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Interventions and Management

1. The Etiology of Neuromuscular Hip Dysplasia and Implications for Management: A Narrative Review

Ana Presedo, Erich Rutz, Jason J Howard, Michael Wade Shrader, Freeman Miller

Review Children (Basel). 2024 Jul 11;11(7):844. doi: 10.3390/children11070844.

This study summarizes the current knowledge of the etiology of hip dysplasia in children with neuromuscular disease and the implications for management. This article is based on a review of development of the hip joint from embryology through childhood growth. This knowledge is then applied to selective case reviews to show how the understanding of these developmental principles can be used to plan specific treatments. The development of the hip joint is controlled by genetic shape determination, but the final adult shape is heavily dependent on the mechanical environment experienced by the hip joint during growth and development. Children with neuromuscular conditions show a high incidence of coxa valga, hip dysplasia, and subluxation. The etiology of hip pathology is influenced by factors including functional status, muscular tone, motor control, child's age, and muscle strength. These factors in combination influence the development of high neck-shaft angle and acetabular dysplasia in many children. The hip joint reaction force (HJRF) direction and magnitude determine the location of the femoral head in the acetabulum, the acetabular development, and the shape of the femoral neck. The full range of motion is required to develop a round femoral head. Persistent abnormal direction and/or magnitude of HJRF related to the muscular tone can lead to a deformed femoral head and a dysplastic acetabulum. Predominating thigh position is the primary cause defining the direction of the HJRF, leading to subluxation in nonambulatory children. The magnitude and direction of the HJRF determine the acetabular shape. The age of the child when these pathomechanics occur acts as a factor increasing the risk of hip subluxation. Understanding the risk factors leading to hip pathology can help to define principles for the management of neurologic hip impairment. The type of neurologic impairment as defined by functional severity assessed by Gross Motor Function Classification System and muscle tone can help to predict the risk of hip joint deformity. A good understanding of the biomechanical mechanisms can be valuable for treatment planning.

PMID: 39062293

2. Muscle Mass as a Biomarker for Health Status and Function in Pediatric Individuals with Neuromuscular Disabilities: A Systematic Review

Isabella R Ferrara, Cristina L Sadowsky

Review Children (Basel). 2024 Jul 3;11(7):815. doi: 10.3390/children11070815.

This systematic review aims to investigate the relationship between muscle mass and specific health outcomes in pediatric populations with neuromuscular disorders. A search was performed for any relevant studies published in English from 1996 to 2023 in five databases. To be included in this analysis, articles must have had participants with an average age ≤21, focus on children with neuromuscular disabilities, and primarily examine relationships between muscle mass and any functional or health outcomes measure. Studies including typically developing children were used to contrast and enhance findings. Thirty-two studies were included, with 10,129 unique individuals represented: seventeen studies focused on healthy/typically developing children; seven on children with cerebral palsy; three on children with Duchenne muscular dystrophy; two on children with sarcopenia; and one study each on children with osteoporosis, congenital muscular dystrophy, and other various neurologic disorders. Thirteen studies assessed functional outcomes, ten assessed bone outcomes, and nine assessed other cardiovascular/metabolic outcomes. All of the included studies demonstrated relationships between muscle mass and respective outcomes in varying measures. The results of this review demonstrate that there is a consistently recognized relationship between muscle mass and important health outcomes in children, supporting clinically targeting muscle mass as a means to optimize desired outcomes.

PMID: 39062264

3. Overground Gait Training With a Wearable Robot in Children With Cerebral Palsy: A Randomized Clinical Trial

Ja Young Choi, Seung Ki Kim, Juntaek Hong, Hankyul Park, Shin-Seung Yang, Dongho Park, Min-Keun Song

Randomized Controlled Trial JAMA Netw Open. 2024 Jul 1;7(7):e2422625. doi: 10.1001/jamanetworkopen.2024.22625.

Importance: Cerebral palsy (CP) is the most common developmental motor disorder in children. Robot-assisted gait training (RAGT) using a wearable robot can provide intensive overground walking experience. Objective: To investigate the effectiveness of overground RAGT in children with CP using an untethered, torque-assisted, wearable exoskeletal robot. Design, setting, and participants: This multicenter, single-blind randomized clinical trial was conducted from September 1, 2021, to March 31, 2023, at 5 rehabilitation institutions in Korea. Ninety children with CP in Gross Motor Function Classification System levels II to IV were randomized. Intervention: The RAGT group underwent 18 sessions of RAGT during 6 weeks, whereas the control group received standard physical therapy for the same number of sessions during the same period. Main outcome and measures: The primary outcome measure was the Gross Motor Function Measure 88 (GMFM-88) score. Secondary outcome measures were the GMFM-66, Pediatric Balance Scale, selective control assessment of the lower extremity, Pediatric Evaluation of Disability Inventory-Computer Adaptive Test (PEDI-CAT), 6-minute walking test scores (distance and oxygen consumption), muscle and fat mass via bioelectrical impedance analysis, and gait parameters measured via 3-dimensional analysis. All assessments were performed for all patients at baseline, at the end of the 6-week intervention, and after the 4-week follow-up. Results: Of the 90 children (mean [SD] age, 9.51 [2.48] years; 49 [54.4%] male and 41 [45.6%] female) in the study, 78 (86.7%) completed the intervention, with 37 participants (mean [SD] age, 9.57 [2.38] years; 19 [51.4%] male) and 41 participants (mean [SD] age, 9.32 [2.37] years; 26 [63.4%] male) randomly assigned to the RAGT and control groups, respectively. Changes in the RAGT group significantly exceeded changes in the control group in GMFM-88 total (mean difference, 2.64; 95% CI, 0.50-4.78), GMFM-E (mean difference, 2.70; 95% CI, 0.08-5.33), GMFM-66 (mean difference, 1.31; 95% CI, 0.01-2.60), and PEDI-CAT responsibility domain scores (mean difference, 2.52; 95% CI, 0.42-4.63), indicating independence in daily living at postintervention assessment. At the 4-week follow-up, the RAGT group showed significantly greater improvements in balance control (mean difference, 1.48; 95% CI, 0.03-2.94) and Gait Deviation Index (mean difference, 6.48; 95% CI, 2.77-10.19) compared with the control group. Conclusions and relevance: In this randomized clinical trial, overground RAGT using a wearable robot significantly improved gross motor function and gait pattern. This new torque-assisted wearable exoskeletal robot, based on assist-as-needed control, may complement standard rehabilitation by providing adequate assistance and therapeutic support to children with CP. Trial registration: CRIS Identifier: KCT0006273.

