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Interventions and Management

1.Functional Profiles and Baseline Correlates of Hand Function Change in Youth with Unilateral Cerebral Palsy Following Constraint-Induced Movement Therapy

Angela Shierk, Ashlie Frederiksen, Fabiola Reyes, Sydney Chapa, Nancy Clegg, Lillian Cates, Heather Roberts

Occup Ther Health Care. 2025 Dec 9. Online ahead of print

Abstract

This study aimed to describe the functional profiles of children with unilateral cerebral palsy who participated in constraint-induced movement therapy and correlate change in hand function after the intervention with factors across the International Classification of Functioning, Disability, and Health (ICF). Twenty-three children aged 5.0 to 13.5 years (SD = 3.08) with unilateral cerebral palsy participated in a two-week (60-h) group-based constraint induced movement therapy program as part of a blinded randomized controlled trial comparing a constraint induced movement therapy camp to constraint induced movement therapy plus virtual reality. The International Classification of Functioning, Disability, and Health Brief Core Set for Cerebral Palsy (ICF CP Core Set) was administered at baseline. Changes in hand function were measured using the Assisting Hand Assessment at baseline and after intervention. Descriptive statistics were used to summarize the ICF CP Core Set results, providing functional profiles of children with unilateral cerebral palsy who participated in constraint induced movement therapy across ICF domains. Assisting Hand Assessment change scores were correlated with the ICF CP Core Set using Spearman's rank analysis to identify characteristics associated with favorable responses to intervention. Positive correlates to change in hand function only included the following ICF CP Core Set environmental supports: Health services, systems, and policies [$p = 0.03$]; Education and training services, systems, and policies [$p = 0.01$]; and the Environmental sum score [$p \leq 0.01$]. While the clinical presentation of this population necessitates a heavy focus on motor deficits, these findings highlight that environmental factors also play an important role in functional improvement and, ultimately independence in this population.

PMID: [41368862](#)

2. Extensor Carpi Ulnaris to Extensor Carpi Radialis Brevis Tendon Transfer in Pediatric Patients with Cerebral Palsy

Christopher S Crowe, Natalie Williams, Zachary Weingrad, Dan A Zlotolow, Scott H Kozin, Eugene Park

Plast Reconstr Surg. 2025 Dec 9. Online ahead of print

Background: Spastic wrist flexion deformity is a common manifestation of cerebral palsy (CP) that not only impairs grasp but also serves as a visible marker of neurologic impairment. The flexor carpi ulnaris (FCU) to extensor carpi radialis brevis (ECRB) transfer is a well-established technique that both reduces wrist flexion force and augments extension, though it carries a risk of postoperative hyperextension deformity. This study describes the surgical technique and outcomes of an alternative procedure—extensor carpi ulnaris (ECU) to ECRB tendon transfer—for the correction of spastic wrist flexion deformity. **Methods:** A retrospective study was performed to analyze outcomes pediatric CP patients who underwent extensor carpi ulnaris (ECU) to extensor carpi radialis brevis (ECRB) tendon transfer to improve wrist extension and grip strength. Primary assessment included wrist position and range of motion, active grasp, and subjective improvement in grasp after surgery. Secondary outcomes included the need for an additional procedure to further correct wrist position after tendon transfer. **Results:** Twenty-six wrists in 24 patients underwent ECU to ECRB transfer. Postoperatively, 22 wrists (85%) achieved extension beyond neutral at an average of 28 degrees. Improved grasp was reported by 21 patients (81%). Five underwent revision for recurrent wrist flexion deformity and one for fixed extension. **Conclusions:** ECU to ECRB tendon transfer is a safe and effective technique to reliably improve wrist posture and grasp in patients with spastic CP.
PMID: [41364464](#)

3. Radiological Assessment of Inter- and Intra-observer Reliability in Hip Migration Measurements in Children With Cerebral Palsy at a Tertiary Referral Center

Joseph Sajeev, Binu Kurian, Jaya V Lal, Arun George, Joe Joseph

Cureus. 2025 Dec 10;17(12):e98870. eCollection 2025 Dec

Background Hip migration is a common deformity in children with cerebral palsy (CP). Although children with CP often have anatomically normal hips at birth, progressive spasticity can lead to hip subluxation, dislocation, and acetabular dysplasia over time. Early recognition of hip migration is crucial because timely intervention can significantly change the prognosis and reduce morbidity. The aim of this study was to evaluate the inter- and intra-observer reliability of radiographic hip migration measurements in children with CP. **Materials and methods** We conducted a prospective observational study from 2020 to 2022 to determine inter- and intra-observer variation in the diagnosis of hip migration among children with CP. Eligible participants were recruited from the clinic and followed up for a period of two years. They underwent serial supine AP pelvic radiographs at six-month intervals. The radiographic parameters evaluated were Reimer's migration percentage (MP) and the acetabular index (AI). Four observers with varying levels of clinical experience independently assessed the radiographs. Inter- and intra-observer agreement was analyzed using intraclass correlation coefficients (ICCs) and standard statistical methods. **Results** Eighteen children (mean age 12.2 years, range 2-18 years, SD 7.72) with spastic CP were included in the study. To ensure consistency and avoid inter-hip variability in the same patient, the hip showing greater displacement served as the unit of analysis. Based on the Gross Motor Function Classification System, nine were classified as level IV, seven as level III, and two as level V. The MP demonstrated consistently high inter- and intra-observer reliability, with ICCs and 95% CIs of 0.999 (0.988-1.000) at baseline and 0.999 (0.999-1.000) at endline. Similarly, the AI also showed excellent inter- and intra-observer reliability, with ICCs and 95% CIs of 0.992 (0.984-0.997) at baseline and 0.998 (0.997-0.999) at endline. These findings indicate strong reproducibility for both measurements across observers and time points. MP analysis showed a significant increase from baseline to endline (Wilcoxon $Z = -3.724$, $p = 0.0002$), indicating progression of hip migration. AI also increased significantly over time (paired $t = -3.944$, $p = 0.0010$), reflecting the progression of acetabular dysplasia. Both represent secondary outcomes of the study. **Conclusions** This study demonstrates that both MP and AI provide comparable and clinically acceptable levels of inter- and intra-observer reliability, with a slight advantage for MP. These results underscore the value of MP as a primary surveillance metric while reaffirming AI as a reliable adjunct for evaluating acetabular morphology in children with CP. By contributing additional evidence on the reproducibility of these measurements, our study supports their continued use within structured hip surveillance programs. Further multicenter, prospective studies are needed to validate these findings in broader populations and to strengthen the foundation for standardized, universally applicable surveillance protocols.
PMID: [41383873](#)

4.Unilateral hip reconstruction combined with contralateral guided growth versus bilateral reconstruction in children with cerebral palsy and unilateral hip displacement

María Galán-Olleros, María Muñoz de la Espada, Jaime García-Fernández, Ana Ramírez-Barragán, Manuel Fraga-Collarte, Susana Cartas-Carrión, Ignacio Martínez-Caballero

J Pediatr Orthop B. 2025 Dec 8. Online ahead of print

Abstract

Level III, retrospective comparative study.

PMID: [41362092](#)

5.Evaluating radiologic outcomes of surgical techniques used in foot valgus deformity of cerebral palsy patients: a systematic review and meta-analysis

Iman Menbari Oskouie, Sepehr Metanat, Nazanin Rahimdoost, Amir Kasaeian, Farzad Pourghazi, Maysa Eslami, Alireza Arvin, Mohammad Hossein Nabian, Ana Presedo

BMC Musculoskelet Disord. 2025 Dec 12. Online ahead of print

Abstract

No abstract available

PMID: [41382110](#)

6.Morphological Variations in the Talus and Calcaneus in Adults With Cerebral Palsy Comparing With and Without Lateral Column Lengthening

Andrew C Peterson, Kassidy Knutson, Joseph J Krzak, Peter A Smith, Amanda T Whitaker, Karen M Kruger, Amy L Lenz

J Foot Ankle Surg. 2025 Dec 9. Online ahead of print

Background: Foot deformities, particularly pes planovalgus, are common in individuals with cerebral palsy, often requiring surgical interventions such as lateral column lengthening (LCL) to improve foot alignment and function. While LCL is a well-established procedure for treating valgus deformities, the long-term effects on bone morphology, particularly in the talus and calcaneus, have not been thoroughly explored.

