP.

PMID: [37121109](https://pubmed.ncbi.nlm.nih.gov/37121109/)

## **8. The efficacy of dance interventions for the activity and participation of individuals with cerebral palsy - a systematic review and meta-analysis**

Eduardo Duarte Machado, Michael H Cole, Laura Miller, Thomas B McGuckian, Peter H Wilson

Disabil Rehabil. 2023 Apr 25;1-17. doi: 10.1080/09638288.2023.2200259. Online ahead of print.

**Purpose:** The aim of this review was to examine the efficacy of dance interventions for individuals with cerebral palsy (CP), measured at any level of the International Classification of Functioning, Disability and Health (ICF). **Methods:** A systematic review and meta-analysis was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). A comprehensive search of peer-reviewed articles was performed using six electronic databases. **Results:** Fourteen studies were included in this review, nine of which were also included in the meta-analysis. The meta-analyses yielded a large overall effect for cognitive, motor, and social-emotional function outcomes, with a high degree of heterogeneity between outcome effects, attributable to differences in study design. **Conclusion:** Although recent studies provide support for the acceptance and efficacy of dance interventions for people with CP, the systematic review revealed significant limitations in study design (only 2 randomised control trials). High-quality research that measures outcomes across all dimensions of the ICF, and particularly at the level of participation, are needed to improve the level of empirical support for dance-based interventions.

PMID: [37122166](#)

### **9. Contralaterally-controlled functional electrical stimulation-induced muscle contraction for severe lower extremity paralysis**

Tadashi Imura, Hiroki Wada, Motoya Matsui, Naoki Hotta, Tomoo Mano

Case Reports J Phys Ther Sci. 2023 May;35(5):395-398. doi: 10.1589/jpts.35.395. Epub 2023 May 1.

**[Purpose]** We describe a new method of functional electrical stimulation therapy for severe hemiparesis. Conventional functional electrical stimulation of the lower legs has limited applications. It is only suitable for patients who can monitor their muscle contractions, and it has complicated equipment installation procedures. **[Participant and Methods]** The participant was a male in his 40s with severe motor paralysis following brain surgery. We monitored the participant's healthy side using the external assist mode of an Integrated Volitional Control Electrical Stimulation (IVES® OG Giken, Okayama, Japan) system while forcibly contracting the paralyzed side. The participant received this new functional electrical stimulation therapy five times per week. **[Results]** Two weeks after initiation of therapy, paralysis was noticeably improved, and motor function was maintained for approximately 1 year. **[Conclusion]** The outcomes of this case suggest that the addition of forced contraction therapy, mirror therapy, and repetitive exercise therapy to regular physical therapy may be beneficial. This treatment method may also be useful in postoperative patients with central motor palsy and no muscle contraction ability.

PMID: [37131352](#)

### **10. Clinical functional outcome measures for children with cerebral palsy after gait corrective orthopaedic surgery: A scoping review**

Maxine M Fong, Noula Gibson, Sian A Williams, Lynn Jensen

Dev Med Child Neurol. 2023 May 6. doi: 10.1111/dmcn.15622. Online ahead of print.

**Aim:** To identify the most frequently reported non-instrumented measures of gait, activity, and participation in children with cerebral palsy (CP) after undergoing gait corrective orthopaedic surgery. **Method:** Four databases were searched from database inception to the 9th December 2021 for studies that evaluated functional outcomes for children with CP under 18 years undergoing gait corrective orthopaedic surgery. **Results:** Of 547 citations, 44 publications (n = 3535 participants, n = 1789 males, mean age 10 years 5 months [SD = 3 years 3 months], Gross Motor Function Classification System levels I-III at the time of surgery) were eligible for inclusion. Fourteen different outcome measures were used: one measure of gait, 10 measures of activity, and three measures of participation. Gait was measured with the Edinburgh Visual Gait Scale (EVGS; 4 out of 44). The most common activity and participation measures were the Functional Mobility Scale (FMS; 15 out of 44) and Pediatric Outcomes Data Collection Instrument (11 out of 44) respectively. No studies reported a combination of gait, activity, and participation measures. **Interpretation:** The EVGS and FMS should be considered as core outcome measures in gait corrective orthopaedic surgery, while a measure of participation is unclear. Additional considerations for developing a comprehensive suite of outcomes include identifying a combination of clinical measures and performance-reflective questionnaires that are standardized for children with CP undergoing surgery and meaningful to clinicians and families.