PMID: 39037815

4. Motor function and gait decline in individuals with cerebral palsy during adulthood: a narrative review of potential physiological determinants

Anders Gravholt, Bruno Fernandez, Hugo Bessaguet, Guillaume Y Millet, Annemieke I Buizer, Thomas Lapole

Review Eur J Appl Physiol. 2024 Jul 23. doi: 10.1007/s00421-024-05550-y. Online ahead of print.

Cerebral palsy (CP) is the most common childhood-onset disability. The evolution of gait according to severity is well known amongst children and thought to peak between 8 and 12 years of age among those walking without assistive devices. However, among adults, clinical experience as well as scientific studies report, through clinical assessments, questionnaires and interviews, increasing walking difficulties leading to an increased dependency of assistive devices in everyday ambulation. For many individuals with CP, this change will occur around 30-40 years, with the risk of losing mobility increasing with age. This narrative review aims to first provide objective evidence of motor function and gait decline in adults with CP when ageing, and then to offer mechanistic hypotheses to explain those alterations. Many studies have compared individuals with CP to the typically developing population, yet the evolution with ageing has largely been understudied. Comorbid diagnoses comprise one of the potential determinants of motor function and gait decline with ageing in people with CP, with the first manifestations happening at an early age and worsening with ageing. Similarly, ageing appears to cause alterations to the neuromuscular and cardiovascular systems at an earlier age than their typically developing (TD) peers. Future studies should, however, try to better understand how the physiological particularities of CP change with ageing that could pave the way for better strategies for maintaining function and quality of life in people with CP.

PMID: 39042142

5. Design of an SMA-Based Actuator for Replicating Normal Gait Patterns in Pediatric Patients with Cerebral Palsy

Paloma Mansilla Navarro, Dorin Copaci, Janeth Arias, Dolores Blanco Rojas

Biomimetics (Basel). 2024 Jun 21;9(7):376. doi: 10.3390/biomimetics9070376.

Cerebral Palsy refers to a group of incurable motor disorders affecting 0.22% of the global population. Symptoms are managed by physiotherapists, often using rehabilitation robotics. Exoskeletons, offering advantages over conventional therapies, are evolving to be more wearable and biomimetic, requiring new flexible actuators that mimic human tissue. The main objective behind this article is the design of a flexible exosuit based on shape-memory-alloy-based artificial muscles for pediatric patients that replicate the walking cycle pattern in the ankle joint. Thus, four shape-memory-alloy-based actuators were sewn to an exosuit at the desired actuation points and controlled by a two-level controller. The loop is closed through six inertial sensors that estimate the real angular position of both ankles. Different frequencies of actuation have been tested, along with the response of the actuators to different walking cycle patterns. These tests have been performed over long periods of time, comparing the reference created by a reference generator based on pediatric walking patterns and the response measured by the inertial sensors. The results provide important measurements concerning errors, working frequencies and cooling times, proving that this technology could be used in this and similar applications and highlighting its limitations.

PMID: 39056817

6. Does botulinum neurotoxin A make walking easier in children with cerebral palsy? A randomized clinical trial

Siri Merete Brændvik, Anne Elisabeth Ross Raftemo, Karin Roeleveld, Guro Lillemoen Andersen, Kjersti Ramstad, Turid Follestad, Ånen Aarli, Marcin Bonikowski, Torstein Vik; Walking Easier

Dev Med Child Neurol. 2024 Jul 26. doi: 10.1111/dmcn.16038. Online ahead of print.

Aim: To assess the effect of single botulinum neurotoxin A (BoNT-A) injections into the calf muscles on the gross energy cost of walking in children with cerebral palsy (CP) and to evaluate the effect of BoNT-A on walking capacity, physical activity, perceived changes in mobility, and pain. Method: This was an industry-independent, randomized, quadruple-blind, placebo-controlled, multicentre trial (ClinicalTrials.gov registration: NCT02546999). Sixty-one children (33 male, median age [range] = 8 years [4-16 years]) with spastic CP and classified in Gross Motor Function Classification System (GMFCS) levels I and II allocated to single injections of either BoNT-A or 0.9% saline into the calf muscles. The main outcome was gross energy cost (J/kg/m); secondary outcomes were walking capacity, habitual physical activity, perceived change in mobility tasks, and calf pain at baseline, 4 weeks (P1), 12 weeks (P2), and 24 weeks (P3) after the injection. Results: The mean change in energy cost did not differ significantly between groups at the primary time point P2 (-0.27 J/kg/m, 95% confidence interval - 0.91 to 0.36, p = 0.404), nor at P1 or P3. Regarding the secondary outcomes, there was some evidence of a larger reduction in pain intensity in the group given BoNT-A (p = 0.043). Interpretation: One treatment with BoNT-A was not superior to placebo in making walking easier in children with CP classified in GMFCS levels I and II, at least in the short term. BoNT-A may have a pain-reducing effect.

PMID: 39058740

7. Understanding Clinical Effectiveness and Safety Implications of Botulinum Toxin in Children: A Narrative Review of the Literature

Salvatore Crisafulli, Francesco Ciccimarra, Zakir Khan, Francesco Maccarrone, Gianluca Trifirò

Review Toxins (Basel). 2024 Jul 4;16(7):306. doi: 10.3390/toxins16070306.

Since its first approval by the Food and Drug Administration in 1989 for strabismus, botulinum toxin indications of use have been widely expanded. Due to its anticholinergic properties, this toxin is currently approved in adult patients for the treatment of a wide range of neuromuscular, otolaryngologic, orthopedic, gastrointestinal, and urologic disorders. Approved pediatric indications of use include the treatment of blepharospasm associated with dystonia, strabismus, lower-limb spasticity, focal spasticity in patients with cerebral palsy, and neurogenic detrusor overactivity. Alongside these approved indications, botulinum toxin is extensively used off-label. Although several clinical studies have shown that botulinum toxin is effective and well-tolerated in children, uncertainties persist regarding its long-term effects on growth and appropriate dosing in this population. As such, further research is needed to better define the botulinum toxin risk-benefit profile and expand approved uses in pediatrics. This narrative review aimed to provide a broad overview of the evidence concerning the clinical effectiveness and safety of BoNT with respect to its principal authorized and non-authorized pediatric therapeutic indications, as well as to describe perspectives on its future use in children.