Purpose: To evaluate the morphological differences in the talus and calcaneus in individuals with cerebral palsy who have undergone LCL surgery compared to nonsurgical patients and controls.

Study design: Comparative cross-sectional study.

Methods: Thirty individuals were divided into three groups: control, surgical, and nonsurgical. Computed tomography scans were used to generate 3D models of the talus and calcaneus. Statistical shape modeling was employed to analyze and quantify shape variations, utilizing principal component analysis and Hotelling's T-squared test to identify significant morphological differences between groups.

Results: LCL surgery resulted in significant morphological differences in the talus, including a more anterior tibiotalar joint and wider talonavicular articulating surface compared to nonsurgical patients and controls. Significant shape variations in the calcaneus were observed in the surgical group, with a smaller calcaneal tuberosity and altered subtalar facet. Hotelling's T-squared tests confirmed these significant differences between group mean shapes.

Conclusion: LCL surgery results in significant morphological alterations to the talus and calcaneus, suggesting the procedure affects not only the target bone but also neighboring structures. These changes may have long-term implications for foot biomechanics. Future research should investigate functional outcomes and explore longitudinal adaptations in bone shape following surgery.

PMID: [41380989](#)

7. Associations Between Maximal Passive Knee Extension and Sagittal Plane Kinematic Patterns in Children with Spastic Cerebral Palsy: A Longitudinal Study

Inti Vanmechelen, Edwin Råsberg, Eva Broström, Cecilia Lidbeck

J Clin Med. 2025 Dec 3;14(23):8567.

Background/Objectives: There is limited information on the interplay between passive joint motion and joint kinematics from three-dimensional gait analysis (3DGA) and its longitudinal evolution in cerebral palsy (CP). We aimed to associate clinical measurements and gait kinematics over time using a longitudinal study design.

Methods: Ambulatory individuals with spastic CP, aged 4-18, who performed a minimum of two 3DGA at the Karolinska University Hospital between 2008 and 2025 were recruited. Primary outcomes were sagittal plane kinematics and maximum passive knee extension (pKE). Canonical correlation (R) with statistical parametric mapping was used to associate passive maximum knee extension with sagittal hip, knee, and ankle angles at two timepoints.

Results: The 3DGA data of 31 children (age 4-17 years; mean age 10.4 ± 2.9) with 22 bilateral (bCP, GMFCS I = 6; II = 13; III = 3) and 9 unilateral CP (uCP, GMFCS I = 8; II = 1) was included. For the whole and bCP groups, respectively, knee flexion/extension and pKE were correlated throughout stance ($p < 0.001$), with R between -0.47 and -0.57/-0.49 and -0.59 at T1 and between -0.46 and -0.72/-0.50 and -0.76 at T2. Hip flexion/extension and knee pKE were correlated from 17 to 62%/46-52% of the gait cycle ($p < 0.001/p = 0.045$) for the whole and bCP groups, respectively, with R between -0.41 and -0.57/-0.38 and -0.41 at T1 and from 15 to 64%/17 to 61% with R between -0.50 and -0.57/-0.42 and -0.57 at T2.

Conclusions: Reported associations between structural knee properties and knee position during gait demonstrated progression over time, implying that a restricted range of motion may be driven by functional constraints. Combining knee contractures and their longitudinal development with 3DGA is a powerful approach for pre-intervention planning.

PMID: [41375869](#)

8. Impact of single-event multilevel surgery on gait efficiency in children with cerebral palsy: a retrospective study

Corrado Borghi, Daniela Pandarese, Debora Formisano, Silvia Sassi, Valentina Montemaggiori, Francesco Pelillo, Silvia Alboresi, Giancarlo Gargano, Benedetta Casoli, Silvia Faccioli

Eur J Phys Rehabil Med. 2025 Dec 9. Online ahead of print

Background: Single-event multilevel surgery is a widely used intervention for improving gait in children with cerebral palsy. While its effects on kinematics and spatiotemporal parameters are well documented, its impact on gait efficiency remains underexplored.

Aim: To evaluate the impact of single-event multilevel surgery on gait efficiency and quality in children with cerebral palsy.

Design: Retrospective study.

Setting: Pediatric Rehabilitation Unit at AUSL-IRCCS, Reggio Emilia, Italy, using pre- and post-surgical gait analysis data collected from 2011 to 2022.

Population: The study included 109 children with cerebral palsy, categorized into a surgical group (81 patients) who underwent single-event multilevel surgery and a non-surgical group (28 patients).

Methods: Single-event multilevel surgery targeted lower limb pathologies using soft tissue and skeletal corrections. Gait efficiency was assessed through maximum knee and hip extension, and push-off power and energy. Gait quality was evaluated using the Gait Profile Score and Gait Variable Scores. Spatiotemporal parameters were also measured.

Results: In the surgical group, maximum knee extension improved by 6.1° ($P < 0.001$) and hip extension by 1.6° ($P = 0.023$). Ankle push-off power (+24.1%) and energy (+19.8%) increased significantly, while knee energy production decreased (-14%). Gait Profile Score improved by -2.8° ($P < 0.001$). Significant gait variable score reductions included knee flexion-extension (-4.0°), ankle plantarflexion-extension (-3.8°), and foot progression angle (-4.0°). Spatiotemporal metrics remained largely unchanged. Correlations revealed a modest inverse relationship between age and push-off power ($\rho = -0.28$, $P = 0.012$) and an association between Gross Motor Function Classification System levels and push-off power ($P = 0.018$). The non-surgical group showed no significant changes in any efficiency or quality metrics.

Conclusions: Single-event multilevel surgery significantly improves gait efficiency and quality in children with cerebral palsy by enhancing joint kinematics and dynamics.

Clinical rehabilitation impact: These findings highlight single-event multilevel surgery's capacity to optimize gait mechanics, prioritizing efficiency and quality improvements over maximal walking performance. This supports its use as a key intervention for improving functional mobility in rehabilitation settings.

PMID: [41364021](#)

9. Feasibility of Designing, Manufacturing and Delivering 3D Printed Ankle-Foot Orthoses: An Updated Systematic Review

Joyce Z Wang, Elizabeth A Wojciechowski, Thomas Paine, Joshua Burns, Tegan L Cheng

J Foot Ankle Res. 2025 Dec;18(4):e70097.

Background: Ankle-foot orthoses (AFOs) are commonly prescribed to manage lower limb impairments, especially foot drop in neurological disorders. With the evolution of 3D technology, digital acquisition using 3D scanning and modelling using computer aided design software is becoming more commonplace to produce AFOs. Our previous systematic review in 2019 identified an emerging field of 3D printed AFOs and we highlighted biomechanical effects, mechanical properties and self-reported outcomes such as comfort. To cover the rapidly growing literature on the effects of 3D printed AFOs in clinical populations, the aim of this systematic review was to update an earlier review from 2019 to determine the feasibility and effect of 3D printed AFOs on biomechanical and satisfaction outcomes.

Method: Seven electronic databases were searched from 1985 to July 2025. Original research papers of any design from healthy or clinical populations of any age were eligible for inclusion. Studies must have investigated the effect of 3D printed AFOs in healthy or pathological populations. The quality of the evidence was assessed using QualSyst.

Results: Twenty-eight papers were included in the updated systematic review. The use of 3D printing methods and materials varied markedly, where fused deposition modelling was more prevalent in recent literature than selective laser sintering, and Nylon 12 was most tested. The sample sizes were all smaller than 12. Walking speed and step length of people wearing 3D printed AFOs were mostly improved compared to those with other AFOs and shod or barefoot only. 3D printed AFOs generally had similar or higher satisfaction scores than traditional AFOs. Although levels of evidence were all lower than four, 10 papers had excellent study quality.

Conclusion: The use of additive manufacturing in AFO fabrication has rapidly increased in the past few years. The novel designed 3D printed AFOs might have potential benefits over traditional designs in terms of biomechanical outcomes. 3D printed AFOs have been further proven to be comparable to traditional ones. Further research is encouraged to conduct with more specific condition characteristics such as cerebral palsy within a specific GMFCS level, longitudinal clinical trials and testing in a home or natural environment. Establishing a standard for AFO evaluation and reporting is also recommended.

