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Interventions and Management

1. Change of function and brain activity in patients of right spastic arm paralysis combined with aphasia after contralateral cervical seventh nerve transfer surgery

Juntao Feng, Minzhi Lv, Xingyi Ma, Tie Li, Miaomiao Xu, Jingrui Yang, Fan Su, Ruiping Hu, Jie Li, Yanqun Qiu, Ying Liu, Yundong Shen, Wendong Xu

Eur J Neurosci. 2024 Jun 3. doi: 10.1111/ejn.16436. Online ahead of print.

Left hemisphere injury can cause right spastic arm paralysis and aphasia, and recovery of both motor and language functions shares similar compensatory mechanisms and processes. Contralateral cervical seventh cross transfer (CC7) surgery can provide motor recovery for spastic arm paralysis by triggering interhemispheric plasticity, and self-reports from patients indicate spontaneous improvement in language function but still need to be verified. To explore the improvements in motor and language function after CC7 surgery, we performed this prospective observational cohort study. The Upper Extremity part of Fugl-Meyer scale (UEFM) and Modified Ashworth Scale were used to evaluate motor function, and Aphasia Quotient calculated by Mandarin version of the Western Aphasia Battery (WAB-AQ, larger score indicates better language function) was assessed for language function. In 20 patients included, the average scores of UEFM increased by .40 and 3.70 points from baseline to 1-week and 6-month post-surgery, respectively. The spasticity of the elbow and fingers decreased significantly at 1-week post-surgery, although partially recurred at 6-month follow-up. The average scores of WAB-AQ were increased by 9.14 and 10.69 points at 1-week and 6-month post-surgery ($P < .001$ for both), respectively. Post-surgical fMRI scans revealed increased activity in the bilateral hemispheres related to language centrals, including the right precentral cortex and right gyrus rectus. These findings suggest that CC7 surgery not only enhances motor function but may also improve the aphasia quotient in patients with right arm paralysis and aphasia due to left hemisphere injuries.

PMID: [38830753](#)

2. Percutaneous thermal radiofrequency rhizotomy of L2-S1 spinal nerve roots in children with cerebral palsy

Andrey G Shapkin, Iurii Iakimov, Rinat A Sufianov, Galina Z Sufianova, Albert A Sufianov

Neurosurg Focus. 2024 Jun;56(6):E7. doi: 10.3171/2024.3.FOCUS2477.

Objective: This study presents the results of an evaluation of the effectiveness of percutaneous thermal radiofrequency (RF) ablation of spinal nerve roots to reduce spasticity and improve motor function in children with cerebral palsy (CP). **Methods:** A retrospective analysis was conducted on the surgical treatment outcomes of 26 pediatric patients with severe CP (Gross Motor Function Classification System levels IV-V). The assessment protocol included muscle tone assessment using the modified Ashworth scale (MAS), evaluation of passive and active range of motion, gait video recording, and locomotor status evaluation using the Gross Motor Function Measure (GMFM)-88 scale. Thermal RF rhizotomy (ablation of spinal nerve roots) was performed on all patients at the L2-S1 levels at 70°C for 90 seconds. The statistical data analysis was conducted using the t-test and Mann-Whitney U-test. A p value < 0.05 was considered statistically significant. **Results:** Before the operation, the average level of spasticity in the lower-limb muscles of all patients was 3.0 ± 0.2 according to the MAS. In the early postoperative period, the spasticity level in all examined muscle groups significantly decreased to a mean of 1.14 ± 0.15 .

($p < 0.001$). In the long-term postoperative period, the spasticity level in the examined muscle groups averaged 1.49 ± 0.17 points on the MAS ($p < 0.001$ compared to baseline, $p = 0.0416$ compared to the early postoperative period). Despite the marked reduction of spasticity in the lower limbs, no significant change in locomotor status according to the GMFM-88 scale was observed in the selected category of patients. In the long-term period, during the control examination of patients, the GMFM-88 level increased on average by $3.6\% \pm 1.4\%$ (from $22.2\% \pm 3.1\%$ to $25.8\% \pm 3.6\%$). Conclusions: The findings of this study offer preliminary yet compelling evidence that RF ablation of spinal nerve roots can lead to a significant and enduring decrease in muscle tone among children with severe spastic CP. Further studies and longer-term data of the impact on functionality and quality of life of patients with CP after spinal root RF ablation are needed.

PMID: [38823058](#)

3. Editorial. Is percutaneous thermal radiofrequency rhizotomy a viable alternative to selective dorsal rhizotomy or intrathecal baclofen for nonambulatory children with severe spasticity from cerebral palsy?

Kim Burchiel

Editorial Neurosurg Focus. 2024 Jun;56(6):E8. doi: 10.3171/2024.3.FOCUS24170.

No abstract available

PMID: [38823053](#)

4. Spinal catheter revision in pediatric intrathecal baclofen pumps: risk factors and postoperative outcomes

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Neurosurg Focus. 2024 Jun;56(6):E11. doi: 10.3171/2024.3.FOCUS2467.

Objective: Intrathecal baclofen (ITB) pumps are commonly used in pediatric patients with cerebral palsy (CP) and medically refractory spasticity. However, catheter malfunction and associated risk factors are not well understood. The aim of this study was to examine potential risk factors for spinal catheter malfunction and characterize postoperative follow-up to understand the clinical consequences. **Methods:** Patients who received ITB pump replacement or revision at Boston Children's Hospital between 2010 and 2023 were retrospectively reviewed. The spinal catheter revision cohort (SCRC) included patients whose spinal catheter was occluded requiring lumbar catheter revision. The second cohort included abdominal pump replacements only (APRC). Between-group comparisons and multivariable regression identified factors associated with catheter revision and postoperative outcomes. **Results:** Forty-one (33.6%) patients underwent spinal catheter revision and were compared with 81 patients (66.4%) who underwent abdominal pump replacement only. Younger age at surgery and an elevated preoperative lower-extremity modified Ashworth scale grade were associated with spinal catheter revision ($p < 0.05$). Catheter model type, tip location, and history of spinal fusion were not associated with obstruction. Postoperatively, SCRC patients experienced a higher rate of infection (17.1%) relative to APRC patients (0%) within 30 days from their ITB pump replacement procedure ($p < 0.05$) and greater likelihood of subsequent ITB system removal compared with the APRC (24.4% vs 7.4%, $p < 0.05$). Although not differing preoperatively, SCRC patients had lower postoperative ITB doses when compared with the APRC group (median dose 143 vs 350 $\mu\text{g}/\text{day}$, $p < 0.05$) at hospital discharge and remained statistically different at the 6-month and 1-year follow-ups ($p < 0.05$). There were no postoperative differences in baclofen overdose, withdrawal, or median number of hospital readmissions within 30 days. Overall, 31.7% of spinal catheter revisions were unanticipated by the clinical team at time of surgery. **Conclusions:** Younger age at surgery and increased preoperative lower-extremity tone may be risk factors for catheter obstruction, resulting in a higher rate of postoperative infection and subsequent ITB pump removal compared with pump replacement alone. Spinal catheter occlusion can complicate revision or replacement procedures, especially when unanticipated. Routine clinical assessment may be inadequate for diagnosing insidious catheter malfunction. Catheter occlusion deserves further study, and routine assessment of catheter patency may be warranted to prevent suboptimal tone therapy.

PMID: [38823047](#)

5. Nonselective lumbosacral ventral-dorsal rhizotomy for the management of lower-limb hypertonia in nonambulatory children with cerebral palsy

Sunny Abdelmageed, Mahalia Dalmage, James M Mossner, Robin Trierweiler, Timothy Krater, Jeffrey S Raskin

Neurosurg Focus. 2024 Jun;56(6):E9. doi: 10.3171/2024.3.FOCUS2472.

