Monday 02 March 2026

Interventions and Management

1. Clinical Profile of Children with Cerebral Palsy

Emily Mree, Jatin Sarmah, Paresh Kumar Sarma, Indira Das

Abstract
No abstract available
PMID: 41760849

2. Outcomes of hip reconstruction in ambulatory patients with cerebral palsy and spastic hip displacement: a retrospective study of 73 hips in 55 consecutive patients

Kyeong Hyeon Park, Byoung Kyu Park, Isaac Rhee, Kun Bo Park, Hoon Park, Yun Ho Roh, Hyun Woo Kim

Background and purpose: No specific strategy exists for surgical management of spastic hip displacement in ambulatory cerebral palsy. This study evaluated outcomes of hip reconstructions performed within a single-event multilevel surgery (SEMLS) framework.
Methods: Retrospective review of patients with GMFCS levels II and III undergoing combinations of reduction procedures, iliac osteotomy, proximal and distal femoral osteotomies, and varus derotational osteotomy. Hip development was assessed using the Melbourne Cerebral Palsy Hip Classification Scale.
Results: Seventy-three hips (55 patients) were included. Mean age at surgery was 9.7 years. Sixty-nine hips achieved successful outcomes. Preoperatively, most hips had migration percentages of 30–60% or 60–100%. At final follow-up, hips were distributed across MCPHCS grades 1–5, with the majority in grades 1–3. Fifty-two patients maintained or improved their GMFCS level.
Conclusion: Within the SEMLS approach, tailored hip reconstruction yielded satisfactory outcomes in 69 of 73 hips, with sustained improvements in stability at long-term follow-up.
PMID: 41729139

3. Muscle architecture predicts lower extremity power generation during a power leg press test in individuals with cerebral palsy

Mattie E Pontiff, Evrim Oral, Noelle G Moreau

Clin Biomech (Bristol). 2026 Feb 24;135:106797. Online ahead of print.

Background: The purpose of this cross-sectional study was to examine relationships between power and muscle architecture in individuals with cerebral palsy (CP).
Methods: Participants (n = 26; 19.3 ± 7.8 years; range 10–37 years; Gross Motor Function Classification System level I–III) performed five power leg presses with the concentric phase at high velocity. Peak Power was calculated as the highest value across the five presses. Architectural outcomes included muscle thickness, cross-sectional area, and fascicle length of the vastus lateralis, medial gastrocnemius, and rectus femoris. Simple linear and multiple regression examined associations between architecture and Peak Power.
Findings: Peak Power was positively associated with all architectural variables (p < 0.05) except rectus femoris fascicle length (p = 0.058). Rectus femoris thickness alone explained 50.8% of variance in Peak Power. Combined rectus femoris and medial gastrocnemius cross-sectional area with fascicle length explained 68.5–69.2% of variance (p < 0.001). Rectus femoris cross-sectional area, age, and Gross Motor Function level together explained 71.6% of variance (p < 0.001).
Interpretation: Muscle architecture significantly predicts lower extremity muscle power in individuals with CP. Muscle size was a stronger predictor than fascicle length; however, combining variables improved predictive strength. Age and GMFCS level added explanatory value, highlighting the importance of muscle architecture in muscle performance in CP.
PMID: 41759460

4. Body-weight support is the primary driver of elevated walking cost in cerebral palsy

Andrew J Ries, Katherine M Steele, J Maxwell Donelan, Michael H Schwartz

Research Square. Preprint. 2026 Feb 16.

Background: Children with cerebral palsy (CP) exhibit substantially elevated energetic costs of walking, yet the biomechanical origins of this excessive cost remain unclear, limiting the effectiveness of current interventions.
Methods: We tested the hypothesis that elevated energetic cost of walking in CP arises primarily from increased demands for body-weight support and lateral stabilization. Using a custom mechatronic system, we independently applied controlled vertical body-weight support (1–60% body weight) and mediolateral stabilization stiffness (50–1500 N/m) while children with CP and typically developing peers walked on a treadmill at a fixed nondimensional speed. Steady-state energetic cost was quantified using indirect calorimetry, and linear regression models examined energetic responses.
Results: Providing body-weight support significantly reduced net energetic cost in both groups, with a 3.5-fold greater effect in children with CP (n = 23). Across the support range, energetic cost decreased by 41% in CP, normalizing walking energy expenditure to typical levels. Higher baseline cost of walking and greater knee flexion during stance were associated with larger reductions (p < 0.01). In contrast, mediolateral stabilization had negligible effects in both groups.
Conclusions: Body-weight support is the primary contributor to elevated walking cost in children with CP, while lateral stabilization contributes minimally. These findings identify gravitational support as a key target for energy-focused rehabilitation and assistive technologies.
PMID: 41756464

5.Does Patella Alta Influence Trochlear Morphology in Pediatric Patients with Cerebral Palsy? Associations with Age and Functional Status

Giulia Beltrame, Patrick P Nian, Samuel A Beber, Zhenkun Gu, Marco Crippa, Shae K Simpson, Minah Waraich, Paulo R P Selber, Daniel W Green

HSS J. 2026 Feb 24. Online ahead of print.

Background: Patella alta is common in children with cerebral palsy (CP), often resulting from quadriceps spasticity and tendon elongation. In typically developing children, patella alta is linked to trochlear dysplasia and instability. Whether these associations exist in CP, and how they vary with age and functional ability, has not been established.
Purpose: We sought to determine whether patella alta is associated with alterations in trochlear morphology in ambulatory children with CP and to evaluate the influence of age and functional severity.
Methods: We conducted a retrospective study of pediatric patients under 18 years with hemiplegic or diplegic CP, classified as Gross Motor Function Classification System levels I–III. Inclusion required lateral knee radiographs and axial CT scans showing the anterior tibial tuberosity. Eligible patients were identified through electronic medical records from 2016–2024.
Results: Of 164 patients identified, 31 met imaging criteria; 6 were excluded for poor image quality, yielding 25 patients and 48 limbs. Patella alta was present in 17 knees (35.4%). No differences in trochlear morphology were observed between groups or across functional levels. In both groups, older age correlated with features of physiologic trochlear development, including increased trochlear groove depth and narrower sulcus angle. In patients with patella alta, age also correlated with greater tibial tubercle to trochlear groove distance.
Conclusion: Patella alta was not associated with trochlear dysplasia in ambulatory children with CP. Its persistence may alter patellofemoral alignment through age-related increases in tibial tubercle to trochlear groove distance, highlighting a potential contributor to pain or instability and the importance of early recognition.
PMID: 41756209

6.Lessons learned while exploring the impact of movement-tracking feedback on the experiences of children with neuromotor disorders taking part in interactive home exercise programs: a multi-case mixed methods study

Marina Petrevska, F Virginia Wright, Ajmal Khan, Selvi Sert, Ilana Ferreira, Sarah Munce, Darcy Fehlings, Elaine Biddiss

J Neuroeng Rehabil. 2026 Feb 27. Online ahead of print.