PMID: [41363222](#)

10. Soft vs. Traditional AFOs: A Comparative Study on Gait Kinematics, Kinetics, and Muscle Activity

Thomas E Augenstein, Breanna Bordine, Nyari Bhatt, Shreeya Buddaraju, Olugbenga P Adeeko, Edward P Washabaugh, Chandramouli Krishnan

Restor Neurol Neurosci. 2025 Dec 8. Online ahead of print

Abstract

Reduced toe clearance during the swing phase of gait, often referred to as foot drop, is a common cause of walking disability in clinical populations like stroke, cerebral palsy, or multiple sclerosis. Individuals with foot drop often wear an ankle-foot orthosis (AFO) to prevent excessive plantarflexion, but many commercially available AFOs overly restrict ankle mobility or make the wearer feel unstable/uncomfortable. Soft AFOs—AFOs with soft attachment points and elastic assistance—are designed to retain ankle mobility and comfort. However, their effect on gait biomechanics, as compared to traditional AFOs, is not well understood. Therefore, the objective of the current study was to perform a comprehensive biomechanical and neurophysiological comparison of soft AFOs with traditional AFOs. Sagittal plane kinematics, ground reaction forces, and lower extremity muscle activation were measured in 23 neurologically intact individuals while walking on a treadmill without assistance from an AFO (No AFO) and then with unilateral assistance from four commercially available AFOs (rigid anterior, flexible posterior leaf spring, and two soft AFOs). We found that soft AFOs allowed for greater ankle dorsiflexion velocity, plantarflexion velocity, and plantarflexion angle while retaining or increasing dorsiflexion during the swing phase. We also found that the traditional AFOs reduced propulsive ground reaction forces compared to the soft AFOs, and the rigid anterior AFO reduced plantarflexor muscle activity compared to the soft AFOs. These results highlight the differences between different commercially available AFOs and present soft AFOs as an exciting alternative to traditional AFOs when ankle mobility is desired.

PMID: [41359298](#)

11. Sonomyography accurately captures joint kinematics during volitional and electrically stimulated motion in healthy adults and an individual with cerebral palsy

Shriniwas Patwardhan, Noah Rubin, Katharine E Alter, Diane L Damiano, Thomas C Bulea

J Neuroeng Rehabil. 2025 Dec 11. Online ahead of print

Background: Despite significant advances in biosignal extraction techniques for studying neuromotor disorders, there remains an unmet need for a method that effectively links muscle structure and dynamics to muscle activation. Addressing this gap could improve the quantification of neuromuscular impairments and pave the way for precision rehabilitation. In this study, we demonstrate the proof of concept of recording multimodal signals from the brain, muscles, and resulting limb kinematics. We also explore the use of ultrasound imaging to extract limb kinematics.

Methods: We collected data from three healthy volunteers and one individual with cerebral palsy during single degree-of-freedom ankle and wrist movements. Participants performed range of motion (ROM) tasks at approximately 1-second intervals, either volitionally or through functional electrical stimulation. We simultaneously recorded electroencephalography, surface electromyography (EMG), continuous ultrasound imaging, and motion capture data. Joint kinematics were computed from ultrasound imaging using a technique called sonomyography (SMG), and we evaluated the technical feasibility of estimating joint kinematics from both sonomyography and surface EMG signals.

Results: The technical feasibility study evaluated joint angle prediction using EMG and SMG under volitional (FES-OFF) and electrically stimulated (FES-ON) conditions. Root mean squared error (RMSE) between predicted and measured joint angles was computed for multiple methods of extracting kinematics from EMG and SMG. EMG-based RMSE ranged from 0.34 to 0.57 (FES-OFF) and 0.43-0.51 (FES-ON). SMG-based RMSE ranged from 0.10 to 0.25 across all conditions and methods. Linear regression analysis produced R^2 values between 0.31 and 0.81 depending on joint, condition, and method. No significant RMSE difference was found between FES-ON and FES-OFF conditions within SMG. SMG RMSE values were also comparable to previously reported values (10-25%) in prior literature.

Conclusion: Our findings suggest that sonomyography can be used as a noninvasive method for estimating joint kinematics when the joint movement is driven either by volition or by functional electrical stimulation. This technique can potentially be useful in evaluating altered muscle dynamics and driving assistive and rehabilitation devices in individuals with neuromotor disorders such as cerebral palsy.

PMID: [41382132](#)

12. Factors influencing the long-term maintenance of spasticity neurotoxin treatment

Mallory L Hacker, Lucas Chang, Sheffield Sharp, Jack Slatton, Eli A Abdou, Ariana Zarghami, Emily Butler, Kelly Harper, Ashley Eaves, Kevin Berry, C J Plummer, David Charles

J Neurol Sci. 2025 Dec 4;480:125692. Online ahead of print

Introduction: Spasticity is a motor disorder often impairing mobility, daily function, and quality of life. While botulinum neurotoxin (BoNT) is safe and effective for spasticity, treatment discontinuation is common. This study aimed to identify the factors influencing long-term BoNT therapy maintenance among spasticity patients.

Methods: Forty participants with spasticity who received at least five BoNT cycles completed a structured cross-sectional telephone interview. Interviews covered key dimensions of living with spasticity, such as impact on daily activities, experience of pain associated with spasticity, and the broader implications for quality of life. Data were summarized using descriptive statistics.

Results: The cohort (60% male, aged 45.1 ± 14.8 years) featured multiple etiologies of spasticity, including cerebral palsy (35%), stroke (20%), and traumatic brain injury (20%). Most were treated with onabotulinumtoxinA (36/40), three were receiving abobotulinumtoxinA, and one was treated with incobotulinumtoxinA. Primary reasons for maintaining BoNT treatment included reduction of symptoms (55%), improvement in mobility/movement (27%), and relief of pain or tension (12%). A majority of subjects (95%) stated their treatment met or exceeded their expectations. Over 90% of participants maintained a strong relationship with their physician and were well-informed about the therapy, including what to expect from treatment (98%), potential side effects (90%), and treatment duration (90%).

Conclusion: Results suggest spasticity patients are likely to continue treatment if they are properly educated on BoNT therapy, experience improvement in spasms and mobility, and have a strong physician-patient relationship. These findings highlight the importance of effective physician-patient relationships and proper education on BoNT therapy.

PMID: [41380469](#)

13. Letter to the Editor: High effectiveness of multilevel orthopaedic surgery and guided growth in spastic hemiplegia children

Shyam Sundar Sah, Abhishek Kumbhalwar

J Child Orthop. 2025 Dec 8. Online ahead of print

Abstract

No abstract available

PMID: [41376864](#)

14. Effect of music-driven movement therapy on behavior and hand function in children and adolescents with cerebral palsy

Jennifer Gabriella Vincent, Divya Mohan, Suruliraj Karthikbabu

Physiother Theory Pract. 2025 Dec 9. Online ahead of print

Background and aim: Individuals with cerebral palsy exhibit poor movement coordination, reduced selective motor control, and balance dysfunction, all of which affect their overall behavior. This study aimed to examine whether music-driven movement therapy is beneficial for behavior and hand function in children and adolescents with cerebral palsy.

Methods: This one-group pretest-posttest pragmatic feasibility trial was conducted in special schools in Bangalore, India. Twenty-two children and adolescents with cerebral palsy aged 8-15 years, spastic and dyskinetic groups, with a Gross Motor Function Classification System level of I-IV, or a Manual Ability Classification System level of I-III were included in the study. They participated in non-directional goal-oriented movement sequences driven by playing joyful rhythmic beats on musical instruments. All of them practiced a one-hour session per day, 3 days a week, over a six-week duration. Behavioral function was measured using the Behavior Rating Inventory of Executive Function version 2.0 teacher form (BRIEF2), and hand function was assessed using the manual ability questionnaire - ABILHAND.

Results: Following music-driven movement practice, the Behavior Regulation Index, Emotion Regulation Index, Cognitive Regulation Index, and Global Executive Composite of the BRIEF2 and ABILHAND improved significantly ($p < .001$).

Conclusion: Music-driven movement therapy was beneficial for improving the behavior and hand function of children and adolescents with cerebral palsy.

