Cerebral palsy research news

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Interventions and Management

1. Wrist-hand extension function recovery in spastic hemiplegia patient by botulinum toxin injection plus surface electromyography biofeedback therapy: A case report
Zhang-Xiang Wu, Chao Wang, Zheng Huang, Xue-Han Liu, Mei Shen

Case Reports Medicine (Baltimore). 2021 Apr 9;100(14):e25252. doi: 10.1097/MD.0000000000025252.

Rationale: Wrist-hand extension function rehabilitation is a vital and difficult part of hand function recovery in spastic stroke patients. Although botulinum toxin type A (BoNTA) injection plus post injection therapy was applied to the wrist-hand rehabilitation in previous reports, conclusion was inconsistent in promoting function. For this phenomenon, proper selection of patients for BoNTA injection and correct choice of post-injection intervention could be the crucial factors for the function recovery. Patient concerns: We reported a 46-year-old male suffered a spastic hemiplegia with wrist- hand extension deficit. Diagnoses: Computed tomography showed cerebral hemorrhage in the left basal ganglia region. Interventions: Four hundred units of BoNTA were injected into the spasticity flexors, and four-week post injection surface electromyography (sEMG) biofeedback therapy was applied to the patient. Outcomes: The patient exhibited post-intervention improvement in wrist-hand extensors performance (strength, range of motion, sEMG signals), the flexors spasticity, and upper extremity function. Lessons: The present case showed that 4-week of BoNTA injection plus sEMG biofeedback exercise improved the performance and function of wrist-hand extensors in the patient for short- and long-term. Proper selection of patients for BoNTA injection and correct choice of post injection exercise could play a vital role in the hand rehabilitation for patient with spastic hemiplegia.

PMID: 33832085

2. Impact of Upper Extremity Impairment and Trunk Control on Self-Care Independence in Children With Upper Motor Neuron Lesions
Jeffrey W Keller, Annina Fahr, Jan Lieber, Julia Balzer, Hubertus J A van Hedel

Phys Ther. 2021 Apr 19;pzab112. doi: 10.1093/ptj/pzab112. Online ahead of print.

Objective: We evaluated the relative importance of different approaches measuring upper extremity selective voluntary motor control (SVMC), spasticity, strength, and trunk control for explaining self-care independence in children affected by upper motor neuron lesions. Methods: Thirty-one patients (12.5 ± 3.2 years) with mild to moderate arm function impairments participated in this observational study. Self-care independence was evaluated with the Functional Independence Measure for children (WeeFIM). Upper extremity SVMC was quantified with the Selective Control of the Upper Extremity Scale (SCUES), a similarity index (SISCUES) calculated from simultaneously recorded sEMG muscle activity patterns, and an accuracy and involuntary movement score derived from an inertial-measurement-unit-based assessgame. We further applied the Trunk Control Measurement Scale (TCMS) and assessed upper extremity spasticity (Modified Ashworth Scale) and

strength (dynamometry). To determine the relative importance of these factors for self-care independence, we created three regression models: one included only upper extremity SVMC measures, one upper extremity and trunk SVMC measures (overall SVMC model), and one all measures (final self-care model). Results: In the upper extremity SVMC model (total variance explained 52.5%), the assessgame (30.7%) and SCUES (16.5%) were more important than the SISCUES (4.5%). In the overall SVMC model (75.0%), trunk SVMC (39.0%) was followed by the assessgame (21.1%), SCUES (11.0%), and SISCUES (4.5%). In the final self-care model (82.1%), trunk control explained 43.2%, upper extremity SVMC 23.1%, spasticity 12.3%, and strength 2.3%. Conclusion: While upper extremity SVMC explains a substantial portion of self-care independence, overall trunk control was even more important. The question whether training trunk control and SVMC can translate to improved self-care independence should be the subject of future research. Impact: This study highlights the importance of trunk control and SVMC for self-care independence in children with upper motor neuron lesions.

PMID: 33872354

3. Validity and reliability of an electromyography-based upper limb assessment quantifying selective voluntary motor control in children with upper motor neuron lesions
Jeffrey W Keller, Annina Fahr, Julia Balzer, Jan Lieber, Hubertus Ja van Hedel

Sci Prog. Apr-Jun 2021;104(2):368504211008058. doi: 10.1177/00368504211008058.

Current clinical assessments evaluating selective voluntary motor control are measured on an ordinal scale. We combined the Selective Control of the Upper Extremity Scale (SCUES) with surface electromyography to develop a more objective and interval-scaled assessment of selective voluntary motor control. The resulting Similarity Index (SI) quantifies the similarity of muscle activation patterns. We aimed to evaluate the validity and reliability of this new assessment named SISCUES (Similarity Index of the SCUES) in children with upper motor neuron lesions. Thirty-three patients (12.2 years [8.8;14.9]) affected by upper motor neuron lesions with mild to moderate impairments and 31 typically developing children (11.6 years [8.5;13.9]) participated. We calculated reference muscle activation patterns for the SISCUES using data of 33 neurologically healthy adults (median [1st; 3rd quantile]: 32.5 [27.9; 38.3]). We calculated Spearman correlations (ρ) between the SISCUES and the SCUES and the Manual Ability Classification System (MACS) to establish concurrent validity. Discriminative validity was tested by comparing scores of patients and healthy peers with a robust ANCOVA. Intraclass correlation coefficients2,1 and minimal detectable changes indicated relative and absolute reliability. The SISCUES correlates strongly with SCUES ($\rho = 0.76$, $p < 0.001$) and moderately with the MACS ($\rho = -0.58$, $p < 0.001$). The average SISCUES can discriminate between patients and peers. The intraclass correlation coefficient2,1 was 0.90 and the minimal detectable change was 0.07 (8% of patients' median score). Concurrent validity, discriminative validity, and reliability of the SISCUES were established. Further studies are needed to evaluate whether it is responsive enough to detect changes from therapeutic interventions.