Background: Home exercise programs prescribed to children with cerebral palsy (CP) are often associated with low adherence. Interactive technologies can help motivate and guide children through exercise programs at home, reducing onus on parents. This study sought to understand the impact of movement-tracking feedback on children's engagement and parents' experiences within an interactive computer play home exercise program (ICP-HEP), Bootle Boot Camp.
Methods: A multi-case mixed methods study was conducted with three children with CP and their parents. In the quantitative single case experimental design with alternating treatments phase, children used the ICP-HEP with and without movement-tracking feedback for four weeks, and exercise adherence, exercise fidelity (movement performance quality), perceived level of fun and helpfulness for the body (i.e., 5-point rating scales and survey) were evaluated. The version (feedback/no feedback) with the highest exercise adherence was carried out for two additional weeks. Dyadic (child/parent) qualitative interviews followed. Quantitative data were analyzed using visual and statistical approaches. Qualitative data were analyzed using directed content analysis. Quantitative and qualitative results were merged through narrative weaving and joint displays.
Results: Accuracy of the movement tracking and feedback provided varied among children, exercises, and play environments. Feedback may have contributed positively to exercise adherence for two children, with a significant enhancement (p < 0.001) for one of these children, and no observed negative impacts for the third child. Parents and one child perceived feedback as generally being useful for learning about movement quality, however when perceived to be inaccurate, it may have been ignored. While children had varied perspectives on how fun and helpful feedback was, it was valued by all parents. All children experienced some frustration due to sporadic technical issues. All children/parents preferred Bootle Boot Camp over conventional home programs, and suggested game refinements to enhance this ICP-HEP experience.
Conclusion: Use of an interactive therapy game has the potential to support children's adherence to and children's/parents' experiences with home exercise, with feedback impacting children differently based on personal and environmental factors. This study serves as a foundation for future game refinements and larger-scale testing that will continue to explore the impact of feedback within an ICP-HEP.
PMID: 41761323

7.A "motor learning based intervention for lower extremities (MOBILE)" to target walking performance in ambulant children with cerebral palsy: A feasibility study

Caitríona O'Shaughnessy, Raymond McCarthy, Dereena Minehane, Jennifer Ryan, Ailish Malone

Background: Cerebral palsy (CP) is the largest contributor to childhood physical disability, with abnormal gait patterns such as toe walking commonly reported. The International Classification of Functioning (ICF) framework outlines three domains—body/structure, activity, and participation—to consider when assessing disability impact. Activity and participation–focused interventions using Motor Learning Theory (MLT) have demonstrated positive results on walking performance, gross motor skills, and upper limb rehabilitation in CP. This study aims to determine feasibility and acceptability of a novel motor learning–based intervention for lower extremities (MOBILE) targeting walking performance in ambulant children with CP to inform a future randomized controlled trial.
Methods: Fourteen ambulant children with CP (aged 6–17) with a walking goal will undergo a tailored intensive MOBILE intervention totalling 30 hours of practice within six weeks or less. Outcomes include feasibility of recruitment, adherence, retention, and outcome measures, and acceptability of the intervention. Clinical outcomes include the Gait Outcomes Assessment List, Six Minute Walk Test, Modified Timed Up and Go, Ten Metre Walk Test, Range of Motion, and Child Health Utility Instrument. Feasibility outcomes will be described using percentages and confidence intervals.
Discussion: Long-term retention of walking improvements after interventions targeting the body/structure domain is reportedly poor in CP. Based on its theoretical framework, the MOBILE intervention may improve walking performance with potential long-term retention and impact on activity and participation. Feasibility and acceptability must be established to inform a future definitive trial.
PMID: 41757273

8.Promoting Functional Mobility in Individuals with Non-Ambulatory Cerebral Palsy: A Scoping Review of the MOVE Programme

Riclef Schomerus, Ginny S Paleg, Roslyn W Livingstone, Britta Dawal, Liane Bächler

Background/objective: Mobility Opportunities Via Education (MOVE) is a structured intervention to enhance independent mobility skills in individuals who are non-ambulatory. This study aims to identify and map the literature related to the MOVE programme and to describe its content according to preselected categories, focusing on individuals with non-ambulatory cerebral palsy.
Methods: A scoping review was conducted across thirteen databases in May 2024, with updates in August 2025. Publications after 1985 were included without restrictions on language, population, or context. Two reviewers independently screened records and extracted data using qualitative content analysis.
Results: From 6,794 records, 228 publications in 15 languages were included. MOVE was developed in the 1980s during a shift toward age-appropriate, functional interventions for individuals with severe disabilities. It is an early task-specific, activity-based, family-centred approach with foundations in dynamic systems theory and motor learning. Implementation follows a structured six-step process embedding mobility training into daily routines. MOVE has been implemented across countries, settings, and populations, particularly for non-ambulatory individuals with cerebral palsy.
PMID: 41749648

9. The Relationship Between the Gross Motor Function Classification System, Functional Mobility Scale, Observational Gait Scale, and the Amsterdam Gait Classification in Children with Cerebral Palsy During Long-Term Treatment with Botulinum Toxin Injections and Combined Integrated, Intensive Rehabilitation

Weronika Pyrzanowska, Magdalena Chrościńska-Krawczyk, Nigar Dursun, Marcin Bonikowski