PMID: [37147852](#)

### **11. Comparison of the forward and sideways locomotor patterns in children with Cerebral Palsy**

Germana Cappellini, Francesca Sylos-Labini, Priscilla Avaltroni, Arthur H Dewolf, Carla Assenza, Daniela Morelli, Francesco Lacquaniti, Yury Ivanenko

Sci Rep. 2023 May 4;13(1):7286. doi: 10.1038/s41598-023-34369-4.

Switching locomotion direction is a common task in daily life, and it has been studied extensively in healthy people. Little is known, however, about the locomotor adjustments involved in changing locomotion direction from forward (FW) to sideways (SW) in children with cerebral palsy (CP). The importance of testing the ability of children with CP in this task lies in the assessment of flexible, adaptable adjustments of locomotion as a function of the environmental context. On the one hand, the ability of a child to cope with novel task requirements may provide prognostic cues as to the chances of modifying the gait adaptively. On the other hand, challenging the child with the novel task may represent a useful rehabilitation tool to improve the locomotor performance. SW is an asymmetrical locomotor task and requires a differential control of right and left limb muscles. Here, we report the results of a cross-sectional study comparing FW and SW in 27 children with CP (17 diplegic, 10 hemiplegic, 2-10 years) and 18 age-matched typically developing (TD) children. We analyzed gait kinematics, joint moments, EMG activity of 12 pairs of bilateral muscles, and muscle modules evaluated by factorization of EMG signals. Task performance in several children with CP differed drastically from that of TD children. Only 2/3 of children with CP met the primary outcome, i.e. they succeeded to step sideways, and they often demonstrated attempts to step forward. They tended to rotate their trunk FW, cross one leg over the other, flex the knee and hip. Moreover, in contrast to TD children, children with CP often exhibited similar motor modules for FW and SW. Overall, the results reflect developmental deficits in the control of gait, bilateral coordination and adjustment of basic motor modules in children with CP. We suggest that the sideways (along with the backward) style of locomotion represents a novel rehabilitation protocol that challenges the child to cope with novel contextual requirements.

PMID: [37142631](#)

## 12. Improved Myelination following Camp Leg Power, a Selective Motor Control Intervention for Children with Spastic Bilateral Cerebral Palsy: A Diffusion Tensor MRI Study

A Vuong, S H Joshi, L A Staudt, J H Matsumoto, E G Fowler

AJNR Am J Neuroradiol. 2023 May 4. doi: 10.3174/ajnr.A7860. Online ahead of print.

**Background and purpose:** Children with spastic cerebral palsy have motor deficits associated with periventricular leukomalacia indicating WM damage to the corticospinal tracts. We investigated whether practice of skilled lower extremity selective motor control movements would elicit neuroplasticity. **Materials and methods:** Twelve children with spastic bilateral cerebral palsy and periventricular leukomalacia born preterm (mean age, 11.5 years; age range, 7.3-16.6 years) participated in a lower extremity selective motor control intervention, Camp Leg Power. Activities promoted isolated joint movement including isokinetic knee exercises, ankle-controlled gaming, gait training, and sensorimotor activities (3 hours/day, 15 sessions, 1 month). DWI scans were collected pre- and postintervention. Tract-Based Spatial Statistics was used to analyze changes in fractional anisotropy, radial diffusivity, axial diffusivity, and mean diffusivity. **Results:** Significantly reduced radial diffusivity ( $P < .05$ ) was found within corticospinal tract ROIs, including 28.4% of the left and 3.6% of the right posterior limb of the internal capsule and 14.1% of the left superior corona radiata. Reduced mean diffusivity was found within the same ROIs (13.3%, 11.6%, and 6.6%, respectively). Additionally, decreased radial diffusivity was observed in the left primary motor cortex. Additional WM tracts had decreased radial diffusivity and mean diffusivity, including the anterior limb of the internal capsule, external capsule, anterior corona radiata, and corpus callosum body and genu. **Conclusions:** Myelination of the corticospinal tracts improved following Camp Leg Power. Neighboring WM changes suggest recruitment of additional tracts involved in regulating neuroplasticity of the motor regions. Intensive practice of skilled lower extremity selective motor control movements promotes neuroplasticity in children with spastic bilateral cerebral palsy.