PMID: 33871293

4. Hip-Spine Relationship: Thoracolumbar Deformation in a Patient with Limited Hip Flexion: A Case Report
Adam Margalit, Paul D Sponseller

JBJS Case Connect. 2021 Apr 21;11(2):e20.00548. doi: 10.2106/JBJS.CC.20.00548.

Case: We describe thoracolumbar kyphosis with severe vertebral deformation in a 13-year-old boy with cerebral palsy, hip extension contractures, and history of hip flexion-adduction releases. Conclusion: Patients with cerebral palsy and hip extension contractures may develop thoracolumbar kyphosis to maintain sitting balance. It is important to recognize hip extension contractures as the underlying cause of the compensatory kyphosis and to be familiar with treatment options that address the hips and the spine.

PMID: 33882047

5. Parents and Caregivers Satisfaction After Palliative Treatment of Spastic Hip Dislocation in Cerebral Palsy
Aleksander Koch, Joanna Krasny, Magdalena Dziurda, Magdalena Ratajczyk, Marek Jozwiak

Front Neurol. 2021 Mar 18;12:635894. doi: 10.3389/fneur.2021.635894. eCollection 2021.

Objectives: Pain appearance is one the most common complication of spastic hip disease in children with cerebral palsy (CP). It determines child and caregiver quality of life and life priorities. Reconstruction hip surgery should be considered as a treatment of choice. Some clinical conditions give the inability to perform such a procedure. In our paper, we would like to present four palliative methods of spastic hip dislocation treatment in children with CP. Material: We analyzed four groups of patients treated because of hip pain. Inclusion criteria were pain appearance (visual analog scale-11 or numeric rating scale-11) and hip joint dislocation (migration percentage >80%). All patients were admitted to our department between 2008 and 2018. In the first group, patients were treated only by steroid injections to hip joints; in the second group, patients were recruits after hip interposition arthroplasty with shoulder spacer; in the third group, they were patients after valgus subtrochanteric osteotomy (Schanz); and in the fourth group, these were patients after proximal femoral resection (Castle procedure). The minimal follow-up time was 2 years. The first group consisted of 15 patients (15 hips) with a mean age of 15.5 (8-17) years; the second group, 20 patients (24 hips) with a mean age of 14.2 (9-22.6) years; the third group, 22 patients (24 hips) with a mean age of 13.5 (7-20.5) years; and the fourth group, 10 patients (15 hips) with a mean age of 12.9 (7-17.6) years. Methods: Radiological evaluation was based on a standardized anteroposterior X-ray of the hip joints. Pain severity before surgery and at the last follow-up time was measured by visual analog scale-11. Parents or caregivers were asked about their child's pain during sitting, perineal care, and rest. During the visit, all caregivers were asked about treatment satisfaction (no 0 to max 10) and if they would decide again for the same surgery. Results: In all groups of patients, we observed a decrease in pain complaints. The observed reduction of pain in the first group was from 7.88 (4-10) to 3.08 (0-8) ($p = 0.05$), but results of injection were observed only for 4 months (2-8), and it has to be repeated (average: two times). In the second group, level of pain was reduced from 4.93 (1-10) to 0.93 (0-5) ($p < 0.001$); in the third group, from 6.22 (3-10) to 0.59 (0-6) ($p < 0.001$); and in the fourth group, pain reduces from 5.43 (2-10) to 2.13 (0-5) ($p < 0.001$). Observed changes concerned mostly sitting position and perineal care. The complication rate was in the second group, 6 of 24 cases of extraarticular ossification; in the third group, 2 of 24 cases with extraarticular ossification, two cases of revision surgery. In the fourth group, two cases needed another femoral resection. In the first group, five patients died during follow-up time, so they were excluded from the study. In the steroid injection group, parents' treatment evaluation was 6.83 (0-10), and only in three cases that they would resign from the treatment. In the hip interposition arthroplasty group, caregivers' evaluation was 7.41 (0-10), and in five cases, parents did not accept the surgery. In the Schanz osteotomy group, parents' evaluation was 5.9 (0-10), and in eight cases, caregivers would not repeat surgery. In the proximal femoral resection group, satisfaction was the highest, 8.3 (3-10), and only two parents would not decide for surgery again. Conclusion: All procedures can be considered as palliative treatment options for pain complain in a spastic hip joint dislocation in children with CP. Steroid injections to the hip joint need to be repeated, and with the follow-up time, it becomes less effective. Steroid injection seems to be the treatment of choice for patients with general anesthesia contraindications. Interposition arthroplasty of the hip joint seems to give better final results, but the highest parents' satisfaction surprisingly was observed in the proximal femoral resection group, but differences were not statistically significant.

PMID: 33868145

6. Knee flexion contracture impacts functional mobility in children with cerebral palsy with various degree of involvement: a cross-sectional register study of 2,838 individuals

Evelina Hanna Sofia Pantzar-Castilla, Per Wretenberg, Jacques Riad

Acta Orthop. 2021 Apr 18;1-7. doi: 10.1080/17453674.2021.1912941. Online ahead of print.

Background and purpose - The impact of knee flexion contracture (KFC) on function in cerebral palsy (CP) is not clear. We studied KFC, functional mobility, and their association in children with CP.Subjects and methods - From the Swedish national CP register, 2,838 children were defined into 3 groups: no (≤ 4°), mild (5-14°), and severe (≥ 15°) KFC on physical examination. The Functional Mobility Scale (FMS) levels were categorized: using wheelchair (level 1), using assistive devices (level 2-4), walking independently (level 5-6). Standing and transfer ability and Gross Motor Function Classification (GMFCS) were assessed.Results - Of the 2,838 children, 73% had no, 14% mild, and 13% severe KFC. KFC increased from 7% at GMFCS level I to 71% at level V. FMS assessment (n = 2,838) revealed around 2/3 were walking independently and 1/3 used a wheelchair. With mild KFC (no KFC as reference), the odds ratio for FMS level 1 versus FMS level 5-6 at distances of 5, 50, and 500 meters, was 9, 9, and 8 respectively. Correspondingly, with severe KFC, the odds ratio was 170, 260, and 217. In no, mild, and severe KFC 14%, 47%, and 77% could stand with support and 11%, 25%, and 33% could transfer with support.Interpretation - Knee flexion contracture is common in children with CP and the severity of KFC impacts function. The proportion of children with KFC rose with increased GMFCS level, reduced functional mobility, and decreased standing and transfer ability. Therefore, early identification and adequate treatment of progressive KFC is important.