PMID: [41367250](#)

15. Comparison of eating behaviors and mothers' eating attitudes based on visual function levels in children with cerebral visual impairment

Özge Cemali, Özgün Elmas, Mustafa Cemali

BMC Pediatr. 2025 Dec 12. Online ahead of print

Background: While there are studies evaluating the eating behaviors of children with cerebral palsy (CP) and the eating attitudes of mothers, studies on eating behaviors and mothers' eating attitudes in children with CP with cerebral visual impairment (CVI) according to visual function level are in their infancy. Based on this, the aim of this study was to compare eating behaviors and mothers' eating attitudes according to the level of visual function in children with CP and CVI.

Methods: A total of 90 children with CP and CVI aged 36-72 months, consisting of 30 level 2, 30 level 3 and 30 level 4 according to the visual function classification system (VFCS) and their mothers participated in the study. Eating behaviors of children with CP and CVI were assessed with the Children's Eating Behavior Questionnaire (CEBQ) and mothers' eating attitudes towards the feeding process of their children were assessed with The Mother's Attitudes Towards the Feeding Process Scale (MAFPS).

Results: According to the results of the study, statistically significant differences were found among the three groups in all subdomains of the CEBQ-except for the emotional overeating subdomain-and in all subdomains and the total score of the MAFPS ($p < 0.001$). There was no statistically significant difference between the groups in the emotional overeating sub-field of CEBQ ($p = 0.184$). In the post hoc analysis, a statistically significant difference was found in all assessment areas except the emotional overeating area in the pairwise comparisons of the groups ($p < 0.05$).

Conclusion: In the study in which eating behaviors of children diagnosed with CP and CVI and eating attitudes of mothers were evaluated according to VFCS levels, it was determined that children at level 4 and their mothers exhibited a more negative picture compared to level 3, and children at level 3 and their mothers exhibited a more negative picture compared to level 2. Worsening vision was found to be a factor that negatively affected the eating behaviors of children with CP and CVI and the mothers' attitudes towards eating. The eating behaviors of children with CP and CVI and the eating attitudes of mothers should be included in routine assessments and intervention approaches that include mothers in this process should be planned.

PMID: [41388450](#)

16. Resin Infiltration Treatment of Developmental Enamel Defects in a Patient With Hydrocephalus and Cerebral Palsy: A Case Report on the Impact on the Maternal Caregiver

Eduarda Martins Fontes Cantarella de Almeida, Anna Luísa Araujo Pimenta, Francisco Wanderley Garcia de Paula-Silva, Fabricio Kitazono de Carvalho, Laurindo Borelli-Neto, Susanne Effenberger, Fernanda de Carvalho Panzeri, Silmara Aparecida Milori Corona, Kelly Fernanda Molena, Alexandra Mussolino de Queiroz

Case Reports Spec Care Dentist. 2025 Nov-Dec;45(6):e70123.

Aims: Developmental defects of enamel (DDEs) can negatively affect both the esthetics and function of teeth, especially in children with neurological impairments. The impact of dental treatments on caregivers' emotional well-being is an important but often overlooked aspect. Herein, we describe the esthetic and functional management of DDEs in a child with hydrocephalus and cerebral palsy (CP), using a minimally invasive resin infiltration technique, and the impact of the treatment on the maternal caregiver.

Methods: A 10-year-old male patient presented to the dental clinic accompanied by his mother, who reported concern regarding the presence of whitish stains on the anterior teeth. Clinical examination identified DDEs consistent with molar-incisor hypomineralization (MIH) and fluorosis. Lesion characteristics were assessed by transillumination. A minimally invasive resin infiltration protocol (Icon) was performed, resulting in immediate esthetic improvement and effective masking of enamel opacities. Caregiver-reported outcomes, assessed through a qualitative interview, revealed a significant emotional impact, including enhanced satisfaction and improved quality of life.

Conclusion: This case highlights the potential of resin infiltration as a minimally invasive treatment for enamel defects in patients with disabilities, improving esthetics, psychosocial well-being, and reinforcing the importance of a family-centered approach in dental care.

PMID: [41355225](#)

17.The feasibility of a subgroup approach to create sensory-motor behavioral response profiles from a modified quantitative sensory test in cerebral palsy

Alyssa M Merbler, Darin J Erickson, Chantel C Burkitt, Donald A Simone, Frank J Symons

Pain. 2025 Dec 9. Online ahead of print

Abstract

Cerebral palsy is the most common motor disorder of childhood, leading to lifelong disability and associated comorbidities, including a high incidence of chronic pain. This hypothesis-generating study aimed to (1) investigate a modeling approach to subgrouping based on behavioral reactivity (BR) to a modified quantitative sensory test (mQST), and (2) explore potential relations between BR subgroups, pain status, and clinical features. For this cross-sectional study, recruitment was conducted through a systematic proportional stratified sampling approach in relation to cerebral palsy type (eg, spastic, mixed type). Caregivers completed the Dalhousie Pain Interview; health history was collected from the medical record. The mQST included 6 tactile stimuli applied to the back of the right and left calves (eg, light touch, pressure, heat), and the BR associated with each application was scored using a modified Face Legs, Activity, Cry, Consolability scale. Of the 188 participants enrolled, 12 (6.4%) did not tolerate the full mQST. Latent class analysis was conducted with 172 participants, and the model with 6 classes had the best fit, with no classes having fewer than 5% of the sample. The 6-class solution revealed subgroups with relatively flat to relatively reactive patterns specific to different stimulus application modalities, providing sufficient evidence that reactivity subgroups can be reliably modeled. Descriptively, there were no apparent differences in the BR profile by sex; however, potentially by age and pain experience. Our results in this study indicate that sensory response profiles may be a promising approach to better understand the nature of chronic pain in cerebral palsy.

PMID: [41380090](#)

18.Visual perception in adults with CP - assessment and individual differences: An exploratory study

Katrine Sand, Kathleen Vancleef, Randi Starrfelt, Ro J Robotham

Clin Neuropsychol. 2025 Dec 11:1-21. Online ahead of print

Objective: Visual perception is frequently impaired in individuals with cerebral palsy (CP). Little is known about the range of visual perceptual impairments that may occur in adults with CP, and few studies have investigated performance at the individual level. Here, we aim to characterize visual perceptual functions in a group of adults with CP.

Method: 21 participants with CP and 40 neurotypical control participants, aged 18-40 years, were assessed with a range of visual perceptual tests commonly used in neuropsychological practice. The tests were selected to make sure that individuals with all severities of CP would be able to take part in the study. The analyses were pre-registered prior to data collection on Open Science Framework: <https://doi.org/10.17605/OSF.IO/S7KBE>. Results were analyzed both at the group level and at an individual level using single case methodology.

Results: Most participants with CP were able to complete the full test battery, despite some having severe motor impairments. The participants with CP performed worse than the control group on indexes of face recognition, reading and visuospatial functions, while there was no difference on an object recognition index. At the individual level, three participants were impaired on ≤ 1 test, while 18 of 21 participants with cerebral palsy were impaired on more than two tests (range: 3-15).

Conclusions: Overall, adults with CP can have a wide range of visual perceptual impairments, even when evaluated using screening tests. The participants with impaired visual perceptual functions showed signs of both dorsal and ventral stream dysfunction.

PMID: [41379421](#)

19.Oral Melatonin Supplementation for Sleep Disturbances in Children with Cerebral Palsy: A Randomized Double-Blind Controlled Trial

Gire Pooja K, Smita Mundada, Janhavi Zambani, Trupti Joshi, Prabha Khaire, Shilpa Pawar, Madhavi Shelke

Indian J Pediatr. 2025 Dec 10. Online ahead of print

Objectives: To assess the efficacy and safety of oral melatonin in treating sleep problems in children with cerebral palsy (CP). **Methods:** A randomized, double-blind, placebo-controlled trial was conducted at a tertiary care government hospital in 120 children with CP (3 to 12 y) suffering from sleep problems and who failed to respond to non-pharmacological therapy (4 wk). Participants were randomized to receive oral melatonin (3 mg escalated to 10 mg)/placebo for 12 wk. Sleep measures included the Sleep Disturbance Scale for Children (SDSC), and caregivers reported sleep and nap diaries (SND). Outcome measures included decreased sleep onset latency (SOL) and increased total sleep time (TST) calculated using sleep diaries at 4 and 12 wk.