Objective: Children with cerebral palsy (CP) often experience medically refractory hypertonia, for which there are surgical therapies including neuromodulation and rhizotomy. Traditional surgical treatment for medically refractory mixed hypertonia or dystonia includes intrathecal baclofen pumps and selective dorsal rhizotomy. A nonselective lumbosacral ventral-dorsal rhizotomy (VDR; ventral and dorsal roots lesioned by 80%-90%) has the potential to address the limitations of traditional

surgical options. The authors highlighted the institutional safety and efficacy of nonselective lumbosacral VDR for palliative tone management in nonambulatory patients with more severe CP. Methods: The authors performed a retrospective analysis of patients who had undergone lumbosacral VDR between 2022 and 2023. Demographic factors, clinical variables, and operative characteristics were collected. The primary outcomes of interest included tone control and quality of life improvement. Secondary outcome measures included, as a measure of safety, perioperative events such as paresthesias. Postoperative complications were also noted. Results: Fourteen patients (7 female) were included in the study. All patients had undergone a T12-L2 osteoplastic laminoplasty and bilateral L1-S1 VDR. Nine patients had quadriplegic mixed hypertonia, 4 had quadriplegic spasticity, and 1 had generalized secondary dystonia. Following VDR, there was a significant decrease in both lower-extremity modified Ashworth Scale (mAS) scores (mean difference [MD] -2.77 ± 1.0 , $p < 0.001$) and upper-extremity mAS scores (MD -0.71 ± 0.76 , $p = 0.02$), with an average follow-up of 3 months. In the patient with generalized dystonia, the lower-extremity Barry-Albright Dystonia Scale score decreased from 8 to 0, and the overall score decreased from 32 to 13. All parents noted increased ease in caregiving, particularly in terms of positioning, transfers, and changing. The mean daily enteral baclofen dose decreased from 47 mg preoperatively to 24.5 mg postoperatively ($p < 0.001$). Three patients developed wound dehiscence, 2 of whom had concurrent infections. Conclusions: Lumbosacral VDR is safe, is effective for tone control, and can provide quality of life improvements in patients with medically refractory lower-limb mixed hypertonia. Lumbosacral VDR can be considered for palliative tone control in nonambulatory patients with more severe CP. Larger studies with longer follow-ups are necessary to further determine safety and long-term benefits in these patients.

PMID: [38823052](#)

6. Multivariate functional principal component analysis and k-means clustering to identify kinematic foot types during gait in children with cerebral palsy

Eric L Dugan, Amy E Barbuto, Cara M Masterson, Jeffrey Shilt

Gait Posture. 2024 Jun 1:113:40-45. doi: 10.1016/j.gaitpost.2024.05.032. Online ahead of print.

Background: Children with neuromuscular disorders, such as cerebral palsy, frequently develop foot deformities, such as equinopronovalgus and equinosupovarus, leading to walking difficulties and discomfort. Traditional assessment methods, including clinical measures and radiographs, often fail to capture the dynamic nature of these deformities, resulting in suboptimal treatment. 3D gait analysis using multisegment foot models offers a more detailed understanding of these deformities. Research question: To determine whether the combination of multisegment foot models, multivariate functional principal component analysis, and k-means cluster analyses could identify distinct, clinically relevant foot types in a large pediatric cohort with cerebral palsy. Methods: This was a retrospective analysis of 3D gait data from 197 patients with cerebral palsy collected using a multisegment foot model. Multivariate functional principal component analysis was used to reduce these data prior to using k-means clustering to identify foot posture clusters. Further analyses, including ANOVA and Fisher's Exact tests, were used to evaluate demographic, radiographic, and gait characteristics to explain the clinical relevance of each cluster. Results: Analysis of kinematic data from 371 feet revealed six clinically significant clusters, with a low misclassification rate of 2%. One-factor ANOVAs demonstrated significant differences across clusters for all MPCs, whereas no significant differences were noted in basic anthropometric variables. Significant variations were observed in radiographic and gait function variables, and a strong association between GMFCS levels and cluster categorization was identified. Significance: The novel approach of integrating multivariate functional principal component analysis and k-means clustering identified a spectrum of foot deformities in children with CP, ranging from equinosupovarus to marked equinopronovalgus. This methodology provides an objective classification based on kinematic data and can facilitate improved diagnosis and treatment of cerebral palsy-related foot deformities.

PMID: [38838379](#)

7. A Novel Video-Based Methodology for Automated Classification of Dystonia and Choreoathetosis in Dyskinetic Cerebral Palsy During a Lower Extremity Task

Helga Haberfehlner, Zachary Roth, Inti Vanmechelen, Annemieke I Buizer, Roland Jeroen Vermeulen, Anne Koy, Jean-Marie Aerts, Hans Hallez, Elegast Monbaliu

Neurorehabil Neural Repair. 2024 Jun 6:15459683241257522. doi: 10.1177/15459683241257522. Online ahead of print.

Background: Movement disorders in children and adolescents with dyskinetic cerebral palsy (CP) are commonly assessed from video recordings, however scoring is time-consuming and expert knowledge is required for an appropriate assessment. Objective: To explore a machine learning approach for automated classification of amplitude and duration of distal leg dystonia and choreoathetosis within short video sequences. Methods: Available videos of a heel-toe tapping task were preprocessed to optimize key point extraction using markerless motion analysis. Postprocessed key point data were passed to a time series classification ensemble algorithm to classify dystonia and choreoathetosis duration and amplitude classes (scores 0, 1, 2, 3, and 4), respectively. As ground truth clinical scoring of dystonia and choreoathetosis by the Dyskinesia Impairment Scale was used. Multiclass performance metrics as well as metrics for summarized scores: absence (score 0) and presence (score 1-4) were determined. Results: Thirty-three participants were included: 29 with dyskinetic CP and 4 typically developing, age 14 years:6

months \pm 5 years:15 months. The multiclass accuracy results for dystonia were 77% for duration and 68% for amplitude; for choreoathetosis 30% for duration and 38% for amplitude. The metrics for score 0 versus score 1 to 4 revealed an accuracy of 81% for dystonia duration, 77% for dystonia amplitude, 53% for choreoathetosis duration and amplitude. Conclusions: This methodology study yielded encouraging results in distinguishing between presence and absence of dystonia, but not for choreoathetosis. A larger dataset is required for models to accurately represent distinct classes/scores. This study presents a novel methodology of automated assessment of movement disorders solely from video data.

PMID: [38842031](#)

8. Is a Three-component Video-based Version of the Foot Posture Index Valid for Assessing Pediatric Patients With Orthopaedic and Neurologic Foot Conditions?

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Clin Orthop Relat Res. 2024 May 9. doi: 10.1097/CORR.0000000000003110. Online ahead of print.

Background: The Foot Posture Index-6 (FPI6) is an assessment of foot position that can be useful for patients with orthopaedic complaints. The FPI6 rates six components of foot position from -2 to +2, resulting in a total score on a continuum between -12 (severe cavus or supination) to +12 (severe planus or pronation). The subscores are ratings made by the examiner and are subjective assessments of deformity severity. The FPI6 requires palpation of bony structures around the foot and therefore must be administered live during physical examination. Because it is sometimes impractical to perform these assessments live, such as for retrospective research, a valid and reliable video-based tool would be very useful. **Questions/purposes:** This study examines a version of the FPI using three of the original six components to determine: (1) Are scores from the three-component version of the FPI (FPI3) associated with those from the original six-component version (FPI6)? (2) Is the three-component FPI3 as reliable as the original six-component FPI6? (3) Are FPI3 assessments done retrospectively from video as reliable as those done live? **Methods:** A retrospective group of 155 participants (106 males; mean age 13 ± 4 years) was studied. All had undergone gait analysis including videotaping and in-person assessment using the FPI6. Ratings for three components (calcaneus inversion/eversion, medial arch congruence, and forefoot abduction/adduction) were extracted yielding an FPI3 score ranging from -6 to +6. The other three components of the FPI6 (talar head palpation, curves above and below the lateral malleolus, talonavicular joint bulge) were excluded from the FPI3. FPI6 and FPI3 scores and side-to-side asymmetry were compared for all participants and for diagnosis subgroups (cerebral palsy and Charcot-Marie-Tooth disease) using a Pearson correlation. Agreement for foot posture categorization between the FPI6 and FPI3 was assessed using weighted kappa. Intra- and interrater reliability of live and video-based assessments for the FPI3 and its components were examined using intraclass correlation coefficients (ICCs) and Bland-Altman analysis. **Results:** Scores from the FPI3 and FPI6 are highly associated with each other, suggesting the FPI3 is an adequate substitute for the FPI6. FPI6 and FPI3 scores ($r = 0.98$) and asymmetry ($r = 0.96$) were highly correlated overall and within the cerebral palsy ($r = 0.98$ for scores; $r = 0.98$ for asymmetry) and Charcot-Marie-Tooth ($r = 0.96$ for scores; $r = 0.90$ for asymmetry) subgroups (all $p < 0.001$). Agreement between the FPI6 and FPI3 was high for foot posture categorization (weighted agreement = 95%, weighted $\kappa = 0.88$; $p < 0.001$). Interrater reliability for live ratings was similar for FPI3 and FPI6 and high for both measures (ICC = 0.95 for FPI6 and 0.94 for FPI3; both $p < 0.001$). High reliability was seen in video versus live ratings for the FPI3 total score and each of its components regardless of whether they were performed by the same (ICC = 0.98) or different (ICC = 0.97) raters (both $p < 0.001$), and interrater reliability remained high when the FPI3 was scored from video recordings (ICC = 0.96; $p < 0.001$). **Conclusion:** The FPI3 is valid and reliable when done live or from video or by the same or different examiners. It is suitable for retrospective and multicenter research studies, provided videos are done using standardized protocols. Further research is recommended investigating possible ceiling and floor effects in patients with pathologic conditions. Level of Evidence Level III, diagnostic study.