PMID: 39057946

8. How best to support parents in the management of standing frame usage in home settings: A mixed methods study

Laerke Hartvig Krarup, Anders Holsgaard-Larsen, Helle Mätzke Rasmussen, Stine Østergaard Kyed, Charlotte Skau Pawlowski

Multicenter Study Child Care Health Dev. 2024 Sep;50(5):e13310. doi: 10.1111/cch.13310.

Background: An improved understanding of the current practice of standing frame use may have implications for supporting parents in managing standing frames. We aimed to investigate how parents of children with cerebral palsy perceive and manage standing frame use in home settings. Methods: We conducted a mixed methods study with an explanatory sequential design, first collecting and analysing quantitative questionnaire data and then using these results to inform a qualitative follow-up phase to explain them. The questionnaire was answered by 103 parents of children with cerebral palsy across five countries, Denmark, Norway, Great Britain, Canada and the United States, and 12 Danish families participated in the subsequent interviews. A descriptive analysis was conducted using the questionnaire data. The qualitative data were analysed using a directed content analysis, enabling integration of the quantitative and qualitative data. Results: The quantitative analysis showed that 89% of the parents felt confident with their child's standing frame, and 82% felt they had sufficient knowledge about how their child's standing frame could/should be used. However, the qualitative analysis showed that even when feeling confident, the parents experienced insecurity regarding whether their child was positioned correctly, and being responsible for positioning was challenging. Conclusion: Our study implies a need for providing educational materials to assist the parents in ensuring optimal positioning of their child in the standing frame to decrease insecurity. Additionally, our study suggests a need to provide more thorough information about the benefits of using a standing frame and ensure alignment of expectations in relation to the child's prognosis of functional independence.

PMID: 39056283

9. Effectiveness of Family-Professional Collaboration on Functional Goals Achievement of Children with Cerebral Palsy and Caregivers' Quality of Life and Burden: A Randomized Comparative Study

Sarah L Al-Otaibi, Maha F Algabbani, Azza M Alboraih, Sami S AlAbdulwahab

J Clin Med. 2024 Jul 11;13(14):4057. doi: 10.3390/jcm13144057.

Background: Family-professional collaboration is important to enhance the outcomes for children with cerebral palsy and their caregivers. Aims: This study examined the effect of implementing a family-professional collaboration practice model on children with cerebral palsy and their caregivers. Materials and methods: A randomized, single-blind comparative study included 28 physical therapists, 44 children with cerebral palsy between the ages of 2 and 12 years old, and their caregivers. Physical therapists in the experimental group received training in how to implement collaboration in their therapy sessions over the course of two sessions (3 h each). The children's achievement goal-range rate was measured using the Goal Attainment Scaling, the caregivers' quality of life was assessed using the World Health Organization Quality of Life-Brief, and the caregiver burden was evaluated using the Zarit Burden Interview. Results: All children showed improvement on the Goal Attainment Scaling change rate ($p = 0.002$), with no significant differences between groups ($p < 0.44$). However, a group × time interaction was observed. The Children Goal Attainment Scaling rate decreased between the two assessment sessions for children in the control group, while the Goal Attainment Scaling change rate was steady for the experimental group. There were no main effects of time and group or interaction of time × group reported on World Health Organization Quality of Life-Brief domains and no main effect of time on the Zarit Burden Interview, but there was a main effect between groups ($p = 0.03$), with partial eta square = 0.11 in favor of the experimental group. Conclusions: The family-professional collaboration practice model could be a potential practice to positively improve the outcomes in children with cerebral palsy and their caregivers.

PMID: 39064097

10. HEP® (Homeostasis-Enrichment-Plasticity) Approach Changes Sensory-Motor Development Trajectory and Improves Parental Goals: A Single Subject Study of an Infant with Hemiparetic Cerebral Palsy and Twin Anemia Polycythemia Sequence (TAPS)

Aymen Balikci, Teresa A May-Benson, Gamze Cagla Sirma, Gul Ilbay

Case Reports Children (Basel). 2024 Jul 19;11(7):876. doi: 10.3390/children11070876.

Background: Early intervention (EI) for infants identified as being at high risk for cerebral palsy (CP), or who have been diagnosed with it, is critical for promotion of postnatal brain organization. The aim of this study was to explore the effectiveness of the Homeostasis-Enrichment-Plasticity (HEP) Approach, which is a contemporary EI model that applies the key principles of enriched environment paradigms and neuronal plasticity from experimental animal studies to ecological theories of human development on the motor development, sensory functions, and parental goals of an infant with twin anemia polycythemia sequence (TAPS) and CP. Methods: An AB phase with follow-up single case study design which consisted of multiple baseline assessments with the Peabody Developmental Motor Scales-2 (PDMS-2) and the Test of Sensory Functions in Infants (TSFI) was used. Non-overlapping confidence intervals analysis was used for pre-post PDMS-2 scores. The measurement of progress toward goals and objectives was conducted using the Goal Attainment Scale (GAS). The HEP Approach intervention consisted of 12 one-hour sessions implemented over a period of 3 months, where a physical therapist provided weekly clinic-based parental coaching. Results: Results found a stable baseline during Phase A and improvement in response to the HEP Approach intervention during Phase B in both the PDMS-2 and TSFI according to 2SD Band analysis. The confidence intervals for the PDMS-2 scores also indicated a significant improvement after HEP intervention. The scores for both the PDMS-2 and the TSFI were consistent or showed improvement throughout the Follow-Up phase. A GAS t-score of 77.14 indicated that the infant exceeded intervention goal expectations. Conclusions: Although our findings suggest that the HEP Approach intervention has promise in enhancing sensory functions, motor skill outcomes, and parental goals in an infant with TAPS and CP, further research is required to validate and apply these results more broadly.

PMID: 39062325

11. Analysis of YouTube-Based Therapeutic Content for Children with Cerebral Palsy

Yerim Do, Yunjae Oh, Na Young Kim, Juntaek Hong

Children (Basel). 2024 Jul 2;11(7):814. doi: 10.3390/children11070814.