Results: The mean (SD) total sleep time in the melatonin and placebo groups was 5.09 (0.76) vs. 4.90 (0.77) h [Mean difference (MD) 0.19; $P = 0.17$] at baseline; 5.66 (0.84) vs. 4.89 (0.83) h (MD 0.77; $P < 0.001$) at 4 wk; 6.29 (0.78) vs. 4.98 (0.85) h (MD 1.31; $P < 0.001$) at 12 wk, respectively. The mean (SD) sleep onset time in melatonin and placebo groups was 79.18 ± 17.89 vs. 76.78 ± 13.60 min (MD 2.4; $P = 0.41$) at baseline; 63.70 ± 16.63 vs. 72.89 ± 15.38 min (MD 9.19; $P < 0.003$) at 4 wk; 43.20 ± 15.57 vs. 70.92 ± 14.95 min (MD 27.72; $P < 0.001$) at 12 wk, respectively. Melatonin was well tolerated with minimal side effects ($n = 10$).

Conclusions: Melatonin, at a dose range of 3-10 mg once daily can significantly reduce SOL and improve TST in children with CP who have sleep problems with minimal adverse effects.

PMID: [41369870](#)

20.Efficacy of Virtual Reality Interventions for Motor Function Improvement in Cerebral Palsy Patients: Systematic Review and Meta-Analysis

Norah Suliman AlSoqih, Faisal A Al-Harbi, Reema Mohammed Alharbi, Reem F AlShammari, May Sameer Alrawithi, Rewa L Alsharif, Reema Husain Alkhalifah, Bayan Amro Almaghrabi, Areen E Almatham, Ahmed Y Azzam

J Clin Med. 2025 Nov 26;14(23):8388.

Introduction: Cerebral palsy (CP) affects motor function development, requiring intensive rehabilitation. Virtual reality (VR) interventions show promise for improving motor learning through immersive, engaging experiences. This systematic review and meta-analysis evaluated VR effectiveness for motor function improvement in children with CP.

Methods: Following PRISMA 2020 guidelines, we searched six electronic databases from inception to 15 June 2025. Included studies compared VR interventions versus control conditions in children with CP (ages 4-18 years), measuring motor function outcomes. Sixteen studies ($n = 397$ participants) met the inclusion criteria for qualitative synthesis. Random-effects models, subgroup analyses, and meta-regression were performed. Evidence certainty was evaluated using GRADE methodology.

Results: Five randomized controlled trials with complete extractable data ($N = 190$ participants, 40 effect sizes) were included in the primary quantitative meta-analysis. The primary meta-analysis demonstrated moderate overall effects favoring VR interventions (standardized mean difference [SMD] = 0.41, 95% CI [0.16, 0.66], $p = 0.001$; $I^2 = 74\%$); however, GRADE quality was rated LOW due to risk of bias and imprecision. Technology type critically moderated outcomes: robotic exoskeleton systems showed large effects (SMD = 1.00, $p = 0.002$), commercial gaming platforms showed small-to-moderate effects (SMD = 0.38, $p = 0.013$), while custom VR systems showed no significant benefit (SMD = 0.01, $p = 0.905$; $Q = 29.00$, $p < 0.001$). Age emerged as the strongest moderator: children (<6 years) demonstrated significant benefits (SMD = 0.98, $p < 0.001$), whereas school-age children (6-12 years) showed no effect (SMD = -0.01, $p = 0.903$; meta-regression slope = -0.236 per year, $p < 0.001$). Dose-response was non-linear, with optimal benefits at 30-40 intervention hours and diminishing returns beyond 50 h. VR proved superior to standard care (SMD = 0.83) but not to active intensive therapies (SMD = 0.09). The safety profile was favorable (1.3% adverse event rate, no serious events). No publication bias was detected.

Conclusions: VR interventions demonstrated moderate, technology-dependent motor function improvements in children with CP, with benefits concentrated in young children using robotic systems. Evidence certainty is low, requiring further high-quality trials. Implementation should prioritize robotic VR for children with 30-40 h protocols.

PMID: [41375689](#)

21. Comparison of Classifier Calibration Schemes for Movement Intention Detection in Individuals with Cerebral Palsy for Inducing Plasticity with Brain-Computer Interfaces

Mads Jochumsen, Cecilie Sørenbye Sulkjær, Kirstine Schultz Dalgaard

Sensors (Basel). 2025 Dec 2;25(23):7347.

Abstract

Brain-computer interfaces (BCIs) have successfully been used for stroke rehabilitation by pairing movement intentions with, e.g., functional electrical stimulation. It has also been proposed that BCI training is beneficial for people with cerebral palsy (CP). To develop BCI training for CP patients, movement intentions must be detected from single-trial EEG. The study aim was to detect movement intentions in CP patients and able-bodied participants using different classification scenarios to show the technical feasibility of BCI training in CP patients. Five CP patients and fifteen able-bodied participants performed wrist extensions and ankle dorsiflexions while EEG was recorded. All but one participant repeated the experiment on 1-2 additional days. The EEG was divided into movement intention and idle epochs that were classified with a random forest classifier using temporal, spectral, and template matching features to estimate movement intention detection performance. When calibrating the classifier on data from the same day and participant, 75% and 85% classification accuracies were obtained for CP- and able-bodied participants, respectively. The performance dropped by 5-15 percentage points when training the classifier on data from other days and other participants. In conclusion, movement intentions can be detected from single-trial EEG, indicating the technical feasibility of using BCIs for motor training in people with CP.

PMID: [41374720](#)

22. Therapeutic Benefits of Robotics and Exoskeletons for Gait and Postural Balance Among Children and Adolescents with Cerebral Palsy: An Overview of Systematic Reviews

Amal Alharbi, Shouq S Alhosaini, Shahad S Alrakebeh, Saleh M Aloraini

Healthcare (Basel). 2025 Dec 1;13(23):3120.

Background/Objectives: Robotic therapies are emerging as a potential management strategy for individuals with cerebral palsy (CP). These devices apply mechanical and electrical forces to regulate neural excitability and promote motor learning. This review aimed to systematically assess and synthesize evidence from published systematic reviews and meta-analyses on the therapeutic benefits of robotics and exoskeletons for gait and postural balance in pediatric CP.

Methods: A comprehensive search of PubMed, CINAHL, Scopus, and The Cochrane Library was conducted. Two independent reviewers screened records to identify studies that were: (1) written in English and published in peer-reviewed journals; (2) included participants <18 years with a diagnosis of CP; and (3) examined robotic therapies or exoskeletons targeting gait or postural balance. Methodological quality of included reviews was appraised with the Assessment of Multiple Systematic Reviews (AMSTAR) tool, and certainty of evidence was evaluated using the Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) framework.

Results: 18 systematic reviews met the inclusion criteria, encompassing 256 primary studies and 5092 participants. Overall methodological quality of the included reviews was rated as moderate to good. A variety of robotic and exoskeleton systems were noted across studies, with heterogeneous protocols and outcomes. Several reviews reported modest improvements in gait and postural balance; however, the findings were inconsistent, and pooled effects, where available, did not yield definitive conclusions regarding efficacy.

Conclusions: Robotic and exoskeleton interventions may offer benefits for gait and postural balance in children and adolescents with CP, but the current evidence base remains inconclusive. Additional high-quality research is required to determine effectiveness more definitively.

PMID: [41373337](#)

23. Effectiveness of treadmill-based virtual-reality biofeedback training to improve gait function in children and adolescents with congenital and acquired brain injury

S H Schless, G Sorek, I Schurr, E Beretta, E Diella, E Biffi

Sci Rep. 2025 Dec 10. Online ahead of print

Abstract

No abstract available

PMID: [41372400](#)

24. Effect of Gamified Balance Training Using Virtual Reality on Postural Control in Children with Spastic Diplegic Cerebral Palsy; A Randomized Controlled Study

Hamada S Ayoub, Rania M Tawfik, Amira H Draz, Dany Alphonse Anwar Habib, Shereen Mohamed Said

NeuroRehabilitation. 2025 Dec 8. Online ahead of print

Background: Effective engagement and motivation during balance training can be achieved through using technology such as virtual reality and promotes positive adaptation and neural plasticity.

Objective: The aim of the study was to explore the effect of gamified balance training using virtual reality on postural control in children with spastic diplegic cerebral palsy.

Methods: Fifty children with spastic diplegic cerebral palsy from both genders with ages ranged from six to twelve years old participated in this study. The participants were allocated randomly into two groups (n = 25). The control group (A) received conventional physical therapy programs based on neurodevelopmental technique including balance and gait training exercises, while the study group (B) received conventional physical therapy programs based on neurodevelopmental technique including balance and gait training exercises in addition to virtual reality balance training. All children were examined clinically pre- and post-treatment using HUMAC balance and tilt system to assess Limit of Stability (LOS), Center of Pressure (COP), and the Modified Clinical Test of Sensory Integration of Balance (mCTSIB).