PMID: [37142433](#)

## 13. Translating deep learning to neuroprosthetic control

Darrel R Deo, Francis R Willett, Donald T Avansino, Leigh R Hochberg, Jaimie M Henderson, Krishna V Shenoy

bioRxiv. 2023 Apr 21;2023.04.21.537581. doi: 10.1101/2023.04.21.537581. Preprint

Advances in deep learning have given rise to neural network models of the relationship between movement and brain activity that appear to far outperform prior approaches. Brain-computer interfaces (BCIs) that enable people with paralysis to control external devices, such as robotic arms or computer cursors, might stand to benefit greatly from these advances. We tested recurrent neural networks (RNNs) on a challenging nonlinear BCI problem: decoding continuous bimanual movement of two computer cursors. Surprisingly, we found that although RNNs appeared to perform well in offline settings, they did so by overfitting to the temporal structure of the training data and failed to generalize to real-time neuroprosthetic control. In response, we developed a method that alters the temporal structure of the training data by dilating/compressing it in time and re-ordering it, which we show helps RNNs successfully generalize to the online setting. With this method, we demonstrate that a person with paralysis can control two computer cursors simultaneously, far outperforming standard linear methods. Our results provide evidence that preventing models from overfitting to temporal structure in training data may, in principle, aid in translating deep learning advances to the BCI setting, unlocking improved performance for challenging applications.

PMID: [37131830](#)

#### **14. Diagnostic concordance of telemedicine as compared to face-to-face care in primary health care clinics in rural India: a randomized crossover trial**

Neha Verma, Bimal Buch, Radha Taralekar, Soumyadipta Acharya

JMIR Form Res. 2023 Apr 11. doi: 10.2196/42775. Online ahead of print.

Background: Due to the COVID-19 pandemic, a growing number of provider-to-provider telemedicine programs have emerged that connect frontline health providers such as nurses and community health workers at primary care clinics with remote doctors at tertiary facilities to facilitate consultations for rural patients. An important question for patients, health providers, and policymakers is whether provider-to-provider telemedicine-based care is comparable to in-person care and whether it is a safe and acceptable alternative when in-person care is not accessible. Objective: To compare the diagnosis and treatment decisions from teleconsultations to those of face-to-face care in teleclinics in rural Gujarat. Methods: We conducted a diagnostic concordance study using a randomized crossover study design with 104 patients at ten telemedicine primary care clinics. Patients received an in-person consultation followed by a teleconsultation or vice versa. The in-person doctor's diagnosis and treatment plan were considered the gold standard. In addition, we surveyed the patients reporting to the teleclinic to understand their acceptability towards telemedicine and its impact on health access. Results: We observed a 74% diagnostic concordance and an 80% concordance in the treatment plan between the in-person and remote doctor. The highest diagnostic concordance was seen in the management of hypertension (95%), diabetes (93%), and obstetrics (80%). The lowest was seen in cardiology (33%) and patients with non-specific issues (30%). The use of a digital assistant to facilitate the consultation resulted in increased adherence to evidence-based care protocols. Conclusions: We found that telemedicine is a safe and effective alternative in rural primary health care delivery in India when in-person care cannot be provided.

PMID: [37130015](#)

#### **15. Factors impacting positive and negative participation of young people with cerebral palsy: a Delphi study of consumers and health professionals**

Jacinta R Quartermaine, Tanya A Rose, Megan L Auld, Leanne M Johnston

Disabil Rehabil. 2023 May 5;1-9. doi: 10.1080/09638288.2023.2194062. Online ahead of print.

Purpose: To identify specific factors influencing the participation experiences of young people with cerebral palsy (CP) aged 15 to 26 years. Materials and methods: A three-round Delphi survey study design was used. Consumers (young people with CP and caregivers) and health professionals were asked to generate and then rate items influencing positive and negative participation experiences. Qualitative content analysis and descriptive statistics were used to classify items across the family of Participation-Related Constructs (fPRC) framework. Results: Sixty-eight participants completed Round I (25 consumers, 43 health professionals). Round II resulted in a consensus for all but two items, with Round III not required. The fPRC construct with the most items rated as extremely important for positive participation experiences was Environment-Availability, and for negative participation, experiences were Environment-Acceptability for both adolescents and young adults. Conclusions: A consensus was reached on the most important items influencing the positive and negative participation experiences of young people with CP. These items should be prioritised when developing support services and allocating funding to improve the participation experiences of young people with CP. Implications for Rehabilitation: This study is reporting consumer and professional consensus on the factors promoting positive and negative participation for young people with cerebral palsy. Ensuring availability of appropriate activities and services is extremely important for enabling positive participation experiences. Promoting acceptable attitudes of others is extremely important for alleviating negative participation experiences.