Abstract
Patients with cerebral palsy experience complex gait disorders that evolve with age, reducing activity and participation. This study analysed gait pattern development over five years and examined relationships between the Observational Gait Scale (OGS), Amsterdam Gait Classification (AGC), Gross Motor Function Classification System (GMFCS), and the Functional Mobility Scale (FMS) during treatment. This retrospective single-centre study involved annual assessments over five years. Treatment included physiotherapy, orthotics, multilevel botulinum toxin type A injections (BoNT-A), and serial casting. Data on BoNT-A, casting, physiotherapy, orthoses, GMFCS levels, and FMS scores were obtained from records. OGS and AGC were evaluated using two-plane video from a single gait laboratory. Two hundred children with bilateral cerebral palsy (120 boys, 80 girls) were included, predominantly GMFCS II (48%) and III (36%). GMFCS levels improved in 33.5% and worsened in 2% (p < 0.001). FMS 5 and 50 improved by 54% and 52%, respectively. OGS scores improved in 74% and 76% of patients, with deterioration in 5% and 7%. Most OGS changes were 1–4 points. A negative correlation was observed between OGS and GMFCS (p < 0.001), and positive correlations between OGS and FMS 5 and 50 (p < 0.001). Significant relationships were also found between AGC and GMFCS and FMS. Complex gait disorders on AGC corresponded with higher GMFCS scores and lower FMS scores. Integrated treatment had a positive effect on mobility and gait.
PMID: 41745766

10. How strength training reshapes body schema in women with severe cerebral palsy: a mixed-methods phenomenological study

San Hong, Taeheon Kim

Purpose: This mixed-methods phenomenological study examined how systematic strength training reshapes body schema in women with severe cerebral palsy (CP).
Materials and methods: Five women with severe CP participated in a year-long, community-based strength-training program using an intervention–withdrawal–intervention design. Quantitative outcomes were assessed using the Gross Motor Function Measure. Qualitative data were collected via interviews and field notes and analysed using Merleau-Ponty's body schema framework.
Results: Across four assessments, GMFM scores increased during intervention phases, regressed slightly during withdrawal, and reached their highest levels at the final assessment. Thematic analysis identified three transformations: embodied confidence, expanding spatial agency, and enhanced self-determination.
Conclusions: Combining quantitative and phenomenological data shows that strength training improves both motor capacity and body schema. Findings support inclusive, community-based rehabilitation promoting embodied capability and agency in women with severe CP.
PMID: 41739595

11. BCI sports: exploring the potential of BCI-leveraged sport participation for children with quadriplegic cerebral palsy

Daniel Comaduran Marquez, Kenzie Vaandering, Ali Babwani, Brianne Redquest, Dejana Nikitovic, Dion Kelly, Eli Kinney-Lang, Adam Kirton

Purpose: Children with severe disabilities often face barriers to sport participation, limiting their fundamental human rights. Boccia is a Paralympic sport that offers inclusion for individuals with limited mobility, but it does not fully accommodate those with severe motor and communication disabilities. An assistive brain–computer interface (BCI)–controlled Boccia ramp was developed to enable participation for individuals with quadriplegic cerebral palsy (QCP) who are non-speaking. This study explored caregiver and child perspectives on how BCI-leveraged Boccia might affect sport participation opportunities.
Materials and methods: A mixed-methods approach included semi-structured interviews with caregivers of children using BCI (n = 6) and a new 21-item survey for children (n = 6).
Results: Participants identified current participation barriers and facilitators, as well as future possibilities and perceived benefits of BCI-enabled sport access. Children expressed high interest in using a BCI system to play Boccia.
Conclusions: BCI-leveraged sport participation shows promise for children with QCP. Successful implementation requires addressing identified barriers and facilitators to enable access to previously unattainable activities.
Plain language summary
Children with severe motor disability (e.g., quadriplegic cerebral palsy) face additional challenges to access sports and recreational activities.Brain-computer interface (BCI) systems may provide children with severe motor disability the opportunity to participate in sports and other recreational activities, potentially increasing the children's independence and participation.The use of BCI systems in sports such as Boccia can improve self-confidence, self-esteem, and social interactions by enabling children to interact with their peers in a meaningful way.BCI programs should consider the technical and logistical challenges faced by families of children with severe motor disability (e.g., fatigue management, device setup issues, and the need for flexible, hybrid participation options).Early involvement of caregivers and direct feedback from children is crucial for designing successful and sustainable BCI-sport programs, ensuring interventions address individualized needs, preferences, and environmental factors that affect rehabilitation outcomes.
PMID: 41723634

12. Pediatric Oral Cavity Physiologically Based Pharmacokinetic Model to Predict Pharmacokinetics of Mucoadhesive Atropine Gel to Treat Sialorrhea

Madison Parrot, Nancy Murphy, Joseph Rower, Christopher Reilly, Danielle Green, Ariel Tarrell, Kevin Watt, Venkata Yellepeddi

Abstract
Sialorrhea significantly impairs quality of life in children with neurodevelopmental disorders, including cerebral palsy and neuromuscular disorders, yet safe and effective pharmacologic options remain limited. Although atropine is widely used, intraoral administration of ophthalmic drops is limited by poor mucosal retention, frequent dosing, risk of medication errors, and systemic anticholinergic effects. To address these issues, a novel mucoadhesive atropine oral gel (0.01% w/w) was developed to enhance intraoral residence time and local absorption while reducing systemic variability. A Phase I clinical trial in healthy adults informed development of a physiologically based pharmacokinetic (PBPK) model incorporating an oral cavity framework that accounts for salivary flow, mucosal absorption, swallowing, and saliva-tissue exchange across six compartments. Pediatric PBPK simulations were scaled from the adult model using PEAR Physiology™ to support dose selection. Simulations identified a minimum pediatric dose range of 0.25 mg/kg/day with twice-daily dosing to maintain plasma concentrations within the therapeutic window. These findings demonstrate the utility of PBPK modeling in pediatric dose optimization and support further clinical development of the atropine gel as a safer alternative to off-label atropine eye drops for sialorrhea management.
PMID: 41756433

13. Recurrent Severe Hypothermia as a Manifestation of Central Thermoregulatory Dysfunction in a Patient With Cerebral Palsy and Shaken Baby Syndrome