Background/objectives: Cerebral palsy (CP) causes movement and posture challenges due to central nervous system damage, requiring lifelong management. During the COVID-19 pandemic, there was limited access to facility-based treatments, which increased the demand for home-based therapies and digital resources. We analyzed the qualitative and quantitative aspects of YouTube videos focusing on CP therapy for children. Methods: A total of 95 videos were evaluated for content quality using the modified DISCERN (mDISCERN) tool and Global Quality Scale (GQS). The therapeutic program efficacy was assessed via the International Consensus on Therapeutic Exercise and Training (i-CONTENT) tool, Consensus on Therapeutic Exercise Training (CONTENT) scale, and Consensus on Exercise Reporting Template (CERT), and popularity was measured by the video power index (VPI). Results: YouTube-based therapeutic videos for children with CP generally exhibit reliability in video content and effectiveness in therapeutic programming, and no correlations were found between video popularity and quality. However, the qualitative analysis reveals insufficient mention of uncertainty in the treatment principles within the video content as well as a lack of detailed treatment descriptions encompassing aspects such as intensity, frequency, timing, setting, outcome measurement during and post-treatment, and safety considerations within therapeutic programs. In particular, this tendency was consistent regardless of the uploader's expertise level and the classification of the neuromotor therapy type in contrast to that of the exercise type. Conclusions: YouTube-based content for CP children still has significant limitations in how substantive viewers, such as caregivers, can acquire tailored information and apply practical information to their exercise and treatment programs.

PMID: 39062263

12. A Relook at Cerebral Palsy Beyond Motor Pathology: A Cross-Sectional Study of Sensory Processing Abilities

Aakash Mahesan, Prashant Jauhari, Mita Singhal, Sheffali Gulati, Biswaroop Chakrabarty, Vivek Sirolia, Ravindra Mohan Pandey

Neurol India. 2024 May 1;72(3):590-596. doi: 10.4103/ni.ni_1108_22. Epub 2024 Jun 30.

Background: Sensory processing refers to receiving, organizing, and interpreting sensory stimuli from the sensory system. Unlike other neurodevelopmental disorders, knowledge about the sensory processing abilities of children with cerebral palsy (CP) is lacking. Objective: To study the difference in sensory processing abilities of children with cerebral palsy in comparison to age matched typically developing children (TDC). Methods and material: A cross-sectional analysis of sensory processing abilities of children with CP and TDC was performed from July 2018 through February 2020. The child sensory profile2 (CSP2) caregiver questionnaire was used to detect sensory processing differences (SPD) across nine sensory domains and four sensory processing patterns. A comparison was made between the two study groups as well as between the CP subtypes. Result: Around 226 children with CP and 58 TDC were screened. Finally, 150 children with CP and 50 TDC were enrolled. Probable SPD (>1SD) was observed in (121/150) 80.7% of children with CP compared to (13/50) 26% in TDC ($p < 0.001$). Definite SPD (>2SD) was seen in 40.7% (61/150) of children with CP vs. none in TDC ($p < 0.001$). The body position domain which tests the vestibular and proprioceptive processing was primarily affected in CP. Most children with CP fell under the "bystander" pattern suggesting poor registration of sensory stimuli. No significant difference in the pattern of sensory processing was observed between the CP subtypes. Prevalence of definite SPD positively correlated with the gross motor functional classification system level. Conclusion: Sensory processing abilities of children with CP differ significantly from TDC. Proprioceptive and vestibular sensory processing is primarily affected in CP.

PMID: 39041978

13. Nutritional Deficiencies and Associated Oral Health in Adolescents: A Comprehensive Scoping Review

Man Hung, Amy Blazejewski, Samantha Lee, Johanna Lu, Andres Soto, Connor Schwartz, Amir Mohajeri

Review Children (Basel). 2024 Jul 18;11(7):869. doi: 10.3390/children11070869.

Introduction: The shift to processed foods in American diets has increased vitamin and mineral deficiencies among adolescents, impacting growth and health, often manifesting as oral lesions. This review study aimed to explore the link between nutritional deficiencies and adolescent oral health to improve guidance and prevent long-term issues. Methods: A systematic review of literature from 2013 to 2023 was conducted on adolescents aged 10-19 years, using PRISMA guidelines. Searches in PubMed, Web of Science, Dentistry & Oral Sciences Source-Ebscohost, and Scopus included peer-reviewed articles, excluding reviews and non-empirical studies. Data were screened and extracted with independent reviews for accuracy. Results: Malnutrition strongly correlates with poor oral health. Undernourished children have a 60% increase in dental caries, exacerbated by high sugar intake. Early malnutrition delays dental eruption, temporarily protecting against caries, while stunting and infections cause enamel defects. Chronic conditions like cerebral palsy and celiac disease worsen oral health, with risks persisting into adulthood. Conclusions: Nutritional deficiencies and oral health are interconnected, requiring integrated healthcare. Early interventions and holistic strategies can improve outcomes and reduce long-term burdens. Comprehensive health education and routine dental evaluations are essential for prevention and treatment, enhancing health across all demographics.

PMID: 39062318

14. ENIGMA-Chronic Pain: a worldwide initiative to identify brain correlates of chronic pain

Yann Quidé, Neda Jahanshad, Jamila Andoh 4, Georgia Antoniou, Apkar Vania Apkarian, Yoni K Ashar, Bashar W Badran, C Lexi Baird, Luke Baxter, Tyler R Bell, Laura Blanco-Hinojo, Jeffrey Borckardt, Chloe L Cheung, Daniel Ciampi de Andrade, Bruno A Couto, Simon R Cox, Yenisel Cruz-Almeida, Udo Dannlowski, Enrico De Martino, Marina de Tommaso, Joan Deus, Martin Domin, Natalia Egorova-Brumley, James Elliott, Silvia Fanton, Camille Fauchon, Herta Flor, Carol E Franz, Justine M Gatt, Paul Gerdhem, Jodi M Gilman, Randy L Gollub, Varan Govind, Thomas Graven-Nielsen, Gustaf Håkansson, Tim Hales, Courtney Haswell, Nils Jannik Heukamp, Li Hu, Lejian Huang, Ahmed Hussain, Karin Jensen, Tilo Kircher, William S Kremen, Elisabeth J Leehr, Martin Lindquist, Marco L Loggia, Martin Lotze, Katherine T Martucci, Timothy J Meeker, Susanne Meinert, Samantha K Millard, Rajendra A Morey, Carlos Murillo, Frauke Nees, Igor Nenadic, Haeme R P Park, Xiaolong Peng, Markus Ploner, Jesus Pujol, Linda E Robayo, Teddy Salan, David A Seminowicz, Angela Serian, Rebeccah Slater, Frederike Stein, Jennifer Stevens, Sebastian Strauss, Delin Sun, Etienne Vachon-Presseau, Pedro A Valdes-Hernandez, Sven Vanneste, Mark Vernon, Madeleine Verriotis, Tor D Wager, Eva Widerstrom-Noga, Anna Woodbury, Fadel Zeidan, Ravi R Bhatt, Christopher R K Ching, Elizabeth Haddad, Sophia I Thomopoulos, Paul M Thompson, Sylvia M Gustin