PMID: 33870826

7. Kinematic and Temporospatial Changes in Children with Cerebral Palsy during the Initial Stages of Gait Development
Rigas Dimakopoulos, George Syrogiannopoulos, Ioanna Grivea, Zoe Dailiana, Sotirios Youroukos, Arietta Spinou

Dev Neurorehabil. 2021 Apr 19;1-9. doi: 10.1080/17518423.2021.1914763. Online ahead of print.

Purpose: To identify changes in the gait kinematics and temporospatial parameters of children with bilateral Cerebral Palsy (CP) at 8 months after the onset of independent walking and identify differences to Typical Development (TD) children at the onset of independent walking and at 8 months follow up.Method: Sixteen children with bilateral CP, GMFCS levels I and II, and 15 TD children were recruited. Gait kinematics and temporospatial parameters were recorded using a 3-D gait analysis system; the sagittal plane of the lower limb joints was analyzed. Baseline measurements were recorded at the individual's onset of independent walking and follow up was after 8 months.Results: Compared to baseline, children with bilateral CP demonstrated increased (mean difference ± SE) plantar flexion (11.79 ± 2.96), single support (0.04 ± 0.01), step length (0.2 ± 0.05) and stride length (0.4 ± 0.09), at follow up; all $p < .05$. Compared to TD children, they also had lower gait speed (0.16 ± 0.05), higher single support (0.02 ± 0.01) and lower maximum knee extension (9.14 ± 4.49) during the swing phase, at baseline and follow up (0.1 ± 0.04, 0.05 ± 0.01, 23.04 ± 4.17, respectively); all $p < .05$.Conclusion: There are changes in the sagittal plane kinematics and temporospatial parameters of the gait during the first 8 months of independent walking. These indicate gait maturation changes and highlight the impact of walking experience on the gait characteristics of children with bilateral CP.

PMID: 33872103

8. Protocol for The Toxin Study: Understanding clinical and patient reported response of children and young people with cerebral palsy to intramuscular lower limb Botulinum neurotoxin-A injections, exploring all domains of the ICF. A pragmatic longitudinal observational study using a prospective one-group repeated measures design
Lesley R Katchburian, Kate Oulton, Eleanor Main, Christopher Morris, Lucinda J Carr

BMJ Open. 2021 Apr 21;11(4):e049542. doi: 10.1136/bmjopen-2021-049542.

Introduction: Botulinum neurotoxin-A (BoNT-A) is an accepted treatment modality for the management of hypertonia in children and young people with cerebral palsy (CYPwCP). Nevertheless, there are concerns about the long-term effects of BoNT-A, with a lack of consensus regarding the most meaningful outcome measures to guide its use. Most evidence to date is based on short-term outcomes, related to changes at impairment level (restrictions of body functions and structures), rather than changes in adaptive skills (enabling both activity and participation). The proposed study aims to evaluate clinical and patient reported outcomes in ambulant CYPwCP receiving lower limb BoNT-A injections over a 12-month period within all domains of the WHO's International Classification of Functioning, Disability and Health and health-related quality of life (HRQoL). Methods and analysis: This pragmatic prospective longitudinal observational study will use a one-group repeated measures design. Sixty CYPwCP, classified as Gross Motor Function Classification System (GMFCS) levels I-III, aged between 4 and 18 years, will be recruited from an established movement disorder service in London, UK. Standardised clinical and patient reported outcome measures within all ICF domains; body structures and function, activity (including quality of movement), goal attainment, participation and HRQoL, will be collected preinjection and at 6 weeks, 6 months and up to 12 months postinjection. A representative subgroup of children and carers will participate in a qualitative component of the study, exploring how their experience of BoNT-A treatment relates to clinical outcome measures. Ethics and dissemination: Central London Research Ethics Committee has granted ethics approval (#IRAS 211617 #REC 17/LO/0579). Findings will be disseminated in peer-reviewed publications, conferences and via networks to participants and relevant stakeholders using a variety of accessible formats including social media.

PMID: 33883158

9. Barriers and facilitators of physical activity participation for people with disabilities: a parent's perspective
Cynthia Frisina

Dev Med Child Neurol. 2021 Apr 16. doi: 10.1111/dmcn.14897. Online ahead of print.

PMID: 33864245

10. Gradual Deprogramming of Self-Inflicted Oral Trauma Habit in a Child with Cerebral Palsy
Aline Dos Santos Letieri, Mariana Leonel Martins, Julio Cesar Campos Ferreira Filho, Michelle Agostini, Gloria Fernanda Barbosa de Araújo Castro

J Dent Child (Chic). 2021 Jan 15;88(1):58-61.

The purpose of this paper is to report the successful noninvasive treatment of a self-inflicted traumatic lesion on the lower labial mucosa in a 22-month-old boy with cerebral palsy. An acrylic appliance was cemented on the anterior maxillary region to reduce repetitive self-injury by gradual deprogramming. The wound healed after a few weeks, but four weeks after the appliance was removed new trauma was observed at the site. The appliance was replaced by a new one on the anterior region of the mandibular arch, and complete remission of the habit was achieved after three weeks. In order to prevent relapse, the appliance was gradually reduced in size with carbide drills every two weeks and was removed three weeks after the final reduction. After 24 months of follow-up, the labial mucosa was completely healed and no recurrence of the traumatic habit has been observed.