PMID: [37147876](#)

#### **16. Prevalence and trends for Aboriginal and Torres Strait Islander children living with cerebral palsy: A birds-eye view**

Tanya Martin, Sarah McIntyre, Emma Waight, Gareth Baynam, Linda Watson, Katherine Langdon, Susan Woolfenden, Hayley Smithers-Sheedy, Juanita Sherwood; ACPR Birds-Eye View Group

Dev Med Child Neurol. 2023 May 5. doi: 10.1111/dmcn.15617. Online ahead of print.

Aim: To provide a birds-eye view of the trends of cerebral palsy (CP) for Australian Aboriginal and Torres Strait Islander children and young adults. Method: Data were obtained for this population-based observational study from the Australian Cerebral Palsy Register (ACPR), birth years 1995 to 2014. The Indigenous status of children was classified by maternal Aboriginal and Torres Strait Islander or non-Indigenous status. Descriptive statistics were calculated for socio-demographic and clinical characteristics. Prenatal/perinatal and post-neonatal birth prevalence was calculated per 1000 live births and per 10 000 live births respectively, and Poisson regression used to assess trends. Results: Data from the ACPR were available for 514 Aboriginal and Torres Strait Islander individuals with CP. Most children could walk independently (56%) and lived in urban or regional areas (72%). One in five children lived in socioeconomically disadvantaged remote/very remote areas. The birth

prevalence of prenatal/perinatal CP declined after the mid-2000s from a high of 4.8 (95% confidence interval 3.2-7.0) to 1.9 per 1000 live births (95% confidence interval 1.1-3.2) (2013-2014), with marked declines observed for term births and teenage mothers. Interpretation: The birth prevalence of CP in Aboriginal and Torres Strait Islander children in Australia declined between the mid-2000s and 2013 to 2014. This birds-eye view provides key stakeholders with new knowledge to advocate for sustainable funding for accessible, culturally safe, antenatal and CP services.

PMID: [37147854](#)

### **17. Acupuncture on intrauterine growth restriction associated brain injury: case study including use of magnetic resonance imaging**

Xin Zhixiong, L I Jiyuan, X U Yanni, Ling Jing, Jiang Min, Y U Yutian

J Tradit Chin Med. 2023 Jun;43(3):602-605. doi: 10.19852/j.cnki.jtcm.2023.03.006.

Brain injury due to intrauterine growth restriction (IUGR) is a thorny clinical problem that often leads to permanent neurological deficits such as cerebral palsy. Few practical therapies can treat an IUGR-associated brain injury. We employed acupuncture to treat a 6-month-old male patient with severe hypoxic-ischemic encephalopathy (HIE) due to IUGR, as confirmed by magnetic resonance imaging (MRI). Three courses of acupuncture treatment significantly improved some of the patient's clinical characteristics, such as his insensitive responsiveness and motor deficits, with remarkably reversed HIE features on MRI at 1-year of age. This case suggests that acupuncture is a potential treatment option for an IUGR-associated brain injury and warrants further investigation.

PMID: [37147764](#)

### **18. Creatine supplementation increases postnatal growth and strength and prevents overexpression of pro-inflammatory interleukin 6 in the hippocampus in an experimental model of cerebral palsy**

Henrique J C B Gouveia, Raul Manhães-de-Castro, Bárbara J R Costa-de-Santana, Emanuel Ewerton M Vasconcelos, Eliesly Roberto Silva, Angélica Roque, Luz Torner, Omar Guzmán-Quevedo, Ana E Toscano

Nutr Neurosci. 2023 May 4;1-13. doi: 10.1080/1028415X.2023.2206688. Online ahead of print.

Objectives: The aim of this study was thus to evaluate the effect of Cr supplementation on morphological changes and expression of pro-inflammatory cytokines in the hippocampus and on developmental parameters. Methods: Male Wistar rat pups were submitted to an experimental model of CP. Cr was administered via gavage from the 21st to the 28th postnatal day, and in water after the 28th, until the end of the experiment. Body weight (BW), food consumption (FC), muscle strength, and locomotion were evaluated. Expression of interleukin-1 $\beta$  (IL-1 $\beta$ ), interleukin-6 (IL-6), and tumor necrosis factor  $\alpha$  (TNF- $\alpha$ ) were assessed in the hippocampus by quantitative real-time polymerase chain reaction. Iba1 immunoreactivity was assessed by immunocytochemistry in the hippocampal hilus. Results: Experimental CP caused increased density and activation of microglial cells, and overexpression of IL-6. The rats with CP also presented abnormal BW development and impairment of strength and locomotion. Cr supplementation was able to reverse the overexpression of IL-6 in the hippocampus and mitigate the impairments observed in BW, strength, and locomotion. Discussion: Future studies should evaluate other neurobiological characteristics, including changes in neural precursor cells and other cytokines, both pro- and anti-inflammatory.