Pain. 2024 Jul 26. doi: 10.1097/j.pain.0000000000003317. Online ahead of print.

No abstract available

PMID: 39058957

15. Markerless motion analysis to assess reaching-sideways in individuals with dyskinetic cerebral palsy: A validity study

Inti Vanmechelen, Ellen Van Wonterghem, Jean-Marie Aerts, Hans Hallez, Kaat Desloovere, Patricia Van de Walle, Annemieke I Buizer, Elegast Monbaliu, Helga Haberfehlner

J Biomech. 2024 Jul 17:173:112233. doi: 10.1016/j.jbiomech.2024.112233. Online ahead of print.

This study aimed to evaluate clinical utility of 2D-markerless motion analysis (2DMMA) from a single camera during a reaching-sideways-task in individuals with dyskinetic cerebral palsy (DCP) by determining (1) concurrent validity by correlating 2DMMA against marker-based 3D-motion analysis (3DMA) and (2) construct validity by assessing differences in 2DMMA features between DCP and typically developing (TD) peers. 2DMMA key points were tracked from frontal videos of a single camera by DeepLabCut and accuracy was assessed against human labelling. Shoulder, elbow and wrist angles were calculated from 2DMMA and 3DMA (as gold standard) and correlated to assess concurrent validity. Additionally, execution time and variability features such as mean point-wise standard deviation of the angular trajectories (i.e. shoulder elevation, elbow and wrist flexion/extension) and wrist trajectory deviation by mean overshoot and convex hull were calculated from key points. 2DMMA features were compared between the DCP group and TD peers to assess construct validity. Fifty-one individuals (30 DCP;21 TD; age:5-24 years) participated. An accuracy of approximately 1.5 cm was reached for key point tracking. While significant correlations were found for wrist ($\rho = 0.810;p < 0.001$) and elbow angles ($\rho = 0.483;p < 0.001$), 2DMMA shoulder angles were not correlated ($\rho = 0.247;p = 0.102$) to 3DMA. Wrist and elbow angles, execution time and variability features all differed between groups (Effect sizes 0.35-0.81;$p < 0.05$). Videos of a reaching-sideways-task processed by 2DMMA to assess upper extremity movements in DCP showed promising validity. The method is especially valuable to assess movement variability.

PMID: 39053292

16. Experiences of health services for adults with cerebral palsy, their support people, and service providers

Manjula Manikandan, Claire Kerr, Jennifer Fortune, Michael Walsh, Jennifer Ryan, Aisling Walsh

Dev Med Child Neurol. 2024 Jul 19. doi: 10.1111/dmcn.16037. Online ahead of print.

Aim: To explore the experiences of health services among adults with cerebral palsy (CP) in Ireland, from the perspectives of adults with CP, their support people, and service providers. Method: A qualitative descriptive study design was used. In-depth semi-structured interviews were conducted between March and August 2021 with adults with CP, people who supported them, and health professionals. Thematic analysis was used to evaluate the data. Results: Twenty-one adults with CP, seven support people (family carer[s], spouse or partner, or friend), and 15 service providers participated in the study. Adults had a mean age of 38 years 5 months (range 22-58 years) and were classified in Gross Motor Function Classification System levels I to V. Five themes were identified from the data: (1) access challenges in adult services; (2) knowledge and understanding of CP; (3) support people's role and care burden; (4) communication and interaction in adult services; and (5) health system challenges. Conclusion: Adults with CP in Ireland face multiple challenges accessing the health services they need. Services were reported to be inadequate, with limited resources and understanding of CP. Participants highlighted a need for system-level interventions, including enhanced training for health professionals to effectively meet the needs of adults with CP.

PMID: 39032015

17. Development of a new social prescribing intervention for families of children with cerebral palsy

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Dev Med Child Neurol. 2024 Jul 19. doi: 10.1111/dmcn.16039. Online ahead of print.

Aim: To co-design a social prescribing intervention (the EPIC-CP programme: Equitable Pathways and Integrated Care in Cerebral Palsy) with children with cerebral palsy (CP), their families, and clinicians to address unmet social needs. Method: The study was conducted (August 2021 to March 2023) at the paediatric rehabilitation departments of the three tertiary paediatric hospitals in New South Wales, Australia. Eligible participants attended or worked at one of the departments, including children with CP, parents/caregivers, and clinicians. Mixed-methods co-design was used in intervention co-production and prototyping. The project was overseen by research advisors with lived experience of CP. Results: More than 200 participants contributed to the co-design research. Families experienced a substantial burden of unmet social needs. Co-designed interventions involved systematic identification of unmet social needs with (1) targeted community resources and (2) engagement with a 'community linker' who supported children/young people and their families to access health, education, and social services that matched their identified needs and preferences. Research participants co-developed the programme logic model and prototype. This was piloted in research action cycles and iteratively refined until consensus was achieved. Interpretation: We co-designed a social prescribing programme responsive to the needs of its end-users and purposefully developed to be embedded in the Australian health setting. A pilot randomized controlled trial will further evaluate this intervention.

PMID: 39031596

18. Sociodemographic and clinical indicators of children and young people with cerebral palsy and reported unmet social needs

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Dev Med Child Neurol. 2024 Jul 22. doi: 10.1111/dmcn.16041. Online ahead of print.