Results: There were significant improvements of all measured variables in both control and study groups with significant difference between groups in favor to the study group ($p < 0.05$).

Conclusion: Gamified balance training using virtual reality has a beneficial effect on improving postural control in children with spastic diplegic cerebral palsy.

PMID: [41359269](#)

25. Paediatric neurological care in Sub-Saharan Africa: Current status and future directions

Mabel Frimpong, Siham Mohamed, Miracle Olayeri Ibukun, Yaa Asieduwaa Owusu, Andrew Awuah Wireko

Brain Dev. 2025 Dec 10;48(1):104490. Online ahead of print

Abstract

Paediatric neurology has evolved significantly since its early recognition as a subspecialty in the mid-20th century, though interest in childhood neurological conditions dates back centuries. In Sub-Saharan Africa (SSA), however, the field remains underdeveloped, despite a rising burden of neurological disorders such as epilepsy, cerebral palsy, cerebral malaria, autism spectrum disorder, and paediatric brain tumours. These conditions represent a significant proportion of paediatric morbidity and mortality in the region, yet limited epidemiological data, underdiagnosis, and health system constraints continue to obscure their true impact. Aetiological factors in SSA are diverse and include infectious diseases, perinatal complications, genetic disorders and environmental exposures. While countries such as South Africa, have made strides in diagnosis and care, progress remains uneven across the region. Structured training programmes like the African Paediatric Fellowship Programme and public engagement initiatives have contributed to capacity building, but most countries in the region still lack adequate specialist care, essential diagnostic tools such as electroencephalography and magnetic resonance imaging, and sustained investment in paediatric neurology infrastructure and epidemiological research. To address these gaps, this narrative review recommends expanding local training programmes, integrating task-shifting approaches to empower general practitioners and community health workers, and investing in clinical and epidemiological research. Equally critical is the need to strengthen health systems, improve access to diagnostic services, and promote inclusive, stigma reducing advocacy. Only through coordinated efforts can paediatric neurological care in SSA be advanced to meaningfully improve child health outcomes across the region. Thus, this narrative review explores the evident burdens of paediatric neurology care in SSA and proposes potential strategies to address these challenges.

PMID: [41380658](#)

26. Orthopaedic-related pathological conditions in the paediatric population presenting at outreach clinics in central South Africa over a 20-year period

J P J Smit, G Joubert, J Du Toit, M C Burger

S Afr Med J. 2025 Jun 3;115(5):e2558.

Background: Outreach, as a component of health service delivery in South Africa (SA), increases diagnostic and treatment capacity for populations living in remote areas. It further allows for close population surveillance of specific health-related conditions. Paediatric orthopaedic outreach for central SA provides a unique opportunity to provide insight into the incidence rates of common paediatric orthopaedic-related conditions.

Objective: To investigate the absolute numbers and incidence rates of orthopaedic-related pathological conditions in the paediatric population presenting at outreach in central SA between 1997 and 2016.

Methods: A retrospective investigation was conducted, which included all paediatric patients residing in the Northern Cape and Free State provinces accessing public healthcare for orthopaedic-related conditions during outreach services. Patient demographic and clinical data were collected and divided into (i) periods; (ii) age groups; (iii) geographical location; and (iv) presenting pathology. Age group-specific incidence rates (ASIR) and paediatric incidence rates (PIR) were calculated using census data from 2001, 2006 and 2011, and estimated values were adjusted to reflect the percentage of the population expected to use public health facilities per 10,000 paediatric population per year.

Results: A total of 3,418 patients were included, with the largest number of patients seen in the Central Free State (n=985). The ASIR for all age groups varied considerably between geographic regions and periods, with the highest rates (2005–2008, 21.8 per 10,000 per year) observed in the neonate/infant age group in the northern Free State region. The PIR for pathological groups also varied considerably, with high incidences of congenital talipes equinovarus observed in the northern and eastern Free State regions and a high incidence of cerebral palsy in the central (2001–2004, 0.79 per 10,000 per year) and Eastern Free State (2001–2004, 0.62 per 10,000 per year).

Conclusion: This information can provide a unique context for planning healthcare service delivery and pathology-orientated scientific research.

PMID: [41378611](#)

27. Eating and drinking abilities and nutritional status in children with cerebral palsy: A population-based study

Anna Nyman, Anita McAllister, Elisabet Rodby-Bousquet

Dev Med Child Neurol. 2025 Dec 10. Online ahead of print

Aim: To investigate the prevalence of eating and drinking difficulties as classified with the Eating and Drinking Ability Classification System (EDACS) in a large population-based cohort of children with cerebral palsy (CP) at all levels of motor function, and how EDACS classifications relate to undernutrition.

Method: This was a cross-sectional study based on data from the Swedish CP follow-up programme of children aged 19 years and younger. EDACS ratings were compared to z-scores for weight for age and height for age, calculated using standard references. Regression models were used to estimate how height for age was affected by EDACS levels when controlling for gross motor function and CP subtype.

Results: We included 2280 children with CP (945 females, 1335 males), median age 10 years 2 months. Almost a third (30.6%) had safety concerns during mealtimes (EDACS levels III-V). Most children (57.5%) could eat and drink independently, 20.2% required assistance, and 22.4% were totally dependent. One in five had undernutrition (19.9%) and there was an association between EDACS level and nutrition ($p < 0.001$). Height for age decreased from EDACS level II and also when controlling for gross motor function and CP subtype.

Interpretation: Almost one in three children with CP have dysphagia. Growth is affected in children with CP already from EDACS level II.

PMID: [41370525](#)

28. Current Practice of Physiotherapists in the Management of Children With Cerebral Palsy in Benin Country: A Cross-Sectional Online Survey

Emmanuel Segnon Sogbossi, Murielle Gbaglo, Wilfried Dahoueto, Toussaint Kpadonou, Catherine Mercier

Child Care Health Dev. 2026 Jan;52(1):e70192.

Background: In low- and middle-income countries, physiotherapy is often the only available rehabilitative care, making the quality of physiotherapy care particularly important. However, how well physiotherapy practice in managing children with cerebral palsy (CP) is supported by evidence-based guidelines remains unclear. This study aims to describe the current practice of physiotherapists in managing children with CP in Benin, a French-speaking country in Sub-Saharan Africa.

Methods: This study used a cross-sectional online survey, addressed to physiotherapists working in Benin.

Results: A total of 91 physiotherapists participated in the study, 52 of whom worked with children with CP. One-third of the children with CP treated were under 2 years old. Physiotherapy sessions were delivered twice or thrice weekly and lasted 30-45 min. Most of the physiotherapists working with children with CP (63.5%) received no certified paediatric neurorehabilitation training. About 54% rarely or never used a standardized outcome measure, and 36.5% used such measures occasionally. CP-specific common classification systems were mostly unused and unknown. The most common intervention modalities were handling techniques (muscle stretching, joint mobilization and Bobath therapy [for movement normalization]), but functional exercises (milestones) were also commonly used. About 58% felt confident in the management of children with CP, and the need for training on modern approaches was stressed.

Conclusion: The management of children with CP in Benin does not meet the standards of evidence-based practice. The results of this study will help develop strategies to improve the physiotherapy quality of care provided to children with CP in Benin and beyond.

PMID: [41367238](#)

29. Mixed-methods study exploring medium to longer-term outcomes following selective dorsal rhizotomy in ambulatory children with cerebral palsy at a tertiary hospital in the UK: MOSAiC study protocol

Deepti Chugh, Cherry Kilbride, Hortensia Gimeno, Kristian Aquilina, Lucy Alderson, Tim Theologis, Eleanor Main

BMJ Open. 2025 Dec 8;15(12):e108558.

Introduction: Selective dorsal rhizotomy (SDR) is one of the treatment options available for spasticity management in ambulatory children and young people with cerebral palsy (CYPwCP). Although improvements in gross motor function one to two years after surgery have been established, evidence of longer-term benefit requires further investigation. Given the irreversible nature of SDR and the increased rehabilitation commitments required from families and clinicians, providing evidence of longer-term benefits is essential to support their decision-making. This study aims to investigate medium (3-5 years) and long-term (6-10 years) SDR outcomes in ambulatory children with CP and how SDR affects families' lives over time.