PMID: [37141266](#)

### **19. Charting infants' motor development at home using a wearable system: validation and comparison to physical growth charts**

Manu Airaksinen, Elisa Taylor, Anastasia Gallen, Elina Ilén, Antti Saari, Ulla Sankilampi, Okko Räsänen, Leena M Haataja, Sampsa Vanhatalo

EBioMedicine. 2023 May 1;92:104591. doi: 10.1016/j.ebiom.2023.104591. Online ahead of print.

Background: Early neurodevelopmental care and research are in urgent need of practical methods for quantitative assessment of early motor development. Here, performance of a wearable system in early motor assessment was validated and compared to developmental tracking of physical growth charts. Methods: Altogether 1358 h of spontaneous movement during 226 recording sessions in 116 infants (age 4-19 months) were analysed using a multisensor wearable system. A deep learning-based automatic pipeline quantified categories of infants' postures and movements at a time scale of seconds. Results from an archived cohort (dataset 1, N = 55 infants) recorded under partial supervision were compared to a validation cohort (dataset 2, N = 61) recorded at infants' homes by the parents. Aggregated recording-level measures including developmental age prediction (DAP) were used for comparison between cohorts. The motor growth was also compared with respective DAP estimates based on physical growth data (length, weight, and head circumference) obtained from a large cohort (N = 17,838 infants; age 4-18 months). Findings: Age-specific distributions of posture and movement categories were highly similar between infant cohorts. The DAP

scores correlated tightly with age, explaining 97-99% (94-99% CI 95) of the variance at the group average level, and 80-82% (72-88%) of the variance in the individual recordings. Both the average motor and the physical growth measures showed a very strong fit to their respective developmental models ( $R^2 = 0.99$ ). However, single measurements showed more modality-dependent variation that was lowest for motor ( $\sigma = 1.4$  [1.3-1.5 CI 95] months), length ( $\sigma = 1.5$  months), and combined physical ( $\sigma = 1.5$  months) measurements, and it was clearly higher for the weight ( $\sigma = 1.9$  months) and head circumference ( $\sigma = 1.9$  months) measurements. Longitudinal tracking showed clear individual trajectories, and its accuracy was comparable between motor and physical measures with longer measurement intervals. Interpretation: A quantified, transparent and explainable assessment of infants' motor performance is possible with a fully automated analysis pipeline, and the results replicate across independent cohorts from out-of-hospital recordings. A holistic assessment of motor development provides an accuracy that is comparable with the conventional physical growth measures. A quantitative measure of infants' motor development may directly support individual diagnostics and care, as well as facilitate clinical research as an outcome measure in early intervention trials. Funding: This work was supported by the Finnish Academy (314602, 335788, 335872, 332017, 343498), Finnish Pediatric Foundation (Lastentautiensaatiö), Aivosäätiö, Sigrid Jusélius Foundation, and HUS Children's Hospital/HUS diagnostic center research funds.

PMID: [37137181](#)

## 20. Impact of transcranial magnetic stimulation on motor function in children with acquired brain injury: a scoping review protocol

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BMJ Paediatr Open. 2023 May;7(1):e001885. doi: 10.1136/bmjpo-2023-001885.