Aim: To determine the frequency, type, clinical, and sociodemographic associations of unmet social needs in children with cerebral palsy (CP). Method: We conducted a cross-sectional study of parents and carers of children with CP attending a specialist hospital clinic between July and September 2022. Unmet social needs were self-identified using a survey, guided by the WE CARE survey instrument and adapted to the local context. Sociodemographic and clinical data were obtained from medical records. We performed descriptive analysis of participants' unmet social needs, sociodemographic factors, and clinical factors, and examined for associations using a $\chi2$ test and logistic regression. Results: A total of 105 parents and carers completed the survey. Of these, 68 (64.8%) reported one or more unmet social need, with 24 (22.9%) reporting three or more unmet needs. A higher number (three or more) of unmet needs was associated with Gross Motor Function Classification System levels IV and V (odds ratio [OR] = 3.77, 95% confidence interval [CI] = 1.44-9.86) and intellectual disability (OR = 4.63, 95% CI = 1.61-13.31), but were not significant when corrected for neighbourhood socioeconomic disadvantage. The greatest socioeconomic disadvantage was associated with housing concerns (p = 0.002), food (p = 0.026), and financial insecurity (p = 0.02). Interpretation: Unmet social needs are experienced by most families of children with CP. This study highlights the importance of systematic pathways to identify and address unmet social needs.

PMID: 39039859

19. Motivation in caregiving among mothers of children with intellectual and developmental disabilities in Iran: A qualitative study

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BMC Pediatr. 2024 Jul 25;24(1):472. doi: 10.1186/s12887-024-04957-y.

Background: The motivation of caregivers plays a crucial role in the treatment, follow-up, and care of children with intellectual and developmental disabilities. Previous studies have focused on the older people and end-stage diseases, while giving less attention to the motivation of mothers caring for children with special needs. This study aimed to explore the motivations of mothers caring for children with intellectual and developmental disabilities in Iran. Methods: This study employed a qualitative approach, guided by the Self-Determination Theory. Purposeful sampling was initially used, followed by theoretical sampling until data saturation was achieved. Data were collected through semi-structured interviews with 26 mothers of children with intellectual and developmental disabilities. Mayring's seven-step directed content analysis approach was utilized for coding and categorization. The research adhered to ethical standards and ensured data trustworthiness through credibility, dependability, confirmability, and transferability measures. Results: The findings revealed that mothers' caregiving motivations could be classified into four main categories: (I) intrinsic, (II) identified-extrinsic, (III) introjected-extrinsic, and (IV) external-extrinsic. Additionally, twelve sub-categories were identified within these four main categories. Conclusion: The findings revealed that mothers demonstrated varying levels of intrinsic and extrinsic motivations in caring for children with intellectual and developmental disabilities. By recognizing and enhancing the diverse sources of motivation, healthcare providers and policymakers can better support mothers in their caregiving roles, ultimately contributing to improved outcomes for both the mothers and their children.

PMID: 39049077

20. Resilience and challenges: A qualitative exploration of Jordanian Mothers' experiences with children who have cerebral palsy

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J Pediatr Nurs. 2024 Jul 24:S0882-5963(24)00282-3. doi: 10.1016/j.pedn.2024.07.020. Online ahead of print.

Purpose: This study aimed to explore the experiences of Jordanian mothers of children with cerebral palsy (CP) in order to better understand the challenges they face while caring for their children. Design and methods: A qualitative descriptive study was applied, using semi-structured face to face interviews with a purposive sample of 10 mothers of children with CP. Findings: Mothers caring for children with CP embark on a challenging journey. Navigating the diagnosis begins with shock and disbelief, followed by emotional struggles as they deal with the new reality. This initial phase also involves caregiving challenges and hardships. Mothers may experience societal stigma and feelings of rejection, which can contribute to social isolation. Additionally, the physical demands of care can lead to financial hardships. These financial constraints can further limit access to specialized care, creating a frustrating cycle for mothers. Throughout this process, mothers demonstrate resilience by adapting to the illness. This encompasses making changes in their lives, actively seeking support, and developing expertise in managing their child's specific needs. Conclusions: The results shed light on the emotional, physical, and social challenges faced by mothers of children with CP. The findings show a narrative of adaptation, resilience, and strength, encompassing adjustments to the diagnosis, substantial life changes, seeking support, and addressing challenges such as social stigma, isolation, and various hardships. Practice implications: Our findings lay the foundation for tailored interventions and empathic support for mothers caring for a child with CP.

PMID: 39054110

21. Care Pathways in Rehabilitation for Children and Adolescents with Cerebral Palsy: Distinctiveness of the Adaptation to the Italian Context

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Children (Basel). 2024 Jul 13;11(7):852. doi: 10.3390/children11070852.

Background: In 2020, a multiprofessional panel was set up in collaboration with the Italian FightTheStroke Foundation family association to produce evidence-based recommendations for the management and neuromotor rehabilitation of persons with cerebral palsy aged 2-18 years to implement in clinical practice in Italy. Methods: The recommendations of these care pathways were developed according to the American Academy for Cerebral Palsy and Developmental Medicine guidelines for Care Pathways Development and the Grading of Recommendations Assessment Development and Evaluation working group for adoption, adaptation, or de novo development of recommendations from high-quality guidelines (GRADE-ADOLOPMENT). Results: Four strong positive recommendations were developed regarding comprehensive management, and twenty-four addressed neuromotor treatment. Conclusions: A holistic, individualized approach was affirmed in terms of both multidimensional patient profile and interdisciplinary management in a network with the school where children and adolescents are integrated. It was defined that all motor rehabilitation approaches must be individually tailored considering age and developmentally appropriate activities as interventions and goals, in light of the reference curves addressing prognosis for Gross Motor Function and Manual Ability Classification Systems. Intervention must be structured with adaptations of the task and/or of the context (objects and environment) based on the analysis of the child's skills to support motivation and avoid frustration.

PMID: 39062302

22. Guideline for Growth, Health and Developmental Follow-Up for Children Born Very Preterm.

Preterm Follow-up Guideline Development Group

CRE in Newborn Medicine, Murdoch Children’s Research Institute. 2024 July. ISBN: 978-0-646-89727-2

The *Guideline for Growth, Health and Developmental Follow-up for Children Born Very Preterm* presents the best current scientific evidence to assist decision making for the provision of follow-up services to infants born very preterm in Australia.