PMID: [38843519](#)

9. Neuromuscular contributions to disability in children with cerebral palsy and the impact of dynamic stretching orthoses and therapeutic exercise interventions: a narrative review

Kyle R Leister, Jared Rosenberg, Airon Servais, Rory Leeds

Review Transl Pediatr. 2024 May 31;13(5):803-813. doi: 10.21037/tp-24-73. Epub 2024 May 23.

Background and objective: Cerebral palsy (CP) is the most common motor disability in children. The initial lesion to the developing brain may result in a myriad of neuromuscular comorbidities, including mobility deficiencies. The neuromuscular contributions to disability and rehabilitative frameworks specific to children with CP have been investigated separately. However, few reviews have examined the relationship between neuromuscular pathophysiology and rehabilitative frameworks among children with CP. Therefore, the purpose of this review was to investigate the impact of dynamic stretching orthoses and therapeutic exercise on range of motion (ROM), aerobic capacity, and mobility in relation to the neuromuscular contributions to disability in children with CP. **Methods:** Reviews of PubMed, Google Scholar, and Web of Science were conducted to identify literature focusing on the neuromuscular pathophysiology contributing to disability in children with CP and rehabilitative frameworks associated with this population. The search used a combination of keywords and subject

headings to include 'cerebral palsy', 'musculoskeletal', 'neuromuscular', 'spasticity', 'rehabilitation', 'exercise', 'aerobic', and 'orthosis'. Selected manuscripts featured original cross-sectional and longitudinal research and meta-analyses. Key content and findings: A total of 303 manuscripts were initially identified through search terms, with 182 articles excluded based on title and abstract evaluation, leaving 121 manuscripts for full-text analysis. Seven studies meeting the narrative review criteria were included. Evidence supporting the efficacy of dynamic stretching orthoses for improving lower extremity ROM is inconclusive. Aerobic and progressive resistive training may be beneficial for improving aerobic capacity and muscle strength in children with CP, which may result in enhanced mobility. Conclusions: Depending on the individual's clinical presentation, ROM and therapeutic exercise may be implemented to optimize function. Incorporating progressive resistive and aerobic exercises into a rehabilitation plan may improve mobility and aerobic capacity. As such, clinicians should consider resistance and aerobic exercise prescription as part of a long-term treatment plan for children with CP.

PMID: [38840682](#)

10. Long-term outcomes of reconstructive treatment for painful dislocations in patients with cerebral palsy

Aleksander Koch, Maciej Kasprzyk, Bartosz Musielak, Marek Józwiak

J Child Orthop. 2024 Mar 24;18(3):315-321. doi: 10.1177/18632521241233165. eCollection 2024 Jun.

Purpose: This report presents the long-term results of the hip joint reconstruction in patients with spastic hip disease through open reduction, proximal femur varus derotation osteotomy, and Dega transiliac osteotomy. Methods: We analyzed retrospectively patients diagnosed with a spastic form of bilateral cerebral palsy with painful hip subluxation or dislocation. All patients underwent the same surgical procedure. The minimum follow-up time was 15 years. The study group comprised 15 patients (22 hips), classified with the Gross Motor Function Classification System as levels IV and V. The hip joint range of motion and anteroposterior X-ray examination at the final follow-up visit were compared with pre-operative data. The pain level was evaluated using the Visual Analogue Scale (VAS), and the femoral head shape was assessed using the Rutz classification. The patients' caregivers answered questions regarding pain during sitting, personal hygiene activities, and at rest. The caregivers' satisfaction with the treatment was also assessed with the Caregiver Priorities and Child Health Index of Life with Disabilities questionnaire. Results: We observed a significant reduction of the hip joint pain and improvement in both radiological hip stability parameters and range of motion at the final follow-up visit. Based on the Rutz classification, one hip remained type B, while the other joints became type A. Reduced pain was reported in all three positions, with the most pronounced improvement during sitting and personal hygiene activities. Interestingly, patients with unilateral hip reconstruction were more prone to pain after reconstruction than those operated bilaterally. Conclusion: Primary reconstruction of the painful hip joint neurogenic dislocation results in a stable joint reduction, pain decrease, and improved quality of life in patients with cerebral palsy. Level of evidence: IV case series.

PMID: [38831856](#)

11. Automated facial recognition system using deep learning for pain assessment in adults with cerebral palsy

Álvaro Sabater-Gárriz, F Xavier Gaya-Morey, José María Buades-Rubio, Cristina Manresa-Yee, Pedro Montoya, Inmaculada Riquelme

Digit Health. 2024 Jun 5;10:20552076241259664. doi: 10.1177/20552076241259664. eCollection 2024 Jan-Dec.

Objective: Assessing pain in individuals with neurological conditions like cerebral palsy is challenging due to limited self-reporting and expression abilities. Current methods lack sensitivity and specificity, underlining the need for a reliable evaluation protocol. An automated facial recognition system could revolutionize pain assessment for such patients. The research focuses on two primary goals: developing a dataset of facial pain expressions for individuals with cerebral palsy and creating a deep learning-based automated system for pain assessment tailored to this group. Methods: The study trained ten neural networks using three pain image databases and a newly curated CP-PAIN Dataset of 109 images from cerebral palsy patients, classified by experts using the Facial Action Coding System. Results: The InceptionV3 model demonstrated promising results, achieving 62.67% accuracy and a 61.12% F1 score on the CP-PAIN dataset. Explainable AI techniques confirmed the consistency of crucial features for pain identification across models. Conclusion: The study underscores the potential of deep learning in developing reliable pain detection systems using facial recognition for individuals with communication impairments due to neurological conditions. A more extensive and diverse dataset could further enhance the models' sensitivity to subtle pain expressions in cerebral palsy patients and possibly extend to other complex neurological disorders. This research marks a significant step toward more empathetic and accurate pain management for vulnerable populations.

PMID: [38846372](#)

12. Online video resources pertaining to cerebral palsy: A YouTube-based quality control study

Nicholas D Thomas, Julian Melchor, Rachel Carr, Sarah Ripps, Nicole Pham, Roei Golan, Nakul Talathi, Rachel M

Thompson, David Spence, Hank Chambers

J Child Orthop. 2024 May 6;18(3):308-314. doi: 10.1177/18632521241227803. eCollection 2024 Jun.

Aim: To assess the content and quality of YouTube videos related to cerebral palsy to provide insights into the online video resources available for individuals affected by cerebral palsy and suggest strategies for improvement. **Methods:** YouTube videos were analyzed based on interaction parameters, content characteristics/category, and video source. Video reliability and quality were assessed using the Journal of American Medical Association benchmark, Global Quality Scale, and cerebral palsy-specific score. Statistical analyses examined associations between video characteristics and reliability/quality scores. **Results:** The average video (n = 48) length was 6.8 min, with 29 informational and 19 experiential videos. The mean Journal of American Medical Association score was 2.0, indicating moderate reliability. The Global Quality Scale suggested good quality content (average: 3.5), but only 14% were rated as good via cerebral palsy-specific score. Higher views were associated with higher Journal of American Medical Association score and cerebral palsy-specific score (p = 0.002 and p = 0.006), and nonphysician medical expert videos had lower Journal of American Medical Association scores than academic videos (p = 0.042). Video content was not significantly associated with either score. **Conclusion:** YouTube provides moderate to good quality information on cerebral palsy. Critical evaluation of video sources and content is essential. Findings can guide strategies to enhance the quality of cerebral palsy-related YouTube content, benefiting individuals with cerebral palsy, health care providers, and caregivers.

PMID: [38831853](#)

13. Joystick-Operated Ride-On Toy Navigation Training for Children With Hemiplegic Cerebral Palsy: A Pilot Study

Sudha Srinivasan, Nidhi Amonkar, Patrick D Kumavor, Deborah Bubela, Kristin Morgan

Am J Occup Ther. 2024 Jul 1;78(4):7804185070. doi: 10.5014/ajot.2024.050589.