PMID: 33875054

11. The challenges of posterior drooling in children with cerebral palsy
Dinah S Reddihough, Anne B Chang

Dev Med Child Neurol. 2021 Apr 16. doi: 10.1111/dmcn.14898. Online ahead of print.

PMID: 33864259

12. Analgesia and sedation modalities used with botulinum toxin injections in children with cerebral palsy: a literature review
Ahmed Nugud, Shahad Alhoot, Maha Agabna, Mohamed O E Babiker, Haitham El Bashir

Review Sudan J Paediatr. 2021;21(1):6-12. doi: 10.24911/SJP.106-1604549033.

Cerebral palsy (CP) is a non-progressive motor dysfunction leading to multiple morbidities, including spasticity, which can be managed with botulinum toxin injection (BTI). This literature review aims to examine published studies on the efficacy and safety of different interventions used to reduce pain and anxiety associated with BTI in children with CP. A literature review of all published evidence in English language, or with an English translation between 1999 and 2019, using PubMed, EBSCO host, and Medline databases was carried out. All identified papers were screened for inclusion criteria. Data from included papers were entered and analyzed on an Excel database. Twenty-one studies conducted in multiple clinical settings identified 10 different analgesia and sedation modalities including intravenous ketamine, midazolam, inhaled nitrous oxide, general anesthesia, and Eutectic Mixture of Local Anesthetics (EMLA®) cream. Most of the studies were descriptive with the exception of two clinical trials and one qualitative study. All interventions had some adverse effects, but they were generally mild and no long-term sequelae were reported. The combination of inhaled nitrous oxide with EMLA® cream showed promising primary results. However, ketamine and midazolam combination could be a safe alternative. Currently, there is no sufficient data to draw on the superiority of any modality. Further high-quality studies are warranted.

PMID: 33879937

13. The Impact of Eye-gaze Controlled Computer on Communication and Functional Independence in Children and Young People with Complex Needs - A Multicenter Intervention Study
Maria Borgestig, Isphana Al Khatib, Sandra Masayko, Helena Hemmingsson

Dev Neurorehabil. 2021 Apr 19;1-14. doi: 10.1080/17518423.2021.1903603. Online ahead of print.

Introduction: Children and young people with complex needs (severe motor impairments and without speech) have few opportunities to use alternative devices for communication. Eye-gaze controlled computers (EGCCs) might provide individuals with complex needs increased opportunities for communication and participation in society. Objective: To investigate the impact of EGCCs on communication, functional independence and participation in activities in children and young people with complex needs. Methods: A multicenter intervention study during seven months, measuring outcomes with or without EGCC at four time points, was conducted in Sweden, Dubai, and in USA. Seventeen participants (aged 3-26 years, diagnosis e.g. cerebral palsy, Rett syndrome) were provided with EGCC and services from an Assistive Technology center to implement EGCC in school and/or at home. Results: Participants significantly increased their expressive communication skills and functional independence with EGCC compared to baseline. All but one (16 of 17) increased their activity repertoire and computer use with EGCC. With EGCC, participation in computer activities averaged 4.1 performed activities (e.g. communication, play), with a duration of 70 minutes/day and a frequency of 76% of days. Discussion: The study strengthened the research evidence that EGCC can be an effective intervention in daily life for children and young people with complex needs. Communication and independence, common goals of intervention, were shown to be relevant EGCC outcomes.

PMID: 33872136

14. Gamification and neurological motor rehabilitation in children and adolescents: A systematic review [Article in English, Spanish]
M Pimentel-Ponce, R P Romero-Galisteo, R Palomo-Carrión, E Pinero-Pinto, J A Merchán-Baeza, M Ruiz-Muñoz, J Oliver-Pece, M González-Sánchez

Review Neurologia. 2021 Apr 15;S0213-4853(21)00049-9. doi: 10.1016/j.nrl.2021.02.011. Online ahead of print.

Introduction: Gamification consists of the use of games in non-playful contexts. It is widely employed in the motor rehabilitation of neurological diseases, but mainly in adult patients. The objective of this review was to describe the use of gamification in the rehabilitation of children and adolescents with neuromotor impairment. Methods: We performed a systematic review of clinical trials published to date on the MEDLINE (PubMed), Scielo, SCOPUS, Dialnet, CINAHL, and PEDro databases, following the PRISMA protocol. The methodological quality of the studies identified was assessed using the PEDro scale. Results: From a total of 469 studies, 10 clinical trials met the inclusion criteria. We analysed the gamification systems used as part of the rehabilitation treatment of different neuromotor conditions in children and adolescents. Cerebral palsy was the most frequently studied condition (6studies), followed by developmental coordination disorder (3), and neurological impairment of balance and coordination (1). Conclusion: The use of gamification in rehabilitation is helpful in the conventional treatment of neuromotor disorders in children and adolescents, with increased motivation and therapeutic adherence being the benefits with the greatest consensus among authors. While strength, balance, functional status, and coordination also appear to improve, future research should aim to determine an optimal dosage.

PMID: 33867183

15. Mothers' perspectives on the influences shaping their early experiences with infants at risk of cerebral palsy in India
Nataya Branjerdporn, Emma Crawford, Jenny Ziviani, Roslyn N Boyd, Katherine Benfer, Leanne Sakzewski

Res Dev Disabil. 2021 Apr 15;113:103957. doi: 10.1016/j.ridd.2021.103957. Online ahead of print.