Brooke Allnutt, Phillip Petrasko, Rafik Jacob

Abstract
Recurrent hypothermia is an uncommon but clinically significant problem in adults with prior traumatic brain injury such as shaken baby syndrome (SBS). Central thermoregulatory dysfunction due to hypothalamic or autonomic injury can lead to episodic hypothermia mimicking endocrine disease. We describe a 38-year-old woman with cerebral palsy and a remote history of SBS who presented with recurrent hypothermia despite normal thyroid and adrenal function. Her episodes were initially treated empirically with corticosteroids, but recurrent events prompted multidisciplinary evaluation. Extensive infectious, endocrine, and neurologic assessments were negative. Imaging demonstrated microcephaly and encephalomalacia consistent with prior traumatic brain injury. Hypothermia was managed with supportive warming and steroid tapering. Neurology and endocrinology attributed symptoms to hypothalamic hypoplasia or autonomic dysfunction resulting from early brain injury. This case highlights the importance of recognizing central hypothermia as a long-term sequela of SBS to avoid unnecessary corticosteroid exposure and improve supportive management.
PMID: 41755931

14. Variability of motor imagery in children with cerebral palsy examined using the Hand Laterality Test

Inbar Breuer Asher, Dafna Guttman, Pavel Goldstein, Tal Krasovsky

Aim: To examine motor imagery performance in children with cerebral palsy (CP) versus typically developing peers and develop a composite score differentiating between groups.
Method: In this cross-sectional case-control study, 37 participants (17 with CP and 20 typically developing; ages 10–20 years) completed the Hand Laterality Task at several rotation angles. Mixed-effects models compared reaction time and accuracy. A composite score combining accuracy and reaction-time variability was developed and validated using 100 random 70/30 train-test partitions.
Results: Children with CP showed lower accuracy ($p = 0.002$) and higher reaction-time variability ($p < 0.001$), with no significant reaction-time differences ($p = 0.46$). The composite score outperformed models using single parameters, with mean AUC = 0.89 (SD 0.09), accuracy = 81% (11%), sensitivity = 81% (19%), and specificity = 84% (18%).
Interpretation: The composite score differentiated motor imagery performance between children with CP and typically developing peers. Reaction-time variability emerged as a distinguishing feature, supporting further research and potential clinical use of the task.
PMID: 41746731

15. Concurrent pulmonary infection with Nocardia spp. and Mycobacterium tuberculosis in an adult with cerebral palsy: a case report

Pooya Vahedi, Mohammad Kord, Kazem Ahmadikia, Nafise Mozafari, Ilad Alavi Darazam

Abstract
No abstract available
PMID: 41735892

16.Seeing the Unseen: The Neurodevelopmental Factors Related to Visual Impairments in Children With Unilateral Cerebral Palsy

Monica Crotti, Nofar Ben Itzhak, Lisa Mailleux, Lize Kleeren, Lisa Decraene, Nicolas Leenaerts, Manuel Lubián-Gutiérrez, Hilde Feys, Els Ortibus

Background: Visual impairments are common yet often unrecognised in children with unilateral cerebral palsy (uCP), and the contribution of brain damage, prematurity, and side of CP remains unclear.
Methods: Visual functions and functional vision were assessed in 41 children with uCP aged 7–15 years. MRI scans were evaluated for lesion timing, location, and severity, as well as corpus callosum length and splenium thickness. Nonparametric statistics explored associations between brain damage and visual outcomes and differences based on prematurity or CP side. Elastic-net regression examined whether gestational age and brain damage predicted impairments.
Results: Damage to cortical lobes and the corpus callosum was associated with reduced visual functions and functional vision. Preterm children showed reduced geniculostriate visual functions and more parietal lobe damage compared to full-term peers. No differences were found between left- and right-sided uCP. Regression models identified shorter corpus callosum length and parietal lesions as key predictors of impaired stereoacuity, and occipital lesions as predictors of impaired visuomotor integration. Models predicting visual perception performed poorly.
Conclusions: Specific brain damage and prematurity are associated with distinct visual impairments in uCP. These findings may guide clinicians toward targeted visual assessments and interventions.
PMID: 41734651

17.Understanding the dynamic association between sleep quality and mood in children and adolescents with cerebral palsy

Hangsel D Sanguino, Chris A Clark, Laura K Brunton, Elizabeth G Condliffe, Daniel C Kopala-Sibley, Melanie E Noel, Sandra J Mish, Carly A McMorris

Background: Children and adolescents with cerebral palsy (CP) are at elevated risk for mental health difficulties. Poor sleep is a known contributor to mood problems, yet most CP research examines average sleep metrics rather than daily variability. This study investigated dynamic, bidirectional associations between sleep quality, sleep duration, and mood using daily assessments.
Methods: Thirty-two youth with CP (ages 11–17) completed daily diaries for seven days, rating sleep quality, sleep duration, and mood (positive and negative affect). Multilevel models examined within-person and between-person associations, controlling for gender, age, and GMFCS level.
Results: Between individuals, higher prior-night sleep quality predicted greater next-day positive mood and lower negative mood, while higher negative mood predicted poorer subsequent sleep quality. Within individuals, day-to-day increases in sleep quality predicted higher next-day positive mood, but sleep duration showed no significant associations.
Conclusion: Sleep quality and mood are dynamically linked in youth with CP, with bidirectional effects at the between-person level and unidirectional effects within individuals. Findings underscore the importance of addressing sleep quality—not just duration—in mental health interventions for youth with CP.
PMID: 41724025

18.Augmented reality and pain during botulinum neurotoxin A injections in children with cerebral palsy: A randomized controlled trial

No authors listed

Abstract
No abstract available
PMID: 41761429

19. Automatic Speech Recognition for Intelligibility Assessment in Children With Dysarthria

Jiyoung Choi, Gemma Moya-Galé, KyungHae Hwang, Julia Hirschberg, Erika S Levy

Purpose: Accurate assessment of speech intelligibility is critical for children with dysarthria secondary to cerebral palsy. Traditional assessment methods, such as human listeners' orthographic transcription and perceptual ratings of ease of understanding (EoU), are time consuming or subjective. Automatic speech recognition (ASR) may offer a more efficient, objective alternative, but its use in this population is unexamined. This study evaluated the potential of ASR for intelligibility assessment in children with dysarthria and identified the most appropriate ASR systems for approximating human listeners' judgments.
Method: Five ASR systems transcribed speech samples from 20 children with dysarthria. Additionally, 168 adult listeners provided orthographic transcriptions and EoU ratings. Word recognition rate (WRR) was used to calculate transcription accuracy. Spearman correlations evaluated relationships between ASR WRR and human WRR and between ASR WRR and EoU ratings.
Results: Four ASR systems (WhisperX-small, WhisperX-medium, WhisperX-large, and Google Cloud) showed strong correlations between ASR WRR and human WRR, with WhisperX-medium performing best. These systems also showed moderate-to-strong correlations with EoU ratings, with Google Cloud ASR demonstrating the strongest association. Wav2Vec2 showed weak correlations with both human WRR and EoU ratings.
Conclusions: ASR shows promise for intelligibility assessment in children with dysarthria. WhisperX-medium appears most accurate relative to human transcription, while Google Cloud ASR aligns best with perceptual ratings. Differences across systems highlight the need for careful ASR selection in clinical settings.
PMID: 41746192