Importance: Children with hemiplegic cerebral palsy (HCP) require intensive task-oriented training to make meaningful gains in affected upper extremity (UE) motor function. **Objective:** To evaluate the acceptability and utility of single joystick-operated ride-on toy (ROT) navigation training incorporated into a modified constraint-induced movement therapy (CIMT) camp for children with HCP. **Design:** Single group pretest-posttest design. **Setting:** Three-wk structured CIMT camp. **Participants:** Eleven children with HCP between ages 3 and 14 yr. **Intervention:** Children received group-based CIMT for 6 hr/day, 5 days/wk, for 3 wk. As part of camp activities, children also received ROT navigation training for 20 to 30 min/day, 5 days/wk, for 3 wk. **Outcomes and measures:** We assessed children's acceptance of ROT training by monitoring adherence and evaluating child engagement (affect and attention) during training sessions. The effects of ROT training combined with other camp activities on children's affected UE motor function were also assessed with the standardized Quality of Upper Extremity Skills Test (QUEST) and training-specific measures of ROT maneuvering accuracy. **Results:** Children demonstrated high levels of training adherence, positive affect, and task-appropriate attention across weeks. Positive engagement during ROT sessions was correlated with independent navigation. We also found medium- to large-sized improvements in QUEST scores and toy-maneuvering capabilities after the combined program. **Conclusions and relevance:** Our pilot data support the use of joystick-operated ROTs as child-friendly therapy adjuncts that can be incorporated into intensive UE training programs to improve adherence and motivation in therapy programs, boost treatment dosing, and promote affected UE motor function in children with HCP. **Plain-Language Summary:** This pilot study offers promising evidence that supports the use of modified single joystick-operated ride-on toys (ROT) for children with hemiplegic cerebral palsy (HCP). The study used ROTs as one of several interventions that were part of a constraint-induced movement therapy (CIMT) camp program for children with HCP. The ROTs boosted children's motivation, their engagement with and adherence to training, and their practice in using their affected upper extremity (UE) for goal-directed activities in their natural settings. ROTs are accessible, age-appropriate, and easy-to-use devices for both occupational therapy clinicians and families to encourage children to use their affected UEs by challenging their perceptual, motor-planning, problem-solving, and movement-control skills in an enjoyable and engaging way. ROTs can be used within and outside conventional rehabilitation settings.

PMID: [38836619](#)

14. Correction to: Prevalence of Sensory Processing Deficits in Children with Spastic Cerebral Palsy - An Indian Caregiver's Perspective

Sapna Dhiman, Ramesh K Goyal, Aakash Mahesan, Puneeta Ajmera, G Shankar Ganesh, Sheffali Gulati

Published Erratum Indian J Pediatr. 2024 Jun 3. doi: 10.1007/s12098-024-05151-9. Online ahead of print.

No abstract available

Erratum for

Prevalence of Sensory Processing Deficits in Children with Spastic Cerebral Palsy - An Indian Caregiver's Perspective. Dhiman S, Goyal RK, Mahesan A, Ajmera P, Ganesh GS, Gulati S.

Indian J Pediatr. 2024 Mar 27. doi: 10.1007/s12098-024-05111-3. Online ahead of print.
PMID: 38536651

PMID: [38829541](#)

15. The effect of constraint-induced movement therapy for children with hemiplegic cerebral palsy in Vietnam

Van Minh Pham, Thi Lien Hoang, Khanh Chi Hoang, Ngoc-Minh Nguyen, Stephanie C DeLuca, Patty Coker-Bolt

Disabil Rehabil. 2024 Jun 3:1-7. doi: 10.1080/09638288.2024.2360060. Online ahead of print.

Purpose: Pediatric constraint-induced movement therapy (CIMT) is an evidence-based treatment that has a long history of demonstrating efficacy for children with hemiparesis. The purpose of this study is to determine the effectiveness of a culturally responsive CIMT program for children with hemiplegic cerebral palsy (CP) developed for the Vietnam healthcare system. **Methods:** Thirty children with hemiplegic CP (mean age = 2.88 years, age range: 1 to 8 yrs, 60% male) were recruited to a CIMT program (7.5 h/week, 4 weeks) developed for the cultural context of Vietnam. Motor abilities of the affected arm and participation in daily activities were evaluated at 3 time points (one-week prior to CIMT (baseline), one-week before (pre) and after (post) CIMT) using the Quality of Upper Extremity Skill Test (QUEST) and Pediatric Motor Activity Log-Revised (PMAL-R). Individual goals were measured using the Goal Attainment Scale (GAS). **Results:** There were significant increases in the "How often scale" and "How Well" scales of the PMAL-R (0.75 and 0.75, $p < 0.00$). Score of Grasp and Dissociated Movement items on the QUEST increased significantly (6.47 and 7.63, $p < 0.001$). Group GAS T-Scores were 52.19 indicating that children met individual goals. **Conclusions:** A model of CIMT was successfully developed and delivered within the Vietnamese healthcare system. Future studies should explore the optimal model for CIMT in various regions of world where the delivery of rehabilitation services may vary.

PMID: [38828697](#)

16. Harmonizing data on correlates of sleep in children within and across neurodevelopmental disorders: lessons learned from an Ontario Brain Institute cross-program collaboration

Patrick G McPhee, Anthony L Vaccarino, Sibel Naska, Kirk Nysten, Jose Arturo Santisteban, Rachel Chepesiuk, Andrea Andrade, Stelios Georgiades, Brendan Behan, Alana Iaboni, Flora Wan Sabrina Aimola, Heena Cheema, Jan Willem Gorter

Front Neuroinform. 2024 May 17:18:1385526. doi: 10.3389/fninf.2024.1385526. eCollection 2024.

There is an increasing desire to study neurodevelopmental disorders (NDDs) together to understand commonalities to develop generic health promotion strategies and improve clinical treatment. Common data elements (CDEs) collected across studies involving children with NDDs afford an opportunity to answer clinically meaningful questions. We undertook a retrospective, secondary analysis of data pertaining to sleep in children with different NDDs collected through various research studies. The objective of this paper is to share lessons learned for data management, collation, and harmonization from a sleep study in children within and across NDDs from large, collaborative research networks in the Ontario Brain Institute (OBI). Three collaborative research networks contributed demographic data and data pertaining to sleep, internalizing symptoms, health-related quality of life, and severity of disorder for children with six different NDDs: autism spectrum disorder; attention deficit/hyperactivity disorder; obsessive compulsive disorder; intellectual disability; cerebral palsy; and epilepsy. Procedures for data harmonization, derivations, and merging were shared and examples pertaining to severity of disorder and sleep disturbances were described in detail. Important lessons emerged from data harmonizing procedures: prioritizing the collection of CDEs to ensure data completeness; ensuring unprocessed data are uploaded for harmonization in order to facilitate timely analytic procedures; the value of maintaining variable naming that is consistent with data dictionaries at time of project validation; and the value of regular meetings with the research networks to discuss and overcome challenges with data harmonization. Buy-in from all research networks involved at study inception and oversight from a centralized infrastructure (OBI) identified the importance of collaboration to collect CDEs and facilitate data harmonization to improve outcomes for children with NDDs.

PMID: [38828185](#)

17. Cerebral palsy research network community registry adult surveys on function & pain: Successes, challenges, and future directions

Mary E Gannotti, Paul H Gross, Deborah E Thorpe, Edward A Hurvitz, Garey H Noritz, Susan D Horn, Michael E Msall, Henry G Chambers, Linda E Krach, Cristina A Sarmiento

Disabil Health J. 2024 May 22:101625. doi: 10.1016/j.dhjo.2024.101625. Online ahead of print.

The formation of a patient-reported outcomes registry to provide information about functional changes and pain among adults with cerebral palsy (CP) was identified as a priority to address the gap in knowledge and practice about aging and CP. The

Cerebral Palsy Research Network collaborated with consumers, clinicians, and researchers to create an interactive internet platform, MyCP, to host a Community Registry. MyCP also provides educational programming, access to webinars and community forums, and fitness opportunities. The registry hosts surveys on function and pain for adults with CP, which provide cross-sectional and longitudinal data about these important issues. Surveys include previously validated measures with normative values that have been used with other populations and investigator developed questions. Enrollment in the registry is growing but needs to reflect the population of adults with CP, which limits generalizability. Future initiatives involve strategies to increase consumer engagement and enrollment.

PMID: [38839558](#)

18. The experiences of families of children with cerebral palsy and complex disability after three years accessing the National Disability Insurance Scheme

Maddison O'Neill, Helen Bourke-Taylor, Anoo Bhojti, Claire Cotter

Aust Occup Ther J. 2024 Jun 5. doi: 10.1111/1440-1630.12973. Online ahead of print.