Background: Accurate diagnosis of cerebral palsy (CP) high-risk status is now possible in infants less than six months corrected age. Parents play a central role in providing nurturing care and implementing early intervention approaches. To design interventions tailored to needs of parents and understand how to improve parental support, this study aimed to understand the influences shaping parent experiences with an infant at high-risk of CP in West Bengal, India. Methods and procedures: This phenomenological qualitative study was conducted with parents of infants at high-risk of CP in West Bengal, India. Individual in-depth interviews explored experiences with health providers, supports for caregiving and challenges of parenting. Interviews were conducted in English with concurrent translation and analysed using thematic analysis. Outcomes and results: Main themes included: limited finances and social networks shape decisions and caregiving practices; trust in the formal health care system; views of disability including explanations for their infant's condition and expectations for the child's future, and everyday adaptations required to meet infants' needs. Conclusions and implications: Low cost models of early intervention may alleviate the financial burden and stress on families. Dependence on health care professionals for care

management is a barrier to family-delivered approaches to care.

PMID: 33866079

16. Acute hypoxemia due to lung collapse in COVID-19: the role of therapeutic bronchoscopy
Sryma Pb, Karan Madan, Anant Mohan, Vijay Hadda, Pawan Tiwari, Randeep Guleria, Saurabh Mittal

Adv Respir Med. 2021 Apr 21. doi: 10.5603/ARM.a2021.0009. Online ahead of print.

Bronchoscopy is an aerosol-generating procedure and involves a high risk of transmission of SARS-CoV-2 to health care workers. There are very few indications for performing bronchoscopy in a patient with confirmed COVID-19. These include atelectasis, foreign body aspiration, and suspected superinfection in immunocompromised patients. Proper use of standard personal protective equipment is mandatory to reduce the risk of transmission to health care workers. In this article, we describe a case of acute lung collapse in a 16-year-old boy with cerebral palsy who was infected with COVID-19. This patient responded to therapeutic bronchoscopy and had complete resolution of lung collapse within 24 hours of the procedure.

PMID: 33881156

17. Feasibility of Whole Body Vibration Therapy in Individuals with Dystonic or Spastic Dystonic Cerebral Palsy: A Pilot Study
Tamis W Pin, Penelope B Butler, Sheila Purves, Nathan C-K Poon

J Rehabil Med Clin Commun. 2019 Oct 25;2:1000021. doi: 10.2340/20030711-1000021. eCollection 2019.

Objective: To examine the feasibility and practicality of whole body vibration therapy for individuals with dystonic or spastic dystonic cerebral palsy. Design: Pilot study. Subjects: Children and adults with dystonic or spastic dystonic cerebral palsy. Methods: Study participants received total body vibration therapy when standing still on a vibration platform for 3 bouts, duration 3-min, of vibration (20 Hz, 2 mm amplitude), 4 days per week for 4 weeks in addition to their usual therapy. All participants were assessed at baseline and completion of the study using the Gross Motor Function Measure Item Set, Timed Up and Go test, Barry-Albright Dystonia Scale, Edinburgh Visual Gait Score, and Pediatric Evaluation of Disability Inventory. Results: Ten participants (mean age 18.60 years (standard deviation (SD) 14.68); 9 males, Gross Motor Function Classification System level II-IV) completed the study with more than 90% attendance rate. All participants tolerated the protocol with no adverse events. Conclusion: The vibration treatment protocol was feasible and safe for all participants. With no significant differences found in all the outcome measures, future studies with more rigorous study designs are required before this intervention is recommended for this population group.

PMID: 33884122

18. Intrathecal baclofen, selective dorsal rhizotomy, and extracorporeal shockwave therapy for the treatment of spasticity in cerebral palsy: a systematic review
Amogh Kudva, Mickey E Abraham, Justin Gold, Neal A Patel, Julian L Gendreau, Yehuda Herschman, Antonios Mammis

Review Neurosurg Rev. 2021 Apr 19. doi: 10.1007/s10143-021-01550-0. Online ahead of print.

Cerebral palsy (CP) is a chronic congenital disorder as the result of abnormal brain development. Children suffering from CP often battle debilitating chronic spasticity, which has been the focus of recent academic literature. In this systematic review, the authors aim to update the current neuromodulation procedures for the treatment of spasticity associated with CP in all age groups. A systematic review following was conducted using PubMed from inception to 2020. After initial title and abstract screening, 489 articles were identified, and 48 studies met the inclusion criteria for this review. In total, a majority of the published articles of treatments for CP were reporting the use of selective dorsal rhizotomy (SDR) (54%), and the remainder were of intrathecal baclofen (ITB) pumps (29%) and extracorporeal shockwave therapy (ESWT) (17%). Each method was

found to have improvement of spasticity at a rate that achieved statistical significance. ITB pump therapy is an all-encompassing method of treating spasticity in children from CP, as it allows for a less invasive treatment that can be titrated to individual patient needs; however, its disadvantages include its long-term maintenance requirements. SDR appears to be an effective method for permanent spasticity relief in young patients. ESWT is a more recent and innovative technique for offering relief of spasticity while being minimally invasiveness. Further studies are needed to establish optimal frequencies and sites of application for ESWT.

PMID: 33871733

19. Water-Based Interventions for People With Neurological Disability, Autism, and Intellectual Disability: A Scoping Review
Karlee Naumann, Jocelyn Kernot, Gaynor Parfitt, Bethany Gower, Kade Davison

Review Adapt Phys Activ Q. 2021 Apr 19;1-20. doi: 10.1123/apaq.2020-0036. Online ahead of print.

The purpose of this study was to produce a descriptive overview of the types of water-based interventions for people with neurological disability, autism, and intellectual disability and to determine how outcomes have been evaluated. Literature was searched through MEDLINE, EMBASE, Ovid Emcare, SPORTDiscus, Google Scholar, and Google. One hundred fifty-three papers met the inclusion criteria, 115 hydrotherapy, 62 swimming, 18 SCUBA (self-contained underwater breathing apparatus), and 18 other water-based interventions. Common conditions included cerebral palsy, spinal cord injury, Parkinson's disease, and intellectual disability. Fifty-four papers explored physical outcomes, 36 psychosocial outcomes, and 24 both physical and psychosocial outcomes, with 180 different outcome measures reported. Overall, there is a lack of high-quality evidence for all intervention types. This review provides a broad picture of water-based interventions and associated research. Future research, guided by this scoping review, will allow a greater understanding of the potential benefits for people with neurological disability, autism, and intellectual disability.