Background: Children with severe acquired brain injury (ABI) require early and effective neurorehabilitation provision to promote a good long-term functional outcome. Transcranial magnetic stimulation (TMS) has been used to improve motor skills for children with cerebral palsy but there is limited material supporting its use in children with ABI who have a motor disorder. Objective: To systematically answer what the TMS intervention effects are on motor function in children with ABI as reported in the literature. Methods and analysis: This scoping review will follow Arksey and O'Malley's scoping review methodological framework. A comprehensive computerised bibliographic databases search will be performed in MEDLINE, EMBASE, CINAHL, Allied and Complementary Medicine, BNI, Ovid Emcare, PsycINFO, Physiotherapy Evidence Database, Cochrane Central Register using keywords related to TMS and children with ABI. Studies that examine the effect of TMS intervention on motor function as either a primary or secondary objective will be included for this review. Study design and publication detail, participant demographic details, type and severity of ABI and other clinical information, TMS procedure, associated therapy intervention, comparator/control parameters and the outcome measure used data will be gathered. The International Classification of Functioning, Disability and Health for Children and Youth framework will be used to report the TMS effect in children with ABI. A narrative synthesis of the findings describing the therapeutic effects of TMS intervention, limitations and adverse effects will be synthesised and reported. This review will help to summarise the existing knowledge base and to guide further research areas. This review outcome may help to evolve therapists' role to next-generation technology-based neurorehabilitation programmes. Ethics and dissemination: No ethical approval is required for this review as we will be collecting data from previously published studies. We will present the findings at scientific conferences and publish in a peer-review journal.

PMID: [37130655](#)

## 21. An Adaptive Brain-Computer Interface to Enhance Motor Recovery After Stroke

Rui Zhang, Chushan Wang, Shenghong He, Chunli Zhao, Keming Zhang, Xiaoyun Wang, Yuanqing Li

IEEE Trans Neural Syst Rehabil Eng. 2023 May 2;PP. doi: 10.1109/TNSRE.2023.3272372. Online ahead of print.

Brain computer interfaces (BCIs) have been demonstrated to have the potential to enhance motor recovery after stroke. However, some stroke patients with severe paralysis have difficulty achieving the BCI performance required for participating in BCI-based rehabilitative interventions, limiting their clinical benefits. To address this issue, we presented a BCI intervention approach that can adapt to patients' BCI performance and reported that adaptive BCI-based functional electrical stimulation (FES) treatment induced clinically significant, long-term improvements in upper extremity motor function after stroke more effectively than FES treatment without BCI intervention. These improvements were accompanied by a more optimized brain functional reorganization. Further comparative analysis revealed that stroke patients with low BCI performance (LBP) had no significant difference from patients with high BCI performance in rehabilitation efficacy improvement. Our findings suggested that the current intervention may be an effective way for LBP patients to engage in BCI-based rehabilitation treatment and may promote lasting motor recovery, thus contributing to expanding the applicability of BCI-based rehabilitation treatments to pave the way for more effective rehabilitation treatments.

PMID: [37130248](#)



## 22. Use of Thalamus L-Sign to Differentiate Periventricular Leukomalacia From Neurometabolic Disorders

Sabahattin Yuzkan, Merve Emecen Sanli, Merve Balci, Pakize Cennetoglu, Ihsan Kafadar, Burak Kocak

J Child Neurol. 2023 May 2;8830738231168973. doi: 10.1177/08830738231168973. Online ahead of print.

**Purpose:** To assess the diagnostic value of the thalamus L-sign on magnetic resonance imaging (MRI) in distinguishing between periventricular leukomalacia and neurometabolic disorders in pediatric patients. **Methods:** In this retrospective study, clinical and imaging information was collected from 50 children with periventricular leukomalacia and 52 children with neurometabolic disorders. MRI was used to evaluate the L-sign of the thalamus (ie, injury to the posterolateral thalamus) and the lobar distribution of signal intensity changes. Age, sex, gestational age, and level of Gross Motor Function Classification System (only for periventricular leukomalacia) constituted the clinical parameters. Statistical evaluation of group differences for imaging and clinical variables were conducted using univariable statistical methods. The intra- and inter-observer agreement was evaluated using Cohen's kappa. Univariable or multivariable logistic regression was employed for selection of variables, determining independent predictors, and modeling. **Results:** The thalamus L-sign was observed in 70% (35/50) of patients in the periventricular leukomalacia group, but in none of the patients with neurometabolic disorder ( $P < .001$ ). The gestational age between groups varied significantly ( $P < .001$ ). Involvement of frontal, parietal, and occipital lobes differed significantly between groups ( $P < .001$ ). In the logistic regression, the best model included negative thalamus L-sign and gestational age, yielding an area under the curve, accuracy, sensitivity, specificity, and precision values of 0.995, 96.1%, 96%, 96.2%, and 96%, respectively. Both the lack of thalamus L-sign and gestational age were independent predictors ( $P < .001$ ). **Conclusions:** The thalamus L-sign and gestational age may be useful in distinguishing between periventricular leukomalacia and neurometabolic disorders.