Introduction: In Australia, children with cerebral palsy and complex disability receive funded supports through the National Disability Insurance Scheme (NDIS). This individualised funding scheme requires parents to navigate and advocate on behalf of their child, supported by expert reports, recommendations, and allied health services. Supports aim to enable participation in all areas of daily life, which may be otherwise largely inaccessible to children with complex disability and their families. This study aimed to explore the experiences of families of children with complex disability after 3 years accessing the NDIS. **Methods:** A qualitative research design with a demographic questionnaire and in-depth interview was undertaken. Purposive sampling was used to recruit participants from one organisation providing occupational therapy and other allied health services. Data analysis implemented Braun and Clarke's thematic approach to examine the experiences of participants. **Consumer and community involvement:** This research was conducted with a registered National Disability Insurance Scheme provider to give voice to parent consumers who raise children with complex disability. **Findings:** Seven mothers and one father (N = 8) of children with complex disability were interviewed. Most parents reported increased success and satisfaction navigating the scheme. Five overall themes were generated from the data: pivotal roles of families, parental empowerment, life-changing equipment, the fallibility of the scheme, and a critical scheme. **Conclusion:** Parents reported reliance on the scheme for their child's basic daily care and a more enriched life for their child and family. Parents were grateful for the scheme but experienced inconsistencies, navigation difficulties, and variable choice and control. Most parents had fears about the sustainability of the scheme, translating into uncertainty about their child's future. Allied health professionals, including occupational therapists, are key advocates for children with complex disability and their families. Collaboration through sharing knowledge and skills to support children, their families, and carers is key to empowering parents to navigate the NDIS.

PMID: [38839565](#)

19. Cross-cultural adaptation of the Rotterdam Transition Profile to Brazilian Portuguese: measuring autonomy in participation of Brazilian youth with cerebral palsy

Gabriela Rovai, Camila Araújo Santos Santana, Marina de Brito Brandão, Ana Carolina de Campos

Braz J Phys Ther. 2024 May 21;28(3):101080. doi: 10.1016/j.bjpt.2024.101080. Online ahead of print.

Background: Autonomy in participation of young adults with cerebral palsy (CP) is not well understood due to the lack of appropriate instruments, especially for the Brazilian population. The Rotterdam Transition Profile (RTP) categorizes autonomy in Participation (education, employment, finances, housing, leisure, intimate relationships, sexuality, transportation) and Health Services (care demands, services and aids, and rehabilitation services) domains. **Objectives:** To cross-culturally adapt the RTP for use in Brazil, and to describe the levels of autonomy in participation and associated factors of Brazilian youth with CP. **Methods:** RTP was translated and content validity was investigated through an expert panel (n = 4 researchers and n = 4 clinicians); 30 adolescents and young adults with CP provided data for construct validity and internal consistency analysis. To analyze influencing factors, 56 youth with CP, mean age 25 years (SD = 6.9 years), with good cognitive level remotely responded to the RTP, sociodemographic information, and functional classifications (gross motor, manual ability). **Results:** Following translation, content and construct validity were established, with changes made to improve the clarity of items. Cronbach's alpha (0.82) was considered good and test-reliability was fair to good for most items. High levels of autonomy were found in the areas of Leisure and Rehabilitation, with the lowest proportion of participants with autonomy in Housing, Intimate Relationships, and Finances. Autonomy in participation was associated with age, gross motor and manual ability classifications, and with context-related factors. **Conclusion:** The Brazilian Portuguese version of the RTP was considered valid and reliable. Findings will support transition planning for young people with CP.

PMID: [38848627](#)

20. The effects of MEPaL on oxidative stress and motor function in the rats affected by prenatal hypoxia

Hadis Nasri, Zohreh Ghotbeddin, Kaveh Rahimi, Mohammad Reza Tabandeh

Brain Behav. 2024 Jun;14(6):e3539. doi: 10.1002/brb3.3539.

Background and objectives: Maternal hypoxia disrupts neural development and subsequently leads to cerebral palsy and epilepsy in newborns. Hypoxia plays a role in neurodegeneration by increasing oxidative stress. *Pistacia atlantica* is known as an important antioxidant, and its anti-inflammatory and antioxidant effects have been shown in various studies. This study aims to investigate the effects of methanolic extract of *P. atlantica* leaves (MEPaLs) on the oxidative parameters in the serum of rats affected by maternal hypoxia. **Material and methods:** In this study, eight pregnant rats were used. The newborns were divided into four groups, including the control and the hypoxia groups, which are affected by maternal hypoxia, hypoxia + MEPaL 100 mg/kg, and hypoxia + MEPaL 150 mg/kg. MEPaL was injected (i.p) for 21 days into the neonatal rats after the lactation period. Hypoxia was induced by keeping pregnant rats in a hypoxic chamber with 7% oxygen and 93% nitrogen intensity for 3 h on the 20th day of pregnancy. Behavioral changes were measured using open-field and rotarod tests. Finally, biomarkers of oxidative stress, nitric oxide (NO), glutathione (GSH), GSSG, TAS, TOS, and oxidative stress index (OSI) were measured in the experimental groups. **Results:** Behavioral results showed that the anxiety behavior in the hypoxia group increased, but the motor activity (moved distance and movement speed) decreased. Moreover, the amount of time spent maintaining balance on the rotarod rod was significantly decreased in the hypoxia group. The concentration of NO in the group of hypoxia + MEPaL 100 mg/kg showed a significant decrease, and MEPaL 100, and 150 mg/kg + hypoxia also increased the concentration of GSH and decreased GSSG. In addition, MEPaL100 and 150 mg/kg caused a significant increase in the ratio of GSH to GSSG and decreased OSI and total oxidant capacity. **Conclusions:** Oxidative stress increased in the rats affected by maternal hypoxia and may be the main mechanism for motor activity impairment and balance disturbance, whereas MELaL improved motor performance by decreasing oxidative stress.

PMID: [38849974](#)

21. Neuroimaging and Neurological Outcomes in Perinatal Arterial Ischemic Stroke: A Systematic Review and Meta-Analysis

Lisa Pabst, Catherine R Hoyt, Ryan J Felling, Alyssa E Smith, Karen Harpster, Andrea C Pardo, Jeffrey A Bridge, Bin Jiang, Alison Gehred, Warren Lo

Pediatr Neurol. 2024 May 8;157:19-28. doi: 10.1016/j.pediatrneurol.2024.04.029. Online ahead of print.

Background: Prediction of outcomes in perinatal arterial ischemic stroke (PAIS) is challenging. We performed a systematic review and meta-analysis to determine whether infarct characteristics can predict outcomes in PAIS. **Methods:** A systematic search was conducted using five databases in January 2023. Studies were included if the sample included children with neonatal or presumed PAIS; if infarct size, location, or laterality was indicated; and if at least one motor, cognitive, or language outcome was reported. The level of evidence and risk of bias were evaluated using the Risk of Bias in Non-Randomized Studies of Interventions tool. Meta-analyses were conducted comparing infarct size or location with neurological outcomes when at least three studies could be analyzed. **Results:** Eighteen full-text articles were included in a systematic review with nine included in meta-analysis. Meta-analyses revealed that small strokes were associated with a lower risk of cerebral palsy/hemiplegia compared with large strokes (risk ratio [RR] = 0.263, P = 0.001) and a lower risk of epilepsy (RR = 0.182, P < 0.001). Middle cerebral artery (MCA) infarcts were not associated with a significantly different risk of cerebral palsy/hemiplegia compared with non-MCA strokes (RR = 1.220, P = 0.337). Bilateral infarcts were associated with a 48% risk of cerebral palsy/hemiplegia, a 26% risk of epilepsy, and a 58% risk of cognitive impairment. **Conclusions:** Larger stroke size was associated with worse outcomes across multiple domains. Widely heterogeneous reporting of infarct characteristics and outcomes limits the comparison of studies and the analysis of outcomes. More consistent reporting of infarct characteristics and outcomes will be important to advance research in this field.

PMID: [38848613](#)

22. White matter characteristics in children with cerebral palsy prior to selective dorsal rhizotomy: a multicenter diffusion tensor imaging study

Weihong Yuan, Charles B Stevenson, Paolo Moretti, Francesco T Mangano, Marco Pavanello, Armando Cama, Domenico Tortora, Chiara Tacchino, Amy F Bailes, Kelly R Greve, Jilda N Vargus-Adams, Jonathan A Dudley, Karen Harpster, Brad G Kurowski, Alexis Mitelputk, Bruce Aronow

J Neurosurg Pediatr. 2024 Jun 7:1-10. doi: 10.3171/2024.4.PEDS23589. Online ahead of print.