PMID: 33873153

20. Single-centre parental survey of paediatric rehabilitation services for children with cerebral palsy
Rachel Bican, Rachel Ferrante, Sarah Hendershot, Jill C Heathcock

BMJ Paediatr Open. 2021 Mar 30;5(1):e000994. doi: 10.1136/bmjpo-2020-000994. eCollection 2021.

Cerebral palsy (CP) is the most common childhood motor disability. The dose of usual care for rehabilitation therapies is unknown. The purpose of this study was to describe current dosage of rehabilitation services for children with CP recruited from a paediatric hospital system in the USA. 96 children with CP were included in this cross-sectional survey. Parents reported frequency, intensity, time and type of therapy services. Weekly frequency was the most common. Children with CP received 0.9-1.2 hours/month of each discipline in the educational setting and 1.5-2.0 hours/month in the clinical setting, lower than the recommendations for improvements in motor skills.

PMID: 33869797

21. Gene Therapy in Movement Disorders: A Systematic Review of Ongoing and Completed Clinical Trials
Aristide Merola, Noelle Kobayashi, Alberto Romagnolo, Brenton A Wright, Carlo Alberto Artusi, Gabriele Imbalzano, Irene Litvan, Amber D Van Laar, Krystof Bankiewicz

Front Neurol. 2021 Apr 6;12:648532. doi: 10.3389/fneur.2021.648532. eCollection 2021.

Introduction: We sought to provide an overview of the published and currently ongoing movement disorders clinical trials employing gene therapy, defined as a technology aiming to modulate the expression of one or more genes to achieve a therapeutic benefit. Methods: We systematically reviewed movement disorders gene therapy clinical trials from PubMed and

ClinicalTrials.gov using a searching strategy that included Parkinson disease (PD), Huntington disease (HD), amino acid decarboxylase (AADC) deficiency, multiple system atrophy (MSA), progressive supranuclear palsy (PSP), dystonia, tremor, ataxia, and other movement disorders. Data extracted included study characteristics, investigational product, route of administration, safety/tolerability, motor endpoints, and secondary outcomes (i.e., neuroimaging, biomarkers). Results: We identified a total of 46 studies focusing on PD (21 published and nine ongoing), HD (2 published and 5 ongoing), AADC deficiency (4 published and 2 ongoing), MSA (2 ongoing), and PSP (1 ongoing). In PD, intraparenchymal infusion of viral vector-mediated gene therapies demonstrated to be safe and showed promising preliminary data in trials aiming at restoring the synthesis of dopamine, enhancing the production of neurotrophic factors, or modifying the functional interaction between different nodes of the basal ganglia. In HD, monthly intrathecal delivery of an antisense oligonucleotide (ASO) targeting the huntingtin protein (HTT) mRNA proved to be safe and tolerable, and demonstrated a dose-dependent reduction of the cerebrospinal fluid levels of mutated HTT, while a small phase-I study testing implantable capsules of cells engineered to synthesize ciliary neurotrophic factor failed to show consistent drug delivery. In AADC deficiency, gene replacement studies demonstrated to be relatively safe in restoring catecholamine and serotonin synthesis, with promising outcomes. Ongoing movement disorders clinical trials are focusing on a variety of gene therapy approaches including alternative viral vector serotypes, novel recombinant genes, novel delivery techniques, and ASOs for the treatment of HD, MSA, and distinct subtypes of PD (LRRK2 mutation or GBA1 mutation carriers). Conclusion: Initial phase-I and -II studies tested the safety and feasibility of gene therapy in PD, HD, and AADC deficiency. The ongoing generation of clinical trials aims to test the efficacy of these approaches and explore additional applications for gene therapy in movement disorders.

PMID: 33889127

22. Recovery of the brain after intraventricular hemorrhage
Bokun Cheng, Praveen Ballabh

Semin Fetal Neonatal Med. 2021 Feb 26;101224. doi: 10.1016/j.siny.2021.101224. Online ahead of print.

Intraventricular hemorrhage (IVH) remains a major complication of prematurity, worldwide. The severity of IVH is variable, ranging from a tiny germinal matrix bleed to a moderate-to-large ventricular hemorrhage or periventricular hemorrhagic infarction. Survivors with IVH often suffer from hydrocephalus and white matter injury. There is no tangible treatment to prevent post-hemorrhagic cerebral palsy, cognitive deficits, or hydrocephalus in these infants. White matter injury is attributed to blood-induced damage to axons and maturing oligodendrocyte precursors, resulting in reduced myelination and axonal loss. Hydrocephalus results from obstructed CSF circulation by blood clots, increased CSF production, and reduced CSF absorption by lymphatics and arachnoid villi. Several strategies to promote neurological recovery have shown promise in animal models, including the elimination of blood and blood products, alleviating cerebral inflammation and oxidative stress, as well as promoting survival and maturation of oligodendrocyte precursors. The present review integrates novel mechanisms of brain injury in IVH and the imminent therapies to alleviate post-hemorrhagic white matter injury and hydrocephalus in the survivors with IVH.

PMID: 33888444

23. Mechanisms Underlying Neurologic Injury in Intrauterine Growth Restriction
Lijia Wan, Kaiju Luo , Pingyang Chen

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Intrauterine growth restriction is a condition that prevents normal fetal development, and previous studies have reported that intrauterine growth restriction is caused by adverse intrauterine factors. This condition affects both short- and long-term neurodevelopmental disorders. Studies have revealed that neurodevelopmental disorders can contribute to gray and white matter damage and decrease the brain volume of affected individuals. Further, these disorders are associated with increased risks of mental retardation, cognitive impairment, and cerebral palsy, which seriously affect the quality of life. Although the mechanisms underlying the neurologic injury associated with intrauterine growth restriction are not completely clear, studies have revealed that neuronal apoptosis, neuroinflammation, oxidative stress, excitatory toxicity, disruption of blood-brain barrier, and epigenetics may be involved in this process. This article reviews the manifestations and possible mechanisms underlying neurologic injury in intrauterine growth restriction and provides a theoretical basis for the effective prevention and treatment of this condition.