20. Design and Evaluation of a Trunk-Limb Robotic Exoskeleton for Gait Rehabilitation in Cerebral Palsy

Hui Li, Ming Li, Ziwei Kang, Hongliu Yu

Abstract
Most pediatric exoskeletons for cerebral palsy focus on lower-limb assistance and neglect trunk control, limiting rehabilitation outcomes. This study presents a self-aligning trunk–limb exoskeleton integrating trunk stabilization with active lower-limb support. The design includes a hip–waist rapid adjustment mechanism, bioinspired gear-rolling knee joint, modular thigh–shank structures, a trunk support module, and body-weight support. A continuous gait-progress–based multi-joint control framework enables coordinated, transparent assistance. Joint motion is defined across the full gait cycle and fused into a unified system-level reference using observability-weighted circular statistics. Phase-consistency-based temporal modulation ensures smooth inter-joint coordination while preserving autonomy. Technical evaluations—including misalignment analysis, simulations, and gait trials—demonstrated a 66.8% reduction in hip misalignment and an 87.4% reduction in knee misalignment. Exoskeleton-assisted gait parameters closely matched baseline walking, confirming natural motion preservation. These findings indicate improved human-robot synergy, enhanced postural stability, and strong potential for pediatric gait rehabilitation.
PMID: 41744548

21.Current status and future prospects of brain-computer interfaces in the field of neurological disease rehabilitation

Yu Luo, Xiaohu Liu, Miaomiao Yang

Abstract
Neurological disorders constitute a major category of diseases with profound global impact, representing the second leading cause of mortality worldwide. Conditions such as stroke, multiple sclerosis, amyotrophic lateral sclerosis, spinal cord injury, Parkinson's disease, and cerebral palsy often result in long-term sequelae that significantly affect daily life. Brain–computer interface (BCI) technology has shown considerable promise for neurorehabilitation, though substantial challenges remain. This review summarizes recent progress in research and clinical application, outlines current limitations, and discusses future directions. It examines the applicability and constraints of BCI technologies across disorders and patient populations and presents comparative tables aligning BCI strategies with therapeutic targets, outcomes, advantages, limitations, and evidence gaps. The review highlights developments beyond motor restoration, including applications for neuropathic pain, and discusses translation to real-world settings. Overarching challenges such as small sample sizes, heterogeneous protocols, and limited longitudinal data are identified. A research and development roadmap is proposed, featuring individualized cortical-network simulators, self-architecting decoders, adaptive therapy progression, and proprioceptive write-back via peripheral interfaces. Key research priorities and unresolved issues are articulated to support advancement in BCI-based neurological rehabilitation.
PMID: 41743427

22.Individualized brain-computer interface for people with disabilities: a review

Simanto Saha, Petra Karlsson, Collin Anderson, Omid Kavehei, Alistair McEwan

Abstract
Brain–computer interfaces (BCIs) enable functional interaction between the brain and external devices, allowing users to bypass peripheral motor pathways to control assistive and rehabilitative technologies. This review critically evaluates state-of-the-art BCI-based assistive and rehabilitative technologies (ARTs), integrating psychosocial and health-related factors that influence user needs. It examines how developmental and age-related brain changes affect BCI design and ethical considerations, including consent challenges for users with communication or cognitive impairments. BCIs offer expanded mobility, cognitive access, and communication for people with disabilities, but innovation is constrained by the diversity and complexity of disability profiles, creating challenges for scalable, individualized design. Trade-offs between implantable and non-implantable BCIs are explored, emphasizing accessibility, generalizability, and usability. The review underscores the necessity of adaptable designs responsive to evolving functional and developmental needs, advocating for user-specific approaches that facilitate broader adoption.
PMID: 41742930

23.Usability of a virtual reality circle drawing task to assess upper-limb motor performance in children and young people with cerebral palsy: pilot study

Mohammed M Alrashidi, Jack O Evans, Richard J Tomlinson, Craig A Williams, Gavin Buckingham

Background: Cerebral palsy (CP) often involves upper-limb motor impairments. Immersive virtual reality (iVR) is emerging in rehabilitation, but its value for assessing upper-limb function in CP is unclear. This study evaluated the usability of an iVR circle-drawing task to assess upper-limb motor performance in children with CP.
Methods: Nine children with CP (mean age 13 ± 2.9 years) completed an iVR circle-drawing task using a Meta Quest 2 headset. Usability was assessed with the System Usability Scale (SUS). Movement time, mean velocity, and roundness metrics obtained from controller kinematics were correlated with Box and Block Test (BBT) scores and Duruoz Hand Index scores.
Results: The average SUS score was 74, indicating good usability and acceptability. No adverse effects occurred. Strong positive correlations were observed between BBT scores and both mean velocity and roundness, while strong negative correlations were observed between DHI scores and these same metrics.
Conclusions: The iVR circle-drawing task is a usable tool for capturing upper-limb motor performance in children with CP and supports further development of iVR-based clinical assessment tools.
PMID: 41735958

24. Fidelity of power mobility interventions for young children with disabilities: a systematic review

Bethany M Sloane, Samuel W Logan

Disabil Rehabil Assist Technol. 2026 Feb 24:1–24. Online ahead of print.