Methods and analysis: This is a convergent parallel mixed-methods study using the International Classification of Functioning, Disability and Health as a theoretical framework. The study aims to recruit 90 CYPwCP participants, who had SDR at a tertiary hospital in the UK when aged between 3 and 14 years. Participants (parents and CYPwCP) will be invited to complete an online survey and attend the hospital for one follow-up visit 3 or more years after SDR.

Comparisons will be made with existing data on objective measures and parent-reported outcomes collected in clinical practice at baseline, 6, 12 and 24 months to understand the trajectory of changes. Semistructured interviews will be conducted with 18-20 parents/carers and 25-30 CYPwCP to understand their perspectives on the outcomes of SDR compared with their prior expectations. The Framework Method will be used to analyse qualitative data both inductively and deductively. Qualitative and quantitative study data will be integrated using joint displays.

Ethics and dissemination: Ethical approval has been obtained through the Coventry and Warwick Research and Ethics Committee (24/WM/0078). Findings will be shared through international conferences, peer-reviewed journals, social media and dissemination events for families and CYP.

Trial registration number: [NCT06518889](https://www.clinicaltrials.gov/ct2/show/study?term=NCT06518889).

PMID: [41365584](https://pubmed.ncbi.nlm.nih.gov/41365584/)

30. Examining the changing demand for orthotic service provision from routinely collected digital patient data: A national retrospective descriptive study across three clinics in Cambodia

Charlotte Spurway, Alex Dickinson, Lucy Gates, Cheryl Metcalf, Sisary Kheng, Carson Harte, Bunthoeun Sam, Sam Simpson, Amos Channon

PLoS One. 2025 Dec 9;20(12):e0338461. eCollection 2025

Abstract

Available data on the demand for orthotic services is limited, especially in low- and middle-income countries, yet the development and delivery of services relies on this information. In this study, routinely collected digital patient records are used to provide insights into orthotic service users from three Cambodian physical rehabilitation centres. Analysis of the digital patient records from 1998-2019 investigated trends by sex, clinic, reason for orthosis use, orthotic type, and age. The analysis showed that the characteristics of service users and the provision of orthotics have changed over time. The predominant reason for orthosis use prior to 2006 was polio, whereas in 2019 it was cerebral palsy. Ankle Foot Orthoses (AFOs) are the most common type of orthosis provided; however, key differences have been found between type of orthosis and age which suggests older individuals have different experiences of physical rehabilitation compared to younger age groups. Longitudinal trends indicate a substantial reduction in orthotics appointments which may be associated with change in service delivery and changing service user characteristics. The study has illustrated the insights which can be derived from digital patient records into the demand for orthotics services over two decades and demonstrates the need for targeted resources and planning for the provision of services.

PMID: [41364686](https://pubmed.ncbi.nlm.nih.gov/41364686/)

31. Genetic diagnostic yield by MRI pattern in children with cerebral palsy: a population-based study

Jesia G Berry, Ajay Taranath, Robert Goetti, Michelle A Farrar, Simona Fiori, Huy-Dat Pham, Murthy N Mittinty, Mark A Corbett, Lyle J Palmer, Dani L Fornarino, Kelly Harper, Catherine S Gibson, Shaneen J Leishman, Shona C Goldsmith, Sarah J McIntyre, Alicia Montgomerie, Rhiannon M Pilkington, John W Lynch, Remo N Russo, Michael C Fahey, Jurgen Fripp, Roslyn N Boyd, Margaret J Wright, James E Rice, Mary-Clare Waugh, Alastair H MacLennan, Jozef Gecz, Clare L van Eyk

EBioMedicine. 2025 Dec;122:106013.

Background: Neuroimaging abnormalities are detected in 80-86% of individuals with cerebral palsy (CP). Lesional white or grey matter injuries (WMI, GMI) are most common and typically attributed to environmental factors, while genetic causes are thought to underlie non-lesional injuries and normal brain imaging. This hypothesis has not been formally tested, and we aimed to evaluate it using the Australian CP biobank.

Methods: This population-based study included 331 children with CP (195 males, 136 females), born between 1986 and 2018. Genomic DNA extracted from blood or saliva samples underwent sequencing, variant filtering, classification using ACMG-AMP criteria, and variant curation. Probandes were classified as 'resolved', 'candidate variant(s) identified', or 'no candidate variant identified'. Paediatric radiologists/neurologists coded brain MRI, CT, and ultrasound using the Magnetic Resonance Imaging Classification System (MRICS). Data analyses included descriptive statistics and multinomial logistic regression.

Findings: A genetic aetiology was identified in 80 children (24%), while 165 (50%) had candidate variants and 86 (26%) had no candidate variant identified. Among children with predominant WMI or GMI (50% and 21%, respectively), 19% and 10% were genetically resolved. Children with maldevelopments, miscellaneous findings, or normal neuroimaging (10%, 10%, and 8%, respectively) were more often genetically resolved (41%, 48% and 39%) compared to those with lesional injuries (WMI or GMI), with relative risk ratios (RRR) of 3.54 (95% CI: 1.65-7.59), 4.75 (95% CI: 2.21-10.2), and 3.27 (95% CI: 1.42-7.52), respectively.

Interpretation: These findings support the hypothesis that genetic aetiologies are more common in non-lesional CP. However, genetic diagnoses were observed across all MRICS categories, including 17% of lesional brain injuries. Notably, almost half of all genetically diagnosed children (39 of 80) were in the WMI and GMI groups. Therefore, we emphasise that neuroimaging should be used as a guide, not an exclusion criterion for genomic testing in CP.

PMID: [41202470](#)

32. Time toxicity and shared decision-making in cerebral palsy

David B Frumberg, Paige T Church, Nathan Rosenberg

Dev Med Child Neurol. 2025 Dec 12. Online ahead of print

Abstract

Clinicians and families regularly enter into a process of shared decision-making. Seldom, if ever, however, is the critical question of time usage, or, more specifically, time-related burdens, accounted for when establishing goals and outcome measures. Time-related burdens are not included, for instance, as an outcome measure in cerebral palsy research—something which may have profound effects about which we are unaware. By contrast, in the field of oncology, time-related burdens, or, more technically, what has been termed time toxicity, has been increasingly studied. Building on that work, we seek to apply the concept of time toxicity to people with disabilities who interface with healthcare at great frequency.

PMID: [41387091](#)

33. Development and Validation of the Toileting Function Classification System for Children With Cerebral Palsy Ages 6-18

Azade Riyahi, Afsoon Hassani Mehraban, Mehdi Rassafiani, Zahra Pournasiri, Isabelle Beaudry-Bellefeuille, Amir Almasi-Hashiani, Malahat Akbarfahimi

Am J Occup Ther. 2026 Jan 1;80(1):8001205030.

Importance: Children with cerebral palsy (CP) and other neurodevelopmental conditions often face significant toileting challenges because of motor, sensory, cognitive, and behavioral impairments, as well as environmental factors such as limited caregiver awareness. These difficulties affect daily function and participation, yet they are often overlooked when documenting daily challenges in existing functional classification systems or care planning.

Objective: To develop and validate the Toileting Function Classification System (TFCS) for children with cerebral palsy ages 6-18, enabling tailored interventions and resource allocation.

Design: A six-phase approach: initial conceptualization and drafting, preliminary refinement, expert consultation through interviews, stakeholder consensus building through nominal and focus groups, Delphi-based content validation, and reliability assessments similar to those of other functional classification systems.

Setting: Various clinical and research environments involving experienced professionals, caregivers, and children with CP.

Participants: One hundred eighty children with CP, 180 caregivers, and 24 professionals with expertise in CP and toileting.

Outcomes and measures: Reliability (interrater and test-retest consistency) was measured using weighted κ ; consensus was evaluated through Delphi surveys.

Results: The Delphi survey achieved over 80% agreement on key TFCS components across two rounds. Reliability values ranged from .61 to 1.00, demonstrating substantial to almost perfect agreement. The system successfully classified toileting functions across five levels, supporting its clinical and research applications.