Objective: The aims of this study were to 1) assess and quantify white matter (WM) microstructural characteristics derived from diffusion tensor imaging (DTI) in children with cerebral palsy (CP) prior to selective dorsal rhizotomy (SDR), and 2) investigate potential associations between WM diffusion properties and gross motor function and spasticity in children with

spastic CP who underwent SDR. Methods: This study is a multisite study based on DTI images acquired prior to SDR as well as postoperative outcome data. DTI data collected from two sites were harmonized using the ComBat approach to minimize intersite scanner difference. The DTI abnormalities between children with spastic CP and controls were analyzed and correlated with the severity of impaired mobility based on the Gross Motor Function Classification System (GMFCS). The improvement in gross motor function and spasticity after SDR surgery was assessed utilizing the Gross Motor Function Measure-66 (GMFM-66), the Modified Tardieu Scale (MTS), and the modified Ashworth scale (MAS). Alterations in these outcome measures were quantified in association with DTI abnormalities. Results: Significant DTI alterations, including lower fractional anisotropy (FA) in the genu of the corpus callosum (gCC) and higher mean diffusivity (MD) in the gCC and posterior limb of the internal capsule (PLIC), were found in children in the SDR group when compared with the age-matched control group (all $p < 0.05$). Greater DTI alterations (FA in gCC and MD in gCC and PLIC) were associated with lower mobility levels as determined based on GMFCS level ($p < 0.05$). The pre- to post-SDR improvement in motor function based on GMFM-66 was statistically significant ($p = 0.006$ and 0.002 at 6-month and 12-month follow-ups, respectively). The SDR efficacy was also identified as improving spasticity in lower-extremity muscle groups assessed with the MTS and MAS. Partial correlation analysis presented a significant association between pre- to post-SDR MTS alteration and DTI abnormalities. Conclusions: The findings in the present study provided initial quantitative evidence to establish the WM microstructural characteristics in children with spastic CP prior to SDR surgery. The study generated data for the association between baseline DTI characteristics and mobility in children with CP prior to SDR surgery. The study also demonstrated SDR efficacy in improving motor function and spasticity based on the GMFM-66, MTS, and MAS, respectively, in association with DTI data.

PMID: [38848583](#)

23. Software and equations using segmental measures to estimate height in children and adolescents with cerebral palsy considering the level of gross motor function

Mercedes Ruiz Brunner, Maria Elisabeth Cieri, Ruben A Lucero Brunner, Ana Laura Condinanzi, Carla Gil, Eduardo Cuestas

Clin Nutr ESPEN. 2024 May 23;62:234-240. doi: 10.1016/j.clnesp.2024.05.014. Online ahead of print.

Background & aims: In children with Cerebral palsy (CP) bone deformities create a difficulty in the collection of height measures by direct methods. Body segments are an alternative to study for anthropometric evaluation in children with CP. Motor compromise affects growth in these children. To our knowledge, no equations have been developed to estimate height that consider the level of involvement of children with CP. The aim was to develop equations to estimate height using segmental measures for children with cerebral palsy (CP). Methods: This was a cross-sectional study. The sample consisted of children and adolescents with CP of both sexes from 2 to 19 years old from five cities in Argentina. Children whose height and knee-heel height (KH) could be measured were included. Height, KH, and clinical covariables were collected. Linear regression models with height as the dependent variable and KH as predictors adjusted for significant covariates were developed and compared for R², adjusted R², and the root mean square of the error. Results: 242 children and adolescents (mean age 9 ± 4 years) with a confirmed diagnosis of CP were included. The interaction between height and other variables such KH, sex, GMFCS, and age was analyzed. Two equations were developed to estimate height according to GMFCS level (GMFCS Level I-III: $H = 1.5 \times KH(\text{cm}) + 2.28 \times \text{age}(\text{years}) + 51$; GMFCS Level IV-V: $H = 2.13 \times KH(\text{cm}) + 0.91 \times \text{age}(\text{years}) + 37$). The concordance correlation coefficient between estimated and observed height was 0.95 (95%CI [0.94; 0.96]). Conclusion: Height in children and adolescents with CP can be predicted using KH, GMFCS, and age. The equations and software can estimate height when this cannot be obtained directly.

PMID: [38848220](#)

24. [Research progress on the dynamic role and intervention value of autophagy in neonatal hypoxic-ischemic brain damage] [Article in Chinese]

Yue He, Yuyuan Liu, Zhifeng Wu

Review Zhonghua Wei Zhong Bing Ji Jiu Yi Xue. 2024 May;36(5):552-556. doi: 10.3760/cma.j.cn121430-20231022-00891.

The repair of the nervous system after hypoxic-ischemic brain damage (HIBD) in neonates lacks specific therapeutic approaches, posing a challenge and hot topic in the medical field. Autophagy, as a cellular self-repair mechanism, plays a role through different signaling pathways at different stages, yet its specific roles and mechanisms in different stages of HIBD remain unclear. This article reviews the recent research advancements on autophagy in different neonatal HIBD stages: heightened autophagic activity manifests during the acute hypoxic-ischemic phase, with its neuroprotective or deleterious impact subject to ongoing debate; during the subacute and chronic phases, autophagy exert dual effects on neuronal death and repair; in sequelae period, autophagy-related studies are still insufficient, but the expression levels of autophagy-related genes (ATG) in children with cerebral palsy suggest both positive and negative aspects of autophagy post-HIBD. Collectively, optimal autophagic flux facilitates the elimination of detrimental substrates and toxic proteins, thereby engendering neuroprotection. Further studies on the roles and mechanisms of autophagy in HIBD therapy holds promise for devising efficacious preventative and therapeutic strategies rooted in autophagy, and to improve the survival rate and quality of life of the children.

PMID: [38845506](#)

25. Parents' experiences of participating in the Small Step early intervention program for infants at high risk of cerebral palsy: essential components and potential dilemmas

Ann-Kristin G Elvrum, Ann-Christin Eliasson, Silja Berg Kårstad, Rannei Sæther, Sylvia Söderström

Disabil Rehabil. 2024 Jun 7:1-9. doi: 10.1080/09638288.2024.2362394. Online ahead of print.

Materials and methods: Thirteen parents (eight mothers and five fathers) of ten children participated in this qualitative study through individual in-depth interviews. Transcripts were analysed using reflexive thematic analysis. Results: The parents emphasized the advantage of having the intervention provided at home with coaching and flexible support from the interprofessional team of therapists. This assured the families and enhanced their capacity to provide the child with playful and enriched learning opportunities integrated in everyday life. However, identification of achievable goals and intervention delivery could be emotionally taxing for parents, especially in the early stages and if treatment effects were below hopes and expectations. Conclusions: Our findings provide insights into what kind of support parents prefer and dilemmas professionals should be aware of when providing early intervention to families of infants at high risk of CP. Parents appreciated being involved as equal partners and receiving home-based guidance. Acknowledging grief and sorrow as natural reactions and fostering open discussions about expectations seem essential in addressing families' individual needs.

PMID: [38845420](#)

26. The dual effect of vagus nerve stimulation in pediatric patients with drug-resistant epilepsy: Is there more than seizure control?

Mohamed Ashraf Mahmoud, Omnia El Rashidi, George Halim, Mohamed Amgad Elkholy, Osama Aglan, Abdel Rahman El Sabbagh, Ahmed Kamel Basha, Hussein Hamdi, Ahmed M El Sayed, Dina Amin Saleh, R H Shatla, Walid Abdel Ghany

Epilepsy Behav Rep. 2024 Feb 12:27:100653. doi: 10.1016/j.ebr.2024.100653. eCollection 2024.

This is a retrospective and comparative pilot study to investigate the role of vagus nerve stimulation (VNS) in improving cognitive functions in the pediatric age group with drug resistant epilepsy (DRE). It was conducted from January 2018 to February 2023. Children between the ages of 4 and 18 years were divided into two groups, the "VNS group" and the "best medical treatment (BMT) group". Follow up period was 12 months. Demographic, clinical, etiological and investigational data were recorded. Cognitive assessment using the Modified Mini-Mental State Examination for children (MMSE) was recorded at baseline and 12 months later for each group. 76.4 % of patients were classified as epilepsy secondary to cerebral palsy. 75 % of patients showed ≥ 50 % seizure frequency reduction among the VNS group as compared to 12.5 % in the BMT group. None of both groups achieved seizure freedom. At 12 months, both BMT and VNS groups showed statistically significantly improved overall cognitive score from baseline records ($p = 0.027$) and ($p = 0.012$), respectively, with a significantly higher improvement in VNS group. Also, statistical sub-analysis of cognitive subscales in cerebral palsy patients in both groups was conducted and revealed a significant improvement ($p = 0.02$) in the VNS group. We concluded that there is a potential role of VNS in improving cognitive functions which was shown by using a cost-effective screening tool. A significant effect was observed specially in cerebral palsy patients. This is very beneficial in limited-resources countries since VNS has good safety profile, high seizure control, and added value to cognitive functions.

PMID: [38841319](#)

27. Enhancing understanding and optimizing outcomes: insights from selective dorsal rhizotomy in pediatric cerebral palsy

Rui Wang, Wenbin Jiang, Min Wei, Junlu Wang, Xidan Yu, Bo Xiao, Qijia Zhan

Transl Pediatr. 2024 May 31;13(5):873-874. doi: 10.21037/tp-24-106. Epub 2024 May 27.