Purpose: To describe study characteristics, intervention components, and fidelity measurement of power mobility interventions for children aged three years and younger with mobility disabilities.
Methods: A systematic review was conducted of studies providing a power mobility device and in-person training across multiple sessions. Searches included PubMed, Web of Science, PsycINFO, and Google Scholar. Data were extracted on study characteristics, intervention components, and fidelity measurement, including adherence, dosage, delivery quality, participant responsiveness, and program differentiation.
Results: Thirty-six studies met eligibility criteria. Samples were small and commonly involved children with cerebral palsy. Modified ride-on cars with switch access were frequently used, and training occurred in clinical and community settings. Frequency and duration varied widely, and out-of-session device use was inconsistently reported. Caregiver education appeared in just over half of studies. Goal-directed activities, exploration, and prompting were the most common strategies. Few studies referenced evidence or theory in intervention design. Only one case report systematically measured fidelity; most studies reported only dosage or participant responsiveness.
Conclusions: Fidelity measurement in power mobility interventions for young children is sparse and inconsistent, limiting interpretation and replication. Future research should define core components, ground interventions in evidence and developmental theory, and apply comprehensive fidelity measures to improve rigour and implementation.
PMID: 41733438

25. A Tale of Two Cerebral Palsies

Victoria D'Amours, Nafisa Husein, Michael Shevell

Pediatr Neurol. 2026 Feb 6;178:32–40. Online ahead of print.

Background: There is limited understanding of cerebral palsy (CP) in low- and middle-income countries (LMICs). This retrospective cross-sectional study compared the phenotype, severity, and etiologic profile of children with CP born in either a LMIC or a high-income country (HIC) assessed in a single service.
Methods: Data from consecutive children initially assessed by one neurologist from 2020–2024 were extracted. Children were categorised by birth location (HIC or LMIC). Pearson chi-square tests compared CP subtype, etiology, MRI findings, functional impairments, and comorbidities.
Results: Eighty-nine Canadian-born (HIC) and 48 LMIC-born children met criteria. LMIC-born children were significantly more likely (p < 0.01) to have spastic quadriparetic or dyskinetic CP, MRI evidence of deep gray matter injury, GMFCS/MACS level IV–V, cognitive disability, and be nonverbal, deaf, or cortically blind. Intrapartum asphyxia and kernicterus were significantly more common etiologies (p < 0.01).
Conclusions: Children with CP born in LMICs have a markedly different and more severe phenotype, likely reflecting higher rates of deep gray matter injury from differing etiologic profiles. These findings identify targets for prevention and highlight the need for additional services for migrant populations.
PMID: 41747616

26. Value of caregivers report at six months of age in predicting cerebral palsy – A prospective cohort study

Marianne Strøm, Allen J Wilcox, Mette Tollånes, Rolv Terje Lie, Ingeborg Forthun, Katrine Strandberg-Larsen, Dag Moster

Objective: Early identification of cerebral palsy (CP) in children without known risk factors is challenging. Parent-identified concerns are important in early CP detection. This study assessed the value of caregiver-reported infant characteristics at age six months in identifying CP among term-born singletons.
Method: Prospective data on term-born singletons from two Northern European birth cohorts were linked to national registries. CP diagnosis, subtype, and severity were obtained from CP registries. Relative risks for CP were calculated based on caregiver-reported developmental and health concerns at six months. Predictive values, sensitivity, specificity, and AUC were evaluated with follow-up from 6–16 years.
Results: Among 150,100 term-born singletons, 203 had CP. Strongest associations were seen for concerns about general motor delay, not handling a toy with both hands, and not grabbing a toy. Caregivers of affected infants more often reported colic, respiratory infections, seizures, and caregiving difficulty. Highest PPV was for "not handle toy with both hands," while "general motor delay" had the highest sensitivity. Associations were strongest for dyskinetic CP and GMFCS IV–V. Combining all characteristics produced an AUC of 0.81.
Conclusion: Caregivers of infants with CP often recognise signs of CP by six months, particularly early handedness. Individual concerns have limited predictive value alone but contribute meaningfully when combined.
PMID: 41741287

27. The right people, in the right place — assessing the impact of a new outreach model for paediatric neurology specialist services in Myanmar

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Background: Myanmar has a severe shortage of paediatric neurologists, with only 11 specialists serving an estimated 14 million children, most of whom live in rural areas far from tertiary care. High out-of-pocket costs and long travel distances create major barriers to timely neurological assessment and follow-up. To address these inequities, a blended outreach and telemedicine model was developed to extend paediatric neurology care to underserved regions beyond major cities.
Methods: A hub-and-spoke model linked paediatric neurologists at Yangon Children's Hospital with general paediatricians in seven regional hospitals. The programme combined quarterly in-person outreach clinics with ongoing virtual support via telemedicine and mobile messaging. Routinely collected data (2017–2020) were analysed to evaluate service reach, diagnostic distribution, and cost impacts.
Results: The programme supported 2,603 consultations. Epilepsy was the most common diagnosis (54%), followed by cerebral palsy (12%). The blended model improved specialist efficiency through better case triage and consistent care planning. Cost analysis showed patient cost reductions of 81%–98% per hospital, with mean consultation cost falling from US$193 (standard tertiary referral) to US$7 (outreach model). Additional benefits included capacity building, strengthened referral pathways, and expanded regional clinical networks.
Conclusions: A hybrid outreach-telemedicine model can deliver accessible, high-quality, cost-effective paediatric neurology services in low-resource settings. Leveraging existing infrastructure and integrating local providers improved access, reduced financial barriers, and increased system capacity. The model offers a scalable framework for other contexts facing similar challenges.
PMID: 41727890

28.Hammersmith Infant Neurological Examination for early detection of cerebral palsy in Ethiopia: A feasibility and knowledge translation study

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Aim: To implement the Hammersmith Infant Neurological Examination (HINE) in Ethiopia using the Knowledge-to-Action Framework, report the percentage of infants classified as having cerebral palsy (CP) or high probability of CP, and evaluate age at detection and referral.
Method: Paediatric staff and residents received HINE training and implemented the tool in selected clinics. Based on global scores, infants were grouped as above the 10th centile, between the 10th centile and high-probability cut-off, or below the high-probability cut-off. Age at CP detection and referral patterns were recorded.
Results: Ninety-eight infants at risk for CP were assessed. Of these, 48 (49%) scored above the 10th centile, 15 (15%) fell into the developmental monitoring/coaching range, and 35 (36%) scored below the high-probability cut-off. Among those diagnosed with CP or high probability of CP, mean age at diagnosis was 10.6 months (range 3–23 months). All were referred for rehabilitation at diagnosis.
Interpretation: Implementing the HINE in Ethiopia enabled early identification of CP or high probability of CP—often before 12 months—supporting timely referral to rehabilitation services.
PMID: 41725500