PMID: 33882746

24. Periventricular leukomalacia: an ophthalmic perspective
Rolli Khurana, Kripanidhi Shyamsundar, Priya Taank, Ankita Singh

Review Med J Armed Forces India. 2021 Apr;77(2):147-153. doi: 10.1016/j.mjafi.2020.05.013. Epub 2020 Jul 15.

Periventricular leukomalacia (PVL) is a common magnetic resonance imaging (MRI) finding in cases of hypoxic ischemic encephalopathy. PVL, in MRI, is identified by the increased signal intensity of periventricular white matter on T2-weighted sequences which is more conspicuous in the posterior cortex. It occurs because of perinatal damage to the cerebral cortex. This insult is in the form of hypoxia, metabolic insults, prematurity, seizures, or infection. Periventricular area is most prone to damage owing to its immaturity and vascular supply. PVL is proven to affect vision in children. Depending on the area and cause of affection, PVL is associated with variable ophthalmic manifestations. It is known that visual function is closely linked to the overall neurodevelopment of a child. A multidisciplinary approach is required to promote the growth and development of these children, and in the midst of multiple disabilities, visual function should not be overlooked. A comprehensive knowledge of the ophthalmological presentation in the developing world can aid us in an early and accurate diagnosis and in intervention for better therapeutic recovery and rehabilitation of these children.

PMID: 33867629

25. Hyperoxia-activated circulating extracellular vesicles induce lung and brain injury in neonatal rats
Anum Ali, Ronald Zambrano, Matthew R Duncan, Shaoyi Chen, Shihua Luo, Huijun Yuan, Pingping Chen, Merline Benny, Augusto Schmidt, Karen Young, Nadine Kerr, Juan Pablo de Rivero Vaccari, Robert W Keane, W Dalton Dietrich, Shu Wu

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Hyperoxia-induced lung injury plays a key role in the development of bronchopulmonary dysplasia (BPD), characterized by inflammatory injury and impaired lung development in preterm infants. Although BPD is a predictor of poor neurodevelopmental outcomes, currently it is uncertain how lung injury contributes to brain injury in preterm infants. Extracellular vesicles (EVs) are a heterogeneous group of cell-derived membranous structures that regulate intercellular and inter-organ communications. Gasdermin D (GSDMD) has emerged as a key executor of inflammasome-mediated cell death and inflammation. In this study, we utilized a neonatal rat model of BPD to assess if hyperoxia stimulates lung release of circulating EVs and if these EVs induce lung and brain injury. We found that hyperoxia-exposed rats had elevated numbers of plasma-derived EVs compared to rats maintained in room air. These EVs also had increased cargos of surfactant protein C, a marker of type II alveolar epithelial cells (AEC), and the active (p30) form of GSDMD. When these EVs were adoptively transferred into normal newborn rats via intravenous injection, they were taken up both by lung and brain tissues. Moreover, EVs from hyperoxic animals induced not only the pathological hallmarks of BPD, but also brain inflammatory injury in recipient rats, as well as inducing cell death in cultured pulmonary vascular endothelial cells and neural stem cells (NSC). Similarly, hyperoxia-exposed cultured AEC-like cells released EVs that also contained increased GSDMD-p30 and these EVs induced pyroptotic cell death in NSC. Overall, these data indicate that hyperoxia-activated circulating EVs mediate a lung to brain crosstalk resulting in brain injury and suggest a mechanism that links lung injury and neurodevelopmental impairment in BPD infants.

PMID: 33888735

26. The association between restricted intrauterine growth and inadequate postnatal nutrition in very-low-birth-weight infants and their neurodevelopmental outcomes: a 50-month follow-up study
Jose Uberos, Sara Jimenez-Montilla, Irene Machado Casas, Carolina Laynez-Rubio, Elizabeth Fernández-Marin, Ana Campos-Martínez

Br J Nutr. 2021 Apr 19;1-22. doi: 10.1017/S000711452100132X. Online ahead of print.

Inadequate nutrition during a critical period of development - as is the case during gestation and the first days of life, especially in very-low-birth-weight (VLBW) infants - can impact on neurodevelopment and favour comorbidities. In this study, we evaluate how neurodevelopment may be affected by intrauterine growth (IUGR) restriction and by an inadequate intake of nutritional energy during the early neonatal period. A longitudinal cohort study was conducted to analyse the nutritional contributions received during the first week of life, among a population of 396 VLBW infants. Motor, cognitive, sensory and behavioural development was assessed at 14, 25, 33 and 50 months. The association between IUGR, postnatal energy restriction and neurodevelopment was examined using multivariate logistic regression techniques. Mild cognitive delay was observed in 35.6% of neonates with IUGR and in 24% of those with appropriate birth weight. IUGR is associated with behavioural disorder (OR 2.60; 95% CI 1.25 - 5.40) and delayed cognitive development (OR 2.64; 95% CI 1.34 - 5.20). Energy restriction during the first week of life is associated with visual deficiency (OR 2.96; 95% CI 1.26 - 6.84) and cerebral palsy (OR 3.05; CI 95% 1.00 - 9.54). In VLBW infants, IUGR is associated with behavioural disorder, while postnatal energy restriction is significantly associated with motor disorder, infantile cerebral palsy and sensory disorder.