No abstract available

PMID: [38840686](#)

28. Before selective dorsal rhizotomy can be judged as beneficial for cerebral palsy, long-term results and controlled studies are needed

Walter Strobl, Josef Finsterer

Comment Transl Pediatr. 2024 May 31;13(5):875-876. doi: 10.21037/tp-24-63. Epub 2024 May 28.

No abstract available

Comment on

Short-term change of tibial torsion in children with spastic cerebral palsy after selective dorsal rhizotomy.

Wang R, Jiang W, Wei M, Wang J, Yu X, Xiao B, Zhan Q.

Transl Pediatr. 2023 Dec 26;12(12):2131-2141. doi: 10.21037/tp-23-339. Epub 2023 Dec 22.

PMID: 38197108

PMID: [38840679](#)

29. Brain MRI Injury Patterns across Gestational Age among Preterm Infants with Perinatal Asphyxia

Corline E J Parmentier, Loubna El Bakkali, Elise A Verhagen, Sylke J Steggerda, Thomas Alderliesten, Maarten H Lequin, Laura A van de Pol, Manon J N L Benders, Frank van Bel, Corine Koopman-Esseboom, Timo R de Haan, Linda S de Vries, Floris Groenendaal

Neonatology. 2024 Jun 5:1-11. doi: 10.1159/000538986. Online ahead of print.

Introduction: Brain injury patterns of preterm infants with perinatal asphyxia (PA) are underreported. We aimed to explore brain magnetic resonance imaging (MRI) findings and associated neurodevelopmental outcomes in these newborns. **Methods:** Retrospective multicenter study included infants with gestational age (GA) 24.0-36.0 weeks and PA, defined as ≥ 2 of the following: (1) umbilical cord pH ≤ 7.0 , (2) 5-min Apgar score ≤ 5 , and (3) fetal distress or systemic effects of PA. Findings were compared between GA ≤ 28.0 (group 1), 28.0-31.9 (group 2), and 32.0-36.0 weeks (group 3). Early MRI (≤ 36 weeks postmenstrual age or ≤ 10 postnatal days) was categorized according to predominant injury pattern, and MRI around term-equivalent age (TEA, 36.0-44.0 weeks and ≥ 10 postnatal days) using the Kidokoro score. Adverse outcomes included death, cerebral palsy, epilepsy, severe hearing/visual impairment, or neurodevelopment ≤ -1 SD at 18-24 months corrected age. **Results:** One hundred nineteen infants with early MRI (n = 94) and/or MRI around TEA (n = 66) were included. Early MRI showed predominantly hemorrhagic injury in groups 1 (56%) and 2 (45%), and white matter (WM)/watershed injury in group 3 (43%). Around TEA, WM scores were highest in groups 2 and 3. Deep gray matter (DGM) (aOR 15.0, 95% CI: 3.8-58.9) and hemorrhagic injury on early MRI (aOR 2.5, 95% CI: 1.3-4.6) and Kidokoro WM (aOR 1.3, 95% CI: 1.0-1.6) and DGM sub-scores (aOR 4.8, 95% CI: 1.1-21.7) around TEA were associated with adverse neurodevelopmental outcomes. **Conclusion:** The brain injury patterns following PA in preterm infants differ across GA. Particularly DGM abnormalities are associated with adverse neurodevelopmental outcomes.

PMID: [38838655](#)

30. Physician Approaches to the Pharmacologic Treatment of Dystonia in Cerebral Palsy

Emma Lott, Darcy Fehlings, Rose Gelineau-Morel, Michael Krueer, Jonathan W Mink, Sruthi P Thomas, Steve Wisniewski, Bhooma Aravamuthan; Cerebral Palsy Research Network

Pediatrics. 2024 Jun 5:e2023065512. doi: 10.1542/peds.2023-065512. Online ahead of print.

No abstract available

PMID: [38836309](#)

31. Motor network dynamic resting state fMRI connectivity of neurotypical children in regions affected by cerebral palsy

Varina L Boerwinkle, Bethany L Sussman, Laura de Lima Xavier, Sarah N Wyckoff, William Reuther, Michael C Krueer, Martin Arhin, Justin M Fine

Front Hum Neurosci. 2024 May 21:18:1339324. doi: 10.3389/fnhum.2024.1339324. eCollection 2024.

Background: Normative childhood motor network resting-state fMRI effective connectivity is undefined, yet necessary for translatable dynamic resting-state-network-informed evaluation in pediatric cerebral palsy. **Methods:** Cross-spectral dynamic causal modeling of resting-state-fMRI was investigated in 50 neurotypically developing 5- to 13-year-old children. Fully connected six-node network models per hemisphere included primary motor cortex, striatum, subthalamic nucleus, globus pallidus internus, thalamus, and contralateral cerebellum. Parametric Empirical Bayes with exhaustive Bayesian model reduction and Bayesian modeling averaging informed the model; Purdue Pegboard Test scores of hand motor behavior were the covariate at the group level to determine the effective-connectivity-functional behavior relationship. **Results:** Although both hemispheres exhibited similar effective connectivity of motor cortico-basal ganglia-cerebellar networks, magnitudes were slightly greater on the right, except for left-sided connections of the striatum which were more numerous and of opposite

polarity. Inter-nodal motor network effective connectivity remained consistent and robust across subjects. Age had a greater impact on connections to the contralateral cerebellum, bilaterally. Motor behavior, however, affected different connections in each hemisphere, exerting a more prominent effect on the left modulatory connections to the subthalamic nucleus, contralateral cerebellum, primary motor cortex, and thalamus. Discussion: This study revealed a consistent pattern of directed resting-state effective connectivity in healthy children aged 5-13 years within the motor network, encompassing cortical, subcortical, and cerebellar regions, correlated with motor skill proficiency. Both hemispheres exhibited similar effective connectivity within motor cortico-basal ganglia-cerebellar networks reflecting inter-nodal signal direction predicted by other modalities, mainly differing from task-dependent studies due to network differences at rest. Notably, age-related changes were more pronounced in connections to the contralateral cerebellum. Conversely, motor behavior distinctly impacted connections in each hemisphere, emphasizing its role in modulating left sided connections to the subthalamic nucleus, contralateral cerebellum, primary motor cortex, and thalamus. Motor network effective connectivity was correlated with motor behavior, validating its physiological significance. This study is the first to evaluate a normative effective connectivity model for the pediatric motor network using resting-state functional MRI correlating with behavior and serves as a foundation for identifying abnormal findings and optimizing targeted interventions like deep brain stimulation, potentially influencing future therapeutic approaches for children with movement disorders.

PMID: [38835646](#)

32. Care for children and youth with cerebral palsy (GMFCS levels III to V) [Article in English, English]

Scott McLeod, Amber Makino, Anne Kawamura

Review Paediatr Child Health. 2024 May 31;29(3):189-196. doi: 10.1093/pch/pxae003. eCollection 2024 Jun.

Cerebral palsy (CP) is the most common physical disability in Canadian children. The comprehensive care of ambulatory children with CP functioning at Gross Motor Function Classification System (GMFCS) level I and II was covered in a previous practice point. This companion document focuses on the care of children with CP functioning at GMFCS levels III to V. Children functioning at GMFCS level III and IV mobilize using devices such as a walker, canes, or powered mobility, while those functioning at GMFCS level V require assisted mobility, such as a manual wheelchair. An overview of key concepts in early detection, rehabilitation services, and therapeutic options for children with CP at these levels is provided, along with practical resources to assist health surveillance for paediatricians caring for this population.

PMID: [38827366](#)

33. Current approach to cerebral palsy

Anna Saranti, Pinelopi Dragoumi, Antigone Papavasiliou, Dimitrios Zafeiriou

Review Eur J Paediatr Neurol. 2024 May 31:51:49-57. doi: 10.1016/j.ejpn.2024.05.015. Online ahead of print.

This teaching review aims to provide an overview of the current approach to children with cerebral palsy (CP), retrieving the best available evidence and summarizing existing knowledge in the field of CP in children. We also highlight areas where more research is needed and novel strategies for diagnosing and treating cerebral palsy. CP includes a group of permanent disorders of movement and posture that cause activity limitation. Multiple risk factors, occurring preconceptionally, prenatally, perinatally, or postneonatically, are involved in the pathogenesis of CP, with the prenatal ones accounting for 80-90 % of cases. Due to its heterogeneity, CP has various classifications, but usually is classified based on clinical findings and motor impairment. Standardized function classification systems have been developed to address inconsistencies in previous classifications. The combination of clinical assessment and validated predictive tools is recommended for an early diagnosis, which is important for early intervention and prevention of secondary impairments. The therapeutic regimen in CP involves prevention and management of the motor and associated problems. It includes the enhancement of motor performance, the enrichment of cognition and communication skills, the prevention of secondary impairments, and the support of parents and caregivers. The care of CP children demands a multidisciplinary approach focused on improving motor skills, reducing comorbidities, enhancing the quality of life, and prolonging survival.