29. Characteristics of unilateral cerebral palsy according to gestational age at birth: A retrospective study

No authors listed

Abstract
No abstract available
PMID: 41761456

30. Systematic review of terminology, definitions, and eligibility criteria in trials of neonatal encephalopathy, hypoxic-ischemic encephalopathy, and perinatal asphyxia

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Background: Appropriate terminology and definitions of neonatal encephalopathy (NE), hypoxic-ischemic encephalopathy (HIE), and perinatal asphyxia (PA) remain controversial. Participant criteria used in therapeutic hypothermia (TH) trials are frequently used as case definitions for NE/HIE/PA but studies are inconsistent. This review aims to assess variations in terminology and case participant criteria between trials for NE/HIE/PA.
Methods: Search strategy retrieved articles from databases (Embase, MEDLINE, CENTRAL, CDSR and WHO) for randomized controlled trials (RCTs) of interventions for NE/HIE/PA using any definition for NE/HIE/PA. Outcomes were a description of the terminology, definitions, and participant criteria. Two reviewers independently screened results. Qualitative results were synthesized in a narrative summary.
Results: The search provided 6768 results. 67 were included in the qualitative synthesis. HIE was the most frequently used term (56/67). NE was the least frequent (16/67). Some of the common inclusion criteria were Apgar scores (63/67), metabolic acidosis (58/67), and reduced level of consciousness (57/67). Most frequently employed exclusion criteria were prematurity (63/67), major congenital abnormalities (62/67), and identification beyond 6 h from birth (62/67).
Discussion: This review identified variations in terminology and in-trial participant criteria between studies. These results will inform a consensus process for developing a definition and case definition of NE/HIE/PA.
Impact: Our article demonstrated significant variations in the terminology used to describe the condition of NE/HIE/PA, which demonstrates a need for more consistent definitions in terminology. A broad but meaningful definition of the condition would provide an inclusive approach while permitting subclassifications within the condition, and permitting comparisons and benchmarking across different settings. Developing consistency across these areas, as far as possible, would allow improved interpretation of interventions on long-term prognosis and greater generalizability of trial results.
PMID: 41760908

31. Cerebral palsy in art and literature throughout history

Patricia do Rocio Litça, Ana C de Souza Crippa, Adrielle Holler Pykocz, Luis F Fabrini Paleare, Marcio Vieira Sanches Silva, Filipe M Barcelos, Helio A G Teive, Gustavo Leite Franklin

Abstract
Cerebral palsy (CP), a term coined by William John Little in 1843, represents a group of non-progressive motor disorders resulting from early brain injury. Beyond its medical characterization, there were early artistic depictions, such as Egyptian reliefs and medieval religious scenes, portraying individuals with asymmetric or contracted limbs mainly through symbolic or moral lenses. During the Renaissance and Baroque periods, artists including Dürer and Velázquez subtly represented physical diversity, though without explicit medical context. Literary portrayals evolved from mythological or moral allegory (e.g., Hephaestus, hagiographies) to empathetic narratives of individuality and inclusion, as seen in Tiny Tim in *A Christmas Carol* and Draper's *Out of My Mind*. In modern times, artists and writers living with CP transformed disability into a means of self-expression and social critique.
PMID: 41759505

32.Shared and distinct phenotypic profiles among neurodevelopmental disorder genes

Hermela Shimelis, Matthew T Oetjens, Bobbi McGivern, Zhancheng Zhang, Janelle E Stanton, Ian McSalley, Shiva Ganesan, Brenda M Finucane, Ingo Helbig, Christa L Martin, Scott M Myers, David H Ledbetter

Abstract
Rare pathogenic variants in many genes contribute to neurodevelopmental disorders (NDDs), including intellectual disability and/or global developmental delay (ID), autism spectrum disorder (ASD), epilepsy (EP), and cerebral palsy (CP). These conditions frequently co-occur and share genetic etiologies, yet the broader phenotypic effects and the extent of shared versus distinct genetic influences remain unclear. Here, we adopt a cross-disorder framework to examine NDD genes across four diagnostic categories, characterize gene-associated phenotypic profiles, and identify convergent pathways that help refine how pathogenic variants in these genes shape clinical outcomes. Using a discovery cohort of 8,973 probands with disease-causing variants in 263 NDD genes, we performed phenotype-based gene clustering and identified six distinct gene clusters. These clusters reveal structured patterns of genetic overlap, showing that subsets of NDD genes preferentially contribute to specific disorder combinations of ID, ASD, EP, and CP. The largest gene cluster was characterized by ID, whereas the other five included one enriched for ASD and ID, two for EP and ID, and two for CP and ID, each with significantly differing frequencies. In an independent validation cohort of 19,704 probands, five of the six clusters were replicated. Gene Ontology enrichment analyses revealed distinct biological processes in each cluster, suggesting that coherent molecular mechanisms underlie the differing NDD diagnostic profiles. Together these findings demonstrate that NDD genes fall into coherent clusters that consistently map onto characteristic phenotype profiles, providing a framework to inform future therapeutic strategies and support early prognostication for individuals with pathogenic variants in NDD genes.
PMID: 41757165

33.A New Case of a Neurodevelopmental Disorder and Myoclonic Dystonia Associated with the C.1404del Variant of the ATP5F1A Gene

Georgi Krastev, Martin Danis

Abstract
ATP synthase is a mitochondrial enzyme responsible for most cellular ATP production, and disease phenotypes associated with subunit mutations are extremely rare. Only a small number of ATPase subunit mutations have been described, with heterogeneous presentations including hypotonia, epilepsy, movement disorders, developmental delay, and intellectual disability. This case report describes a rare neurodevelopmental disorder with myoclonic dystonia associated with an ATP5F1A variant. The patient had been misdiagnosed with cerebral palsy throughout life until genetic testing identified the ATP5F1A mutation. Knowledge of symptoms linked to ATPase mutations may improve diagnostic accuracy and clinical care.
PMID: 41743395

34.Therapies of last resort in paediatric super-refractory status epilepticus: a case report on combined selective amygdalohippocampectomy, vagus nerve stimulation, and anterior corpus callosotomy