PMID: 33866979

27. Childhood neurodevelopmental disorders and maternal hypertensive disorder of pregnancy
Kuan-Ru Chen, Tsung Yu, Lin Kang, Yueh-Ju Lien, Pao-Lin Kuo

Dev Med Child Neurol. 2021 Apr 21. doi: 10.1111/dmcn.14893. Online ahead of print.

Aim: To examine the association of maternal chronic hypertension and pregnancy-induced hypertension (PIH)/preeclampsia with childhood neurodevelopmental disorders (NDDs) in a large-scale population-based cohort. Method: We conducted a linked Taiwan National Health Insurance Research Database cohort study of children born between 2004 and 2008 (n=877 233). Diagnoses of autism spectrum disorder (ASD), attention-deficit/hyperactivity disorder (ADHD), developmental delay, intellectual disability, cerebral palsy (CP), and epilepsy/infantile spasms were identified from birth to the end of 2015. Cox proportional hazards models were fitted with adjustment for potential confounders to estimate the effect of maternal hypertensive disorder of pregnancy on childhood outcomes. Results: Compared with the offspring of unexposed mothers, offspring of mothers with chronic hypertension or PIH/preeclampsia exhibited increased risk of developing a wide spectrum of NDDs. Chronic hypertension was associated with increased risks of ADHD (hazard ratio 1.22, 95% confidence interval [CI] 1.13-1.31), developmental delay (1.29, 1.21-1.38), intellectual disability (1.67, 1.43-1.95), CP (1.45, 1.14-1.85), and epilepsy/infantile spasms (1.31, 1.10-1.56) in the offspring, whereas PIH/preeclampsia was associated with increased risks of ASD (1.27, 1.12-1.43), ADHD (1.23, 1.17-1.29), developmental delay (1.29, 1.24-1.35), intellectual disability (1.53, 1.37-1.71), CP (1.44, 1.22-1.70), and epilepsy/infantile spasms (1.36, 1.22-1.52) in the offspring after adjustment for potential confounders. The co-occurrence of maternal diabetes, preterm deliveries, or fetal growth restriction further increased the risk. Interpretation: Chronic hypertension or PIH/preeclampsia seems to be sufficient to increase the risk of childhood NDDs.

PMID: 33884610

28. Latency Period after Preterm Premature Rupture of Membranes: Singletons versus Twins
Nigel Madden, Maria Andrikopoulou, Eve Overton, Cynthia Gyamfi-Bannerman

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Objective: Several studies have evaluated the differences in duration of latency and clinical outcomes between singleton and twin pregnancies after preterm premature rupture of membranes (PPROM); however, these data are limited to single-institution analyses and based on small sample sizes. The aim of this study was to assess differences in latency and clinical outcomes in singletons versus twin gestations affected by PPROM in a large, diverse cohort of women. Study design: This is a secondary analysis of a multicenter trial of magnesium for neuroprotection in women at high risk of preterm birth. Our study included women with PPROM ≥ 24 weeks with singleton and twin gestations. We compared singleton versus twin gestation and our primary outcome was duration of latency after PPROM. Secondary outcomes included selected perinatal and neonatal outcomes including long-term neurodevelopmental outcomes. We fit a linear regression model to assess independent risk factors for latency duration. Results: Our study included 1,753 women, 1,602 singleton gestations (91%) and 151 twin gestations (9%). The median latency period was significantly shorter in twins (4 [interquartile range, IQR: 1-10] vs. 7 [IQR: 3-16] days, $p < 0.001$) and gestational age at delivery was significantly earlier (29.3 vs. 30.1 weeks, $p = 0.001$). Twins were more likely to develop neonatal sepsis (20.1 vs. 13.4%, $p = 0.004$), but rates of chorioamnionitis and abruption did not differ. Twins were more likely to suffer from adverse short-term neonatal outcomes, had higher rates of neonatal demise (7.9 vs. 3.8%, p =

0.002), and had higher rates of cerebral palsy (7.3 vs. 3.7, p = 0.005). When adjusting for confounders, twin gestation remained an independent risk factor for shorter latency (p < 0.001). Conclusion: Twin gestations affected by PPROM had shorter latency, earlier delivery, and higher rates of short- and long-term morbidity. Despite having longer latency, singleton gestations did not have higher rates of complications associated with expectant management. Key points: · Twins affected by PPROM had shorter latency duration and earlier gestational at delivery. · Twins with PPROM had higher rates of both short- and long-term perinatal morbidity. · Rates of chorioamnionitis and abruption did not differ between twins and singletons with PPROM.

PMID: 33878769

29. Vitamin D, Bone Mineral Density and Serum IGF-1 Level in Non-ambulatory Children with Cerebral Palsy
Namita Gwasikoti, Kapil Bhalla, Jaya Shankar Kaushik, Veena Singh Ghalaut, Zile Singh Kundu

Indian Pediatr. 2021 Apr 17;S097475591600312. Online ahead of print.

Objectives: To compare serum 25-hydroxy vitamin D (25-OHD) status, bone mineral density and Insulin growth factor (IGF-1) level among children with cerebral palsy (CP) aged 1 to 8 years with age and gender matched controls. Methods: A cross-sectional study enrolled thirty children in each group: CP with epilepsy, CP without epilepsy, and healthy controls and bone mineral density (BMD), serum 25-OHD levels, and serum insulin like growth factor (IGF)-1 levels were measured. Results: Z scores of BMD [-1.80 (1.03), -2.12 (0.85) Vs -1.40 (0.90); P<0.01], 25-OHD levels [19.26 (8.28), 20.59 (8.92) Vs 26.79 (12.76) ng/mL; P<0.01] and IGF-1 levels [20.90 (6.42), 23.37 (8.11) Vs 31.77 (11.21) ng/mL; P<0.01] were significantly low among children with CP with epilepsy, CP without epilepsy when compared to controls. Conclusions: Children with CP with or without comorbid epilepsy were prone to vitamin D deficiency, low bone mineral density and growth hormone axis suppression with low IGF-1 levels.

PMID: 33864451