PMID: [38824721](#)

34. Case-based explanation of standard work tools for selective dorsal rhizotomy for cerebral palsy

Nathan A Shlobin, Med Jimson D Jimenez, Maryam N Shahin, Lindsey Hofflander, Robin Trierweiler, Jennifer Misasi, Joshua M Rosenow, Ana-Marie Rojas, Jeffrey S Raskin

Case Reports Neurosurg Focus. 2024 Jun;56(6):E5. doi: 10.3171/2024.3.FOCUS2468.

Objective: Spasticity is a challenging feature of cerebral palsy (CP) that may be managed with selective dorsal rhizotomy

(SDR). Although standard work tools (SWTs) have recently been utilized to inform a standard of care for neurosurgical procedures, no SWTs for SDR have been previously described. The authors present the multidisciplinary approach SWTs for SDR used at their institutions to promote consistency in the field and minimize complication rates. **Methods:** A multidisciplinary approach was used to define all steps in the SDR pathway. Preoperative, intraoperative, and postoperative workflows were synthesized, with specific efforts to improve mobility through inpatient rehabilitation and minimize infection. **Results:** The SWTs have been implemented at two institutions for 7 years. An illustrative case of a patient aged 3 years 10 months with a history of premature birth at 29 weeks, spastic-diplegic CP, right-sided periventricular leukomalacia, and developmental delay who underwent L2-S1 SDR is presented. **Conclusions:** The authors detail SWTs for SDR developed by a multidisciplinary team with specific steps at all points in the patient pathway. The illustrative case emphasizes that SWTs may help ensure the safety of SDR while maximizing its long-term efficacy for individuals with CP.

PMID: [38823046](#)

35. Palliative single-level selective dorsal rhizotomy for children with spastic cerebral palsy Gross Motor Function Classification System level IV and V: a case series and systematic review of the literature

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Case Reports Neurosurg Focus. 2024 Jun;56(6):E6. doi: 10.3171/2024.3.FOCUS2478.

Objective: Single-level selective dorsal rhizotomy (SDR), typically indicated for ambulatory patients, is a controversial topic for severe spastic cerebral palsy (CP) with Gross Motor Function Classification System (GMFCS) level IV or V. The objective of this case series and systematic literature review was to outline the indication and outcome of palliative SDR for nonambulatory patients with CP and GMFCS level IV and V, focusing on improvement of spasticity and of patient and caregiver reported quality of life assessment. **Methods:** A retrospective case series of patients with CP and GMFCS level IV or V who underwent single-level SDR at the authors' institution is presented. Furthermore, two databases (PubMed and Embase) were searched and a systematic review with a search string based on the terms "selective dorsal rhizotomy," "cerebral palsy," and "outcome" was conducted. The primary outcome was the reduction of spasticity based on the modified Ashworth scale (MAS). Secondary outcomes were change on the Gross Motor Function Measure-66 (GMFM-66), evaluation of patient-reported outcome measures (PROMs), surgical morbidity, and mortality. **Results:** Eleven consecutive children under the age of 25 years undergoing palliative single-level SDR were included. All patients showed a reduction in MAS score (mean 1.09 ± 0.66 points) and no surgical morbidity and mortality occurred. For the systematic review results from our case series, in addition to 4 reports, 274 total patients were included. Reduction of spasticity based on MAS score was noted in all studies (mean range 1.09-3.2 points). Furthermore, in 2 studies spasticity of the upper extremities showed a MAS score reduction as well (range 1.7-2.8 points). The GMFM-66 score improved in 72% of the patients, while bladder function improved in 78% of the patients. Based on the PROMs, 92% of the patients/caregivers were satisfied with the outcome and their quality of life after the procedure. Two wound infections (2.7%) and one CSF leak (1.3%) occurred, while no surgery-related deaths were described. **Conclusions:** This analysis showed an improvement in spasticity, daily care, and comfort for patients with CP and GMFCS levels IV and V. Larger cohorts analyzing the outcome of palliative single-level SDR, based on the MAS, GMFM-66, and PROMs, are still needed and should be the focus of future studies. Systematic review registration no.: CRD42024495762 (<https://www.crd.york.ac.uk/prospero/>).

PMID: [38823044](#)

36. History and evolution of surgical treatment for spasticity: a journey from neurotomy to selective dorsal rhizotomy

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Review Neurosurg Focus. 2024 Jun;56(6):E2. doi: 10.3171/2024.3.FOCUS2452.

The evolution of neurosurgical approaches to spasticity spans centuries, marked by key milestones and innovative practitioners. Probable ancient descriptions of spasmodic conditions were first classified as spasticity in the 19th century through the interventions of Dr. William John Little on patients with cerebral palsy. The late 19th century witnessed pioneering efforts by surgeons such as Dr. Charles Loomis Dana, who explored neurotomies, and Dr. Charles Sherrington, who proposed dorsal rhizotomy to address spasticity. Dorsal rhizotomy rose to prominence under the expertise of Dr. Otfried Foerster but saw a decline in the 1920s due to emerging alternative procedures and associated complications. The mid-20th century saw a shift toward myelotomy but the revival of dorsal rhizotomy under Dr. Claude Gros' selective approach and Dr. Marc Sindou's dorsal root entry zone (DREZ) lesioning. In the late 1970s, Dr. Victor Fasano introduced functional dorsal rhizotomy, incorporating electrophysiological evaluations. Dr. Warwick Peacock and Dr. Leila Arens further modified selective dorsal rhizotomy, focusing on approaches at the cauda equina level. Later, baclofen delivered intrathecally via an implanted programmable pump emerged as a promising alternative around the late 1980s, pioneered by Richard Penn and Jeffrey Kroin and then led by A. Leland Albright. Moreover, intraventricular baclofen has also been tried in this matter. The evolution of these neurosurgical interventions highlights the dynamic nature of medical progress, with each era building upon and refining the work of significant individuals, ultimately contributing to successful outcomes in the management of spasticity.

PMID: [38823043](#)

Prevention and Cure

37. Magnesium Sulfate Before Preterm Birth for Neuroprotection: An Updated Cochrane Systematic Review

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Obstet Gynecol. 2024 Jun 3. doi: 10.1097/AOG.0000000000005644. Online ahead of print.

Objective: To systematically review the evidence for the effectiveness and safety of magnesium sulfate as a fetal neuroprotective agent when given to individuals at risk of preterm birth. **Data sources:** We searched Cochrane Pregnancy and Childbirth's Trials Register, ClinicalTrials.gov, the World Health Organization International Clinical Trials Registry Platform (through March 17, 2023), and reference lists of relevant studies. **Methods of study selection:** Randomized controlled trials (RCTs) assessing magnesium sulfate for fetal neuroprotection in pregnant participants at risk of imminent preterm birth were eligible. Two authors assessed RCTs for inclusion, extracted data, and evaluated risk of bias, trustworthiness, and evidence certainty (GRADE [Grading of Recommendations Assessment, Development and Evaluation]). **Tabulation, integration, and results:** We included six RCTs (5,917 pregnant participants and 6,759 fetuses at less than 34 weeks of gestation at randomization). They were conducted in high-income countries (two in the United States, two across Australia and New Zealand, and one each in Denmark and France) and commenced between 1995 and 2018. **Primary outcomes:** up to 2 years of corrected age, magnesium sulfate compared with placebo reduced the risk of cerebral palsy (risk ratio [RR] 0.71, 95% CI, 0.57-0.89; six RCTs, 6,107 children) and death or cerebral palsy (RR 0.87, 95% CI, 0.77-0.98; six RCTs, 6,481 children) (high-certainty evidence). Magnesium sulfate had little or no effect on death up to 2 years of corrected age (moderate-certainty evidence) or these outcomes at school age (low-certainty evidence). Although there was little or no effect on death or cardiac or respiratory arrest for pregnant individuals (low-certainty evidence), magnesium sulfate increased adverse effects severe enough to stop treatment (RR 3.21, 95% CI, 1.88-5.48; three RCTs, 4,736 participants; moderate-certainty evidence). **Secondary outcome:** magnesium sulfate reduced the risk of severe neonatal intraventricular hemorrhage (moderate-certainty evidence). **Conclusion:** Magnesium sulfate for preterm fetal neuroprotection reduces cerebral palsy and death or cerebral palsy for children. Further research is required on longer-term benefits and harms for children, effect variation by participant and treatment characteristics, and the generalizability of findings to low- and middle-income countries. **Systematic review registration:** The review protocol was based on a standard Cochrane Pregnancy and Childbirth template and our previous Cochrane Systematic Review (doi: 10.1002/14651858.CD004661.pub3; published before the introduction of PROSPERO).

PMID: [38830233](#)