Mateusz Zajączkowski, Łukasz Klasa, Stanisław Kwiatkowski, Olga Milczarek

Abstract
Super-refractory status epilepticus (SRSE) is a rare, life-threatening emergency defined as seizures persisting beyond 24 hours despite anaesthetic and antiseizure therapy. Management aims to suppress seizures, provide neuroprotection, and limit excitotoxic injury, with emergency epilepsy surgery considered a last resort. This case report describes an 8-year-old girl with cerebral palsy, drug-resistant epilepsy, cortical visual impairment, and bilateral hearing loss who developed SRSE unresponsive to maximal medical therapy. After multidisciplinary evaluation, a sequential neurosurgical approach was implemented: selective amygdalohippocampectomy, vagus nerve stimulation, and anterior corpus callosotomy. Selective amygdalohippocampectomy resulted in immediate seizure cessation; VNS and callosotomy were added after recurrent events, achieving sustained seizure reduction with Engel class II outcome. This case highlights the potential benefit of combining resective, neuromodulatory, and disconnection procedures in paediatric SRSE when conventional treatments fail.
PMID: 41739236

35.The Cerebral Palsy Link Worker (CP LINK) study: Protocol for a feasibility study with integrated process evaluation

Kimberley J Smith, Erica Ranzato, Miriam Creeger, Valerie L Stevenson, Karen Lowton, Cherry Kilbride, Meriel Norris, Christina Victor, Thelonious McCarthy Budzynski, Emma Livingstone

Background: Cerebral palsy (CP) is the most common lifelong physical disability in the UK and is associated with social, psychological, and health inequalities that increase with age. Many middle-aged and older adults with CP report fragmented, non-specialised care in primary settings, highlighting the need for specialised support.
Project aim: To evaluate a co-developed specialised CP link worker role for adults aged 40+ living with CP.
Methods: A feasibility evaluation will collect data at baseline, 1-week, and 3-months from participants receiving link-worker support. Feasibility outcomes include recruitment and retention, acceptability, completeness of data, and practicality of collecting participant-reported outcomes. Process evaluation will examine fidelity, delivery, contextual influences, sustainability, and stakeholder experiences. The project is co-developed with UP – The Adult Cerebral Palsy Movement and supported by lived experience and stakeholder advisory groups.
PMID: 41729915

Prevention and Cure

36.Sonographic Brain Volume Growth Trajectories in VLBW and Clinical Determinants—Data from the NeoNEVS Project

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Children (Basel). 2026 Feb 18;13(2):281.

Background: Very low birth weight preterm infants are at elevated risk for disrupted brain growth and later neurodevelopmental impairment, yet bedside-accessible tools to monitor cerebral development remain limited.
Methods: In this retrospective pilot cohort study, 153 very low birth weight infants (<32 weeks gestational age and/or <1500 g) from two Level III neonatal intensive care units underwent serial cranial ultrasounds. Total brain volume was estimated using an ellipsoid formula from standardized imaging planes. Growth trajectories were analysed with linear mixed-effects models, and associations with clinical predictors including invasive ventilation, sepsis, and somatic growth were evaluated.
Results: A total of 976 brain volume measurements were collected. Median cerebral volume increased from 164 cm³ to 275 cm³ during hospitalization, corresponding to a median growth rate of 2.3 cm³/day (95% CI: 1.5–3.1). Longer invasive mechanical ventilation was associated with reduced cerebral growth (p < 0.01, R^2 = 0.26). Cerebral volume growth showed a weak but significant correlation with head circumference percentile progression (p < 0.05, ρ = 0.16).
Conclusions: Sonographic brain volumetry is feasible and non-invasive for tracking cerebral development in very low birth weight infants. Findings confirm associations between cerebral and head growth and identify prolonged invasive ventilation as a risk factor for impaired cerebral development.
PMID: 41749637

37.International disparities in use of antenatal magnesium sulfate and antenatal steroids for the preterm baby

Hannah B Edwards, Erika M Edwards, David Odd, Jelena Savović, Sarah Dawson, Mark Adams, Angelika Berger, Paul Corcoran, Jose Maria de Andrade Lopes, Luigi Gagliardi, R Kishore Kumar, Rajesh Sharma, Lloyd Tooke, Frank de Vocht, Karen Luyt

Int J Gynaecol Obstet. 2026 Feb 25. Online ahead of print.

Abstract
Antenatal magnesium sulfate (MgSO₄) and antenatal steroids (ANS) are evidence-based interventions that reduce risk of cerebral palsy and respiratory complications in preterm infants. Despite international guideline recommendations, implementation levels vary widely. This study analysed routine neonatal data for infants born at 24–32 weeks' gestation from the international Vermont Oxford Network, supplemented with UK National Neonatal Research Database data and a literature review. Data from 45,619 infants in ten countries revealed substantial disparities: Ireland and the UK had the highest MgSO₄ use (>80%), whereas South Africa and the UAE had the lowest. Use was significantly higher in high-income countries than middle-income countries. ANS use was higher overall, with less variation. Literature review findings were consistent with the dataset. MgSO₄ and ANS use varies markedly across income groups and countries, highlighting the need to understand barriers and promote equitable access to these essential antenatal interventions.
PMID: 41736529

38.Impact of prolonged invasive mechanical ventilation in extremely preterm infants on long-term neurodevelopmental and neurosensory outcomes: A narrative review

Gustavo Rocha, Rita Amaral

Early Hum Dev. 2026 Feb 21;217:106519. Online ahead of print.

Abstract
Extremely preterm infants born before 28 weeks' gestation frequently require invasive mechanical ventilation due to respiratory immaturity. Although survival has improved, prolonged ventilation contributes significantly to long-term morbidity. This narrative review synthesizes evidence linking extended invasive ventilation with adverse neurodevelopmental and neurosensory outcomes from infancy through adulthood. Observational and cohort studies consistently show increased risks of cognitive impairment, motor delay, cerebral palsy, visual impairment, and hearing loss, with a dose-response pattern where each additional day of ventilation increases impairment risk. Associations persist after adjusting for gestational age and major neonatal morbidities, suggesting prolonged ventilation is both a marker of illness severity and a potential contributor to brain injury. Proposed mechanisms include ventilator-induced lung injury, systemic and cerebral inflammation, hemodynamic instability, fluctuations in oxygen and carbon dioxide, and cumulative exposure to corticosteroids, sedatives, and analgesics during critical periods of brain development. While causality cannot be confirmed due to study heterogeneity, evidence consistently emphasizes minimizing invasive ventilation when possible. Early non-invasive support, lung-protective ventilation, and structured weaning protocols are essential to optimize long-term outcomes.
PMID: 41734702