PMID: [37128731](#)

## 23. Trends in pediatric mild traumatic brain injury during COVID-19 related lockdown - a single-center study

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Neuropediatrics. 2023 May 1. doi: 10.1055/a-2084-2674. Online ahead of print.

**Background:** A relevant number of visits to pediatric emergency departments (pED) are associated to mild traumatic brain injury (mTBI). On March 16th 2020, the Bavarian government declared a first full lockdown (LD) related to the COVID-19 pandemic. **Aim:** The aim of the study was to investigate the impact of LD on pediatric mTBI. **Methods:** Retrospective chart review of presentations to a pED due to mTBI. Study periods covered LD (03/17/2020 through 05/05/2020) and the same time in 2017, 2018, and 2019 as reference period (RP). Comparative analyses were performed by Chi-square or Fisher's exact test. **Results:** Numbers of mTBI cases decreased by half. Age distribution did not differ. A significantly higher proportion of mTBI were related to falls at home ( $p = .001$ ). Further, a higher rate of hospital admissions ( $p = .03$ ), a higher proportion of ICU admissions ( $p = .001$ ), a longer duration of hospital stay ( $p = .02$ ), and a higher rate of intracranial pathologies on neuroimaging was observed during LD ( $p = .007$ ). **Conclusion:** The decrease in mTBI presentations is likely due to an absolute decrease in numbers related to the LD measures, combined with a hesitation to present very minor mTBI to the hospital, because of fear of being infected or not to put additional strain on the health care system during this health care crisis. On the other hand, data of those that presented with mTBI tend to reflect the more severe spectrum of mTBI.

PMID: [37127049](#)

## 24. Predictors of Risk for Cerebral Palsy: A Review

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Pediatr Phys Ther. 2023 May 1. doi: 10.1097/PEP.0000000000001020. Online ahead of print.

**Purpose:** To identify the earliest predictors of risk for diagnosis of cerebral palsy (CP). **Methods:** A comprehensive literature search was conducted using various databases. The publications were reviewed to identify risk factors for CP from conception to early infancy. Studies were critically appraised with Joanna Briggs Institute guidelines for quality appraisal and evaluated for risk of bias using the Agency for Health Care Research and Quality guidelines. **Results:** The initial search yielded 129 studies and 20 studies were included. Forty-seven risk factors for CP were extracted of which several were duplicate terms. The significant risk factors found to be indicative of CP were low birth weight (<1500 g), birth at less than 28 weeks of gestational age, periventricular leukomalacia, grade 3 or 4 intraventricular hemorrhage, preeclampsia, prematurity, an Apgar score of less than 4 at the first minute, birth asphyxia, preterm premature rupture of membrane, and absent fidgety movements. **Conclusion:** Twenty-three factors were consistently reported as predictors of CP.

PMID: [37126801](#)

## 25. The Effects of Botulinum Toxin and Casting in Spastic Children With Cerebral Palsy: A Systematic Review and Meta-Analysis

Deepak Kumar, Rajan Kumar, Shiv K Mudgal, Priya Ranjan, Sanjay Kumar

Review Cureus. 2023 Mar 29;15(3):e36851. doi: 10.7759/cureus.36851. eCollection 2023 Mar.

Cerebral palsy (CP) is a neurological disorder that affects muscle tone, movement, and motor skills in children. One of the most common symptoms of cerebral palsy is spasticity, which is characterised by involuntary muscle contractions and stiffness. Both botulinum toxin and casting have been used as standalone treatments for spasticity in cerebral palsy, but which is better is still unclear. The aim of the present meta-analysis was to compare the effects on spasticity of serial casting and/or botulinum toxin type A (BoNT-A) in conjunction with or as independent therapies. Studies up to February 2022 were identified in four separate databases. The inclusion criteria were randomised controlled trials (RCTs) that compared different therapies (Botulinum toxin A, or BoNT-A, and casting) and assessed spasticity improvement in children with spastic cerebral palsy who were younger than 18 years old and were published in English. With a 95% confidence interval (CI), the standardised mean difference (SMD) was utilised to calculate treatment effects. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 checklist was followed to undertake the current study. The search for relevant literature in four databases generated 147 results. After the abstract and full-text screening, five publications with a total of 190 cerebral palsy patients were included in this systematic review and meta-analysis. In patients with cerebral palsy, both methods - botulinum toxin and casting- apply globally; our systematic review tries to find out the most effective treatment between the two but does not show any significant difference in these methods. As we know, botulinum toxin is expensive, and the casting method is time-consuming and poorly accepted by patients. There is a need for an excellent study to examine the impact of casting and botulinum toxin type A.