Newborn Medicine CRE

23. Does tranexamic acid reduce transfusion requirements in children with cerebral palsy undergoing osteotomies? A systematic review and meta-analysis

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Review J Orthop. 2024 Jun 28:58:66-74. doi: 10.1016/j.jor.2024.06.036. eCollection 2024 Dec.

Introduction: Children with cerebral palsy have postural alterations and hip displacements are common among them, for which osteotomies must be carried out, involving great blood loss. Tranexamic acid (TXA), a fibrinolysis inhibitor, has been shown to reduce bleeding in osteotomies. However, the effectiveness of TXA in children with cerebral palsy has not been well studied, so a comprehensive meta-analysis is required to evaluate its impact. Objective: We conducted a meta-analysis to investigate the effectiveness of tranexamic acid administration in reducing blood loss and transfusions during osteotomies in children with cerebral palsy. Methods: Databases were searched until April 17, 2024, for randomized controlled trials and observational cohort studies comparing TXA use versus a control group. The primary outcome was overall transfusion.Secondary outcomes included intraoperative transfusion, postoperative transfusion, postoperative hemoglobin (Hb), postoperative hematocrit (Hct), drop in Hct, drop in Hb, length of stay, total blood loss (TBL) and estimated blood loss (EBL). The analysis utilized pooled relative risk ratios (RR) for categorical variables, and mean difference (MD) for numerical variables. We utilized the fixed-effects model utilizing the Mantel-Haenszel method. Results: The analysis included 7 articles, which collectively provided data on 943 patients. It was found thatTXA administration decreases overall transfusion rate (RR = 0,65, 95 % CI: 0.47 to 0,90, p = 0,008),postoperative transfusion rate (RR = 0.53, 95 % CI: 0.36 to 0,79, p = 0.002) and TBL (MD = -139,41, 95 % CI: 221,34 to -57,48, p = 0,0009). There was less length of stay in the control group (MD = 0,47, 95 % CI: 0.10 to0,84, p = 0,01). TXA doesn't demonstrate significant differences in EBL, intraoperative transfusion rate, postoperative Hb, postoperative Hct, drop in Hct or drop in Hb. Conclusion: TXA reduces the need of transfusion and total blood loss and increased length of hospital stay. And TXA doesn't demonstrate significant differences in EBL, intraoperative transfusion rate, postoperative Hb, postoperative Hct, drop in Hct or drop in Hb.

PMID: 39055284

24. Mechanistic Association of Hepatoblastoma with Cerebral Palsy: A Narrative Review

Noor Saeed Hasan, Warren Thomas

Review Saudi J Med Med Sci. 2024 Jul-Sep;12(3):203-209. doi: 10.4103/sjmms.sjmms_519_23. Epub 2024 Jun 20.

Hepatoblastoma is a rare liver cancer that occurs most often in children who present with lower birth weight. Cerebral palsy (CP) is a neurodevelopmental disorder distinguished by irregularities in muscle tone, movement, and motor skills. CP is caused by damage to the developing brain and is often associated with secondary complications such as severe constipation. Clinicians must be aware of sudden worsening constipation occurring in CP children because it can also be a sign of hepatoblastoma. The aim of this review is to summarize the current understanding of the risks for hepatoblastoma development in children with CP. Cancer risks likely include dysfunction of the immune system surveillance in CP children. Elevated C-reactive protein and tumor necrosis factor-alpha levels may be higher in children with CP, which weakens their innate immune system. Metabolic disruption increases the risk of some cancers, and poor nutrition and reduced growth that occur in CP patients may have an impact on cancer development through a loss in immune function. Increased mobility and physical activity can increase the T-cell, natural killer cell, and neutrophil population. Children with CP tend to engage poorly in physical activity, and consequently, their immune system is affected. There are multiple factors associated with CP that increase the risk of childhood cancers such as hepatoblastoma.

PMID: 39055079

25. Electroacupuncture activates the peroxisome proliferators-activated receptor pathway to improve the phenotype of cerebral palsy

Zhi-Feng Wu, Hong-Hao Peng, Yun Shu, Li Zhang, Si Zhang, Jing-Yang Zhang, Si-Jie Li, Qiong-Li Fan, Yun Wei, Li Ming, Jing-Jing Tong, Yu-Ping Zhang

CNS Neurosci Ther. 2024 Jul;30(7):e14876. doi: 10.1111/cns.14876.

Aim: This study explores the efficacy of electroacupuncture (EA) in treating cerebral palsy (CP) in Sprague-Dawley (SD) pups, specifically CP animal models, and its molecular mechanisms. Methods: Gait analysis and Y-maze were used to detect the improvement of motor ability and cognitive function of CP rats after EA treatment. Transcription sequencing was used to determine the key pathway for EA to improve the symptoms of CP. PPAR agonists were used to verify the causal relationship between the pathway and the improvement of CP phenotype. Results: The motor ability and cognitive function of CP pups were improved after EA treatment. The results of transcriptome sequencing suggest that the improvement of CP phenotype may be caused by the activation of PPAR pathway. PPAR pathway is widely activated in the epithelium of CP pups treated with EA, which is verified by qPCR. Rosiglitazone (Ros), a PPAR agonist, can improve CP phenotype while activating PPAR pathway, which proves the causal relationship between PPAR pathway activation and CP phenotype improvement. Conclusion: Our study demonstrated behavioral improvements and enhanced cognitive functions in CP models after EA treatment by activating PPAR pathway, suggesting new perspectives for CP rehabilitation, and providing theoretical support for acupuncture treatment of CP.

PMID: 39049731

26. Identification of potential biomarkers for cerebral palsy and the development of prediction models

Haoyang Zheng, Duo Zhang, Yong Gan, Zesheng Peng, Yuyi Wu, Wei Xiang

Exp Biol Med (Maywood). 2024 Jul 9:249:10101. doi: 10.3389/ebm.2024.10101. eCollection 2024.