Conclusions and relevance: The TFCS provides a reliable framework for documenting and addressing toileting challenges in children with CP. Its implementation enhances family-professional communication and guides rehabilitation programs, ultimately improving quality of life. **Plain-Language Summary:** Toileting is a complex part of daily life that can be especially challenging for many children with disabilities. Difficulties with toileting are often linked to a combination of physical, sensory, and cognitive factors and may be even greater when conditions such as cerebral palsy occur alongside intellectual or developmental disabilities. This study focused on children with cerebral palsy and the development of a new classification system to describe their toileting function in a structured way. This tool can help occupational therapists and families better understand a child's needs and plan appropriate supports, contributing to improved care and quality of life.

PMID: [41380691](#)

34. Facilitate Robust Early Screening of Cerebral Palsy via General Movements Assessment with Multi-Modality Co-Learning

Wang Yin, Chunling Huang, Linxi Chen, Xinrui Huang, Zhaohong Wang, Yang Bian, Yuan Zhou, You Wan, Tongyan Han, Ming Yi

IEEE Trans Med Imaging. 2025 Dec 9. Online ahead of print

Abstract

General movement assessment (GMA) is a non-invasive method used to evaluate neuromotor behavior in infants under six months of age and is considered a reliable tool for the early detection of cerebral palsy (CP). However, traditional GMA relies on the subjective judgment of multiple internationally certified physicians, making it time-consuming and limiting its accessibility for widespread use. Furthermore, artificial intelligence (AI) approaches may overcome these limitations but are usually based on motion skeletons and lack the ability to capture detailed body information. Here, we propose CoGMA (Collaborative General Movements Assessment), a novel multi-modality co-learning framework for GMA. By integrating multimodal large language model as auxiliary network during training, CoGMA incorporates four types of input data—skeleton data, clinical information, RGB video, and text descriptions—to enhance representation learning. During inference, however, CoGMA achieves efficient and accurate prediction using only skeleton data and clinical information. Experimental evaluations indicate that CoGMA demonstrates robust performance across both the writhing and fidgety movement stages, while also excelling in zero-shot evaluation of fidget movement, thereby mitigating the issue of limited training samples in this stage. This framework significantly enhances the GMA methodology and lays the groundwork for future advancements in early detection and research on infant neuromotor behavior. Additionally, to facilitate anonymized data sharing, we introduce InfantAnimator, a tool that generates non-identifiable videos while preserving essential motion features, thereby supporting broader research and collaboration.

PMID: [41364569](#)

35. Development of a Practical Guide for Pediatric Constraint-Induced Movement Therapy: Enhancing Understanding and Informed Decision-Making

Lauren Leonardi, Stephanie DeLuca, Mary Rebekah Trucks, Dory A Wallace, Catherine R Hoyt

Am J Occup Ther. 2026 Jan 1;80(1):8001205080.

Importance: Constraint-induced movement therapy (CIMT) is an intervention for hemiplegic cerebral palsy (CP) that has a strong evidence base. CIMT has been shown to be effective in improving functional use of the more impaired upper extremity, yet has not become standard practice. Toolkits have been effectively used in various settings to increase intervention implementation; however, no guide currently exists to support clinical decision-making related to CIMT.

Objective: To provide an overview of the development of a practical guide for pediatric CIMT (pCIMT) that will aid therapists, other health care professionals, and families with children who may be eligible for pCIMT.

Design: Model development research.

Setting: Virtual communication secured in accordance with the Health Insurance Portability and Accountability Act of 1996 (Pub. L. 104-191).

Participants: Content experts (N = 12) with expertise related to pCIMT, hemiplegic CP, and occupational therapy who were recruited via purposive sampling to develop the practical guide.

Outcomes and measures: Development of the practical guide followed a toolkit developmental model. Field notes were used to record all verbal and written feedback provided by content experts.

Results: The participants provided recommendations to include in the guide during the developmental phase. In two rounds of the expert review phase, they recommended revisions related to readability, content, and visuals. The final practical guide included six sections.

Conclusions and relevance: A practical guide was developed to support occupational therapists, health care professionals, and caregivers in making an informed decision about whether pCIMT is the right intervention for a particular child. **Plain-Language Summary:** Hemiplegic cerebral palsy is the most common motor disability that affects children, and it often causes difficulty moving one side of the body. Pediatric constraint-induced movement therapy (pCIMT) is an evidence-based intervention to help children use their more affected side. However, pCIMT is not widely available. With guidance from key informants, we designed a practical guide to support health care professionals and families in determining whether pCIMT could be an appropriate intervention. A three-phase toolkit development model was followed to design the practical guide. In this article, we report on Stages 1 and 2 (the development and expert review phases). Twelve experts and caregivers informed the development of the six sections of the practical guide. Future research should proceed to Stage 3 (the evaluation phase) to evaluate the effectiveness of the practical guide and identify implementation strategies for the guide to support pCIMT usage.

PMID: [41358929](#)

Prevention and Cure

36. Family social risks on neurodevelopmental outcomes in preterm infants without severe brain injury

Li-Wen Chen, Min-Lan Tsai, Yung-Chieh Lin, Han-Yi Tsai, Chi-Hsiang Chu, Chao-Ching Huang

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Background: To assess family-social risks on neurodevelopmental impairment (NDI) outcomes in preterm infants without severe brain injury (SBI).

Method: Infants born <29 weeks' gestation without high-grade intraventricular hemorrhage, periventricular leukomalacia, or cerebellar hemorrhage in the population were assessed using the Bayley Scales of Infant Development. NDI included cognitive/motor delay, cerebral palsy, and bilateral blindness/deafness. Family-social risks included young maternal age, low maternal educational level, minority ethnicity, low family socioeconomic status, and single-parent family. Ordered logistic and linear regression models analyzed family-social and clinical risks for NDI severity outcomes at 24 months. **Results:** Among 459 infants, 82% had no/mild NDI, 14% moderate NDI, and 4% severe NDI. Each additional family-social risk increased severe NDI odds by 1.6 times (95% CI: 1.2-2.0), with each extra day of oxygen therapy raising NDI risk by 3% (2-4%). Family-social risks lowered cognitive (-3.3), language (-3.2), and motor (-2.2) scores at 24 months. Males had lower cognitive (-2.7), language (-4.0), and motor (-1.8) scores than females. Each oxygen therapy day reduced all developmental domain scores by 0.1.

Conclusions: Family social risks, male sex, and oxygen exposure are associated with NDI outcomes in preterm infants without SBI. Additional support for high-risk infants may improve outcomes.

Impact: Nearly one-fifth of preterm infants without severe neonatal brain injury (SBI) have moderate/severe neurodevelopmental impairment (NDI), showing developmental deviations from those with no/mild NDI since age 12 months. Family social risks increase the odds of more severe NDI, complicated by additional days of oxygen therapy. Family social risks and male sex are associated with lower developmental scores at 24 months in cognition, language, and motor abilities. Prolonged oxygen therapy contributes to poorer neurodevelopmental performance in all domains. Preterm infants without SBI but with identifiable demographic and clinical risk factors may benefit from surveillance and early intervention services.

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37. Characteristics of Extremely Preterm Infants Undergoing Procedural Closure of Patent Ductus Arteriosus: A Retrospective Cohort Study

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Background: Patent ductus arteriosus (PDA) is the most common cardiac lesion in preterm newborns. When medical management of a hemodynamically significant PDA is unsuccessful or contraindicated, infants are referred for either transcatheter device closure (TCDC) or surgical ligation. Our objective was to describe the characteristics and outcomes of these infants.

Methods: A retrospective cohort study of infants ≤ 30 weeks' gestation undergoing either TCDC or surgical ligation for PDA from January 2009 to April 2023 was undertaken, in a surgical neonatal intensive care unit. Baseline demographics, echocardiographic data, procedural complications, and neonatal outcomes were obtained.

Results: A total of 136 infants were included. At the time of referral for PDA closure, infants were 5-145 days old, with a corrected gestational age of 24-50 weeks and PDA diameter of 1.5-4.1 mm. TCDC of PDA was performed in 15 neonates compared with 121 neonates who underwent surgical ligation. Procedural complications and important neonatal outcomes were similar for both groups. While the number of infants undergoing TCDC is increasing, there is a decreasing trend in the total number of surgical PDA closures.

Conclusions: This study demonstrates that there is variability in the preclosure demographics and echocardiography characteristics of infants ≤ 30 weeks' gestation referred for procedural PDA closure.

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