PMID: [37123757](#)

## 26. The Use of Tele-Occupational Therapy for Children and Adolescents with Different Disabilities: Systematic Review of RCT Articles

Simin Dehghani, Navid Mirzakhany, Sima Dehghani, Marzieh Pashmdarfard

Review Med J Islam Repub Iran. 2023 Mar 6;37:17. doi: 10.47176/mjiri.37.17. eCollection 2023.

Background: Due to the limited access of clients in non-urban areas to rehabilitation and the difficulty of specialized counseling in such conditions, the need for telehealth services has increased. The purpose of this study is to evaluate the effectiveness of Tele occupational therapy in common disorders of children and adolescents. Methods: In this systematic review study, a research method published from 2010 to 2022 focusing on the effectiveness of tele-rehabilitation and its impact on children and adolescents with different physical disabilities was done in Google Scholar, PubMed, Scopus and EMBASE databases. 467 articles were obtained in the review, and finally, 18 articles were reviewed. Results: In children with CP, Tele occupational therapy will be effective on gross motor function and balance skills, but the impact on the executive function needs more studies. In children with ASD, it will be effective on behavioral problems, but the effect on pro-social behavior needs further studies. In children and adolescents with other movement disorders, it will have an impact on the progress of their physical activity and in children and adolescents with Traumatic Brain Injury (TBI), it will be effective, but the effectiveness of MitiiTM programs needs further studies. Conclusion: The findings of this study showed that tele-occupational therapy could be performed in line with face-to-face occupational therapy, and it can lead to the satisfaction of families, but there is still a need to assess the effectiveness of various interventions and tools on different disorders, outcomes and settings.

PMID: [37123331](#)

## 27. Anesthesia management in a pediatric patient with complicatedly difficult airway: A case report

Jia-Xiang Chen, Xiao-Li Shi, Chang-Sheng Liang, Xing-Gang Ma, Liang Xu

Case Reports World J Clin Cases. 2023 Apr 16;11(11):2482-2488. doi: 10.12998/wjcc.v11.i11.2482.

Background: Reports on perioperative anesthesia management in pediatric patients with difficult airways are scarce. In addition to relatively more difficulties in the technique of endotracheal intubation, the time for manipulation is restricted compared to adults. Securing the airways safely and avoiding the occurrence of hypoxemia in these patients are of significance. Case summary: A 9-year-old boy with spastic cerebral palsy, severe malnutrition, thoracic scoliosis, thoracic and airway malformation, laryngomalacia, pneumonia, and epilepsy faced the risk of anesthesia during palliative surgery. After a thorough preoperative evaluation, a detailed scheme for anesthesia and a series of intubation tools were prepared by a team of anesthesiologists. Awake fiberoptic intubation is the widely accepted strategy for patients with anticipated difficult airways. Given the age and medical condition of the patient, we kept him sedated with spontaneous breathing during endotracheal intubation. The endotracheal intubation was completed on the second attempt after the failure of the first effort. Fortunately, the surgery was successful without postoperative complications. Conclusion: Dealing with difficult airways in the pediatric

population, proper sedation allows time to intubate without interrupting spontaneous breathing. The appropriate endotracheal intubation method based on the patient's unique characteristics is the key factor in successful management of these rare cases.

PMID: [37123316](#)

## **28. Early Cerebral Palsy Detection and Intervention**

Paola Mendoza-Sengco, Caitlin Lee Chicoine, Jilda Vargus-Adams

Review *Pediatr Clin North Am.* 2023 Jun;70(3):385-398. doi: 10.1016/j.pcl.2023.01.014. Epub 2023 Mar 21.

Early identification of cerebral palsy (CP) facilitates optimal care, support, and outcomes for children and their families. Ideally, infants with risk factors or developmental deviations should be evaluated early using standardized assessments of neurodevelopment and brain imaging. If a diagnosis of CP or high risk for CP (HRCP) is established, specialized, evidence-informed therapy and family support should be initiated. With task-specific motor skill training and an enriched environment, infants with CP show greater gross motor and cognitive gains. These enhanced outcomes are only achievable with early diagnosis and subsequent intervention.

PMID: [37121632](#)