Cerebral palsy (CP) is a prevalent motor disorder originating from early brain injury or malformation, with significant variability in its clinical presentation and etiology. Early diagnosis and personalized therapeutic interventions are hindered by the lack of reliable biomarkers. This study aims to identify potential biomarkers for cerebral palsy and develop predictive models to enhance early diagnosis and prognosis. We conducted a comprehensive bioinformatics analysis of gene expression profiles in muscle samples from CP patients to identify candidate biomarkers. Six key genes (CKMT2, TNNT2, MYH4, MYH1, GOT1, and LPL) were validated in an independent cohort, and potential biological pathways and molecular networks involved in CP pathogenesis were analyzed. The importance of processes such as functional regulation, energy metabolism, and cell signaling pathways in the muscles of CP patients was emphasized. Predictive models of muscle sample biomarkers related to CP were developed and visualized. Calibration curves and receiver operating characteristic analysis demonstrated that the predictive models exhibit high sensitivity and specificity in distinguishing individuals at risk of CP. The identified biomarkers and developed prediction models offer significant potential for early diagnosis and personalized management of CP. Future research should focus on validating these biomarkers in larger cohorts and integrating them into clinical practice to improve outcomes for individuals with CP.

PMID: 39045601

27. The emerging importance of multiple motor disorders in cerebral palsy

Simon Paget, Sarah McIntyre

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No abstract available

PMID: 39043938

28. Ageing well with a lifelong disability: A scoping review

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Gerontologist. 2024 Jul 23:gnae092. doi: 10.1093/geront/gnae092. Online ahead of print.

Background and objectives: Existing literature highlights notable health and social inequalities for people ageing with a lifelong disability and the need for research to better understand how we can support this group to age well. This scoping review mapped existing literature related to 'ageing well' in people with lifelong disabilities. Research design and methods: Five scientific databases and grey literature sources were searched for studies related to 'ageing well' and 'lifelong disability' (defined as a disability that a person had lived with since birth or early childhood). Results: We identified 81 studies that discussed ageing well with a lifelong disability, with most (70%) focusing on intellectual disabilities. Two themes captured existing research on ageing well with a lifelong disability: 1.) Framing ageing well with a lifelong disability, which included the ways that people with lifelong disability, their supporters and existing research frame ageing well for this group and 2.) Supporting people to age well with a lifelong disability, which involves the micro, meso and macro-level factors where research suggests interventions to facilitate ageing well could be situated. Discussion and implications: This synthesis highlights how ageing well is currently framed in the literature and where interventions to improve ageing well in this group could be situated. Literature highlights the importance of considering multi-level interventions to improve ageing well. Evidence gaps include the lack of research conducted with groups other than those with intellectual disabilities and the need for more research examining ageing well interventions.

PMID: 39041347

29. Development and validation of a stakeholder-driven, self-contained electronic informed consent platform for trio-based genomic research studies

Bethany Y Norton, James Liu, Sara A Lewis, Helen Magee, Tyler N Kruer, Rachael Dinh, Somayeh Bakhtiari, Sandra H Nordlie, Sheetal Shetty, Jennifer Heim, Yumi Nishiyama, Jorge Arango, Darcy Johnson, Lee Seabrooke, Mitchell Shub, Robert Rosenberg, Michele Shusterman, Stephen Wisniewski, Blair Cooper, Erin Rothwell, Michael C Fahey, M Wade Shrader, Nancy Lennon, Joyce Oleszek, Wendy Pierce, Hannah Fleming, Mohan Belthur, Jennifer Tinto, Garey Noritz, Laurie Glader, Kelsey Steffan, William Walker, Deborah Grenard, Bhooma Aravamuthan, Kristie Bjornson, Malin Joseph, Paul Gross, Michael C Kruer; Cerebral Palsy Research Network.

medRxiv [Preprint]. 2024 May 3:2024.05.01.24306461. doi: 10.1101/2024.05.01.24306461.

Increasingly long and complex informed consents have yielded studies demonstrating comparatively low participant comprehension and satisfaction with traditional face-to-face approaches. In parallel, interest in electronic consents for clinical and research genomics has steadily increased, yet limited data are available for trio-based genomic discovery studies. We describe the design, development, implementation, and validation of an electronic iConsent application for trio-based genomic research deployed to support genomic studies of cerebral palsy. iConsent development incorporated stakeholder perspectives including researchers, patient advocates, institutional review board members, and genomic data-sharing considerations. The iConsent platform integrated principles derived from prior electronic consenting research and elements of multimedia learning theory. Participant comprehension was assessed in an interactive teachback format. The iConsent application achieved nine of ten proposed desiderata for effective patient-focused electronic consenting for genomic research. Overall, participants demonstrated high comprehension and retention of key human subjects' considerations. Enrollees reported high levels of satisfaction with the iConsent, and we found that participant comprehension , iConsent clarity , privacy protections , and study goal explanations were associated with overall satisfaction . Although opportunities exist to optimize iConsent, we show that such an approach is feasible, can satisfy multiple stakeholder requirements, and can realize high participant satisfaction and comprehension while increasing study reach.

PMID: 39040210

30. A systematic review of cell therapy modalities and outcomes in cerebral palsy

Ayberk Akat, Erdal Karaöz

Review Mol Cell Biochem. 2024 Jul 21. doi: 10.1007/s11010-024-05072-3. Online ahead of print.

Cerebral palsy is widely recognized as a condition that results in significant physical and cognitive disabilities. Interventions aim to improve the quality of life and reduce disability. Despite numerous treatments and significant advancements, cerebral palsy remains incurable due to its diverse origins. This review evaluated clinical trials, studies, and case reports on various cell therapy approaches for cerebral palsy. It assessed the clinical outcomes of applying different cell types, including mesenchymal stem cells, olfactory ensheathing cells, neural stem/progenitor cells, macrophages, and mononuclear cells derived from peripheral blood, cord blood, and bone marrow. In 60 studies involving 1474 CP patients, six major adverse events (0.41%) and 485 mild adverse events (32.9%) were reported. Favorable therapeutic effects were observed in 54 out of 60 cell therapy trials, indicating a promising potential for cell treatments in cerebral palsy. Intrathecal MSC and BM-MNC applications revealed therapeutic benefits, with MSC studies being generally safer than other cell therapies. However, MSC and BM-MNC trials have shown inconsistent results, with some demonstrating superior efficacy for certain outcomes. Cell dosage, transplantation route, and frequency of administration can affect the efficacy of these therapies. Our findings highlight the promise of cell therapies for improving cerebral palsy treatment and stress the need for ongoing research to refine treatment protocols and enhance safety. To establish conclusive evidence on the comparative effectiveness of various cell types in treating cerebral palsy, randomized, double-blind clinical trials are essential.

PMID: 39033213