

Monday 10 April 2017

Cerebral Palsy Alliance is delighted to bring you this free weekly bulletin of the latest published research into cerebral palsy. Our organisation is committed to supporting cerebral palsy research worldwide - through information, education, collaboration and funding. Find out more at research.cerebralpalsy.org.au

Professor Nadia Badawi AM

Macquarie Group Foundation Chair of Cerebral Palsy

[Subscribe to CP Research News](#)

Please note: This research bulletin represents only the search results for cerebral palsy and related neurological research as provided by the PubCrawler service. The articles listed below do not represent the views of Cerebral Palsy Alliance.

Interventions and Management

1. Motor learning paradigm and contextual interference in manual computer tasks in individuals with cerebral palsy.

Prado MT, Fernani DC, Silva TD, Smorenburg AR, Abreu LC, Monteiro CB.

Res Dev Disabil. 2017 Mar 25;64:56-63. doi: 10.1016/j.ridd.2017.03.006. [Epub ahead of print]

BACKGROUND: Cerebral palsy (CP) is a group of disorders of movement and posture that cause activity limitations. Due to the different motor problems these individuals encounter there is a need to offer rehabilitation programs that promote motor learning. Additionally, the understanding of the learning patterns of these individuals can help us attend to their learning needs to maximize their learning efficiency. **AIMS:** The present study aimed to add to the knowledge base in regards to motor learning and the contextual interference (CI) effect. **METHODS AND PROCEDURES:** The study included 40 individuals with CP and 40 typically developing (TD) participants matched for age and gender with the CP group. Both groups were divided into 2 subgroups regarding the practice schedule (random or constant practice) of a manual maze test on the computer. The participants who performed in the constant practice schedule performed the same standard maze 30 times, while participants in the random practice schedule performed a total of 30 trials on 5 mazes with a different spatial layout including the standard maze. After 5min of rest, retention was studied with a task in which all participants performed the standard maze. To examine the transfer effect, all participants also performed a maze with a new layout. Time of completion was registered in seconds for each trial. **OUTCOMES AND RESULTS:** The results showed that the performance was lower in individuals with CP compared to typically developing individuals. In addition, only the participants with CP showed a contextual interference effect, with performance after the random practice schedule being superior compared to participants who practiced with a constant practice schedule. **CONCLUSIONS AND IMPLICATIONS:** Overall performance was lower in individuals with CP compared to individuals with TD. Additionally, both TD individuals and individuals with CP showed the contextual interference effect in the transfer phase, with the execution of random practice leading to better performance than constant practice. These findings provide important information to assist clinicians in developing rehabilitation programs for children with CP.

[PMID: 28351764](#)

2. Assessment of Upper Limb Motor Dysfunction for Children with Cerebral Palsy Based on Muscle Synergy Analysis.

Tang L, Chen X, Cao S, Wu, Zhao G, Zhang X.

Front Hum Neurosci. 2017 Mar 23;11:130. doi: 10.3389/fnhum.2017.00130. eCollection 2017.

Muscle synergies are considered to be building blocks underlying motor behaviors. The goal of this study is to explore an objective and effective method to assess the upper limb motor dysfunction of cerebral palsy (CP) children from the aspect of muscle synergy analysis. Fourteen CP children and 10 typically developed (TD) children were recruited to perform three similar upper limb motion tasks related to the movements of elbow and shoulder joints, and surface electromyographic

(sEMG) signals were recorded from 10 upper arm and shoulder muscles involved in the defined tasks. Non-negative matrix factorization algorithm was used to extract muscle synergies and the corresponding activation patterns during three similar tasks. For each subject in TD group, four muscle synergies were extracted in each task. Whereas, fewer mature synergies were recruited in CP group, and many abnormal synergy structures specific to CP group appeared. In view of neuromuscular control strategy differences, three synergy-related parameters were proposed and synergy structure similarity coefficient was found to have high ability in depicting the inter-subject similarity within task and the intra-subject similarity between tasks. Seven upper limb assessment (UPA) metrics, which were defined as the combinations of synergy structure similarity coefficients of three tasks, were proposed to assess the upper limb motor function of CP children. The experimental results demonstrated that these UPA metrics were able to assess upper limb motor function comprehensively and effectively. The proposed assessment method can serve as a promising approach to quantify the abnormality of muscle synergies, thus offering potential to derive a physiologically based quantitative index for assessing upper limb motor function in CP clinical diagnosis and rehabilitation.

[PMID: 28386223](#)

3. Evaluating the Discriminant Validity of the Pediatric Evaluation of Disability Inventory: Computer Adaptive Test in Children With Cerebral Palsy.

Shore BJ, Allar BG, Miller PE, Matheny TH, Snyder BD, Fragala-Pinkham MA.

Phys Ther. 2017 Mar 31. doi: 10.1093/ptj/pzx033. [Epub ahead of print]

BACKGROUND: The PEDI-CAT is a new clinical assessment for children and youth from birth through 20 years of age. **OBJECTIVE:** To determine the discriminant validity of the PEDI-CAT according to Gross Motor Function Classification System (GMFCS) and Manual Ability Classification System (MACS) in children with cerebral palsy (CP). **DESIGN:** A prospective convenience cross-sectional sample of 101 school-aged children with CP was stratified by GMFCS level. **METHODS:** Participants were excluded if they underwent recent surgery (<6 months). Receiver operator curve analysis was used to quantify the discriminant validity of the PEDI-CAT domains to distinguish level of independence in fine and gross motor function. General linear modeling was used to assess discriminant ability across all GMFCS and MACS levels. **RESULTS:** Mean age was 11 years, 11 months (SD 3.7). Mobility and Daily Activities domains exhibited excellent discriminant validity distinguishing between ambulatory and non-ambulatory participants (AUC = 0.98 and 0.97, respectively) and Daily Activities domain exhibited excellent discriminant validity distinguishing between independent and dependent hand function (AUC = 0.93). All PEDI-CAT domains were able to discriminate between ambulatory (GMFCS level I-III) or non-ambulatory (GMFCS level IV-V) as well as manually independent (MACS level I-II) or manually dependent functional levels (MACS level III-V) ($p < 0.001$). **LIMITATIONS:** Our convenience-cross sectional sample included school age children with primarily Caucasian, middle-income parents and may not be representative of other cultural, socio-economic backgrounds. Not all participants had a MACS level assigned; however, we found no differences in PEDI-CAT scores between those with and without MACS scores. **CONCLUSIONS:** These results demonstrate that the PEDI-CAT is a valid outcome instrument for measuring functional abilities in children with CP, able to differentiate across fine and gross motor functional levels.

[PMID: 28379484](#)

4. Abnormality of standing posture improves in patients with bilateral spastic cerebral palsy following lower limb surgery.

Buddhdev P, Fry NR, LePage R, Wiley M, Gough M, Shortland AP.

Gait Posture. 2017 Mar 9;54:255-258. doi: 10.1016/j.gaitpost.2017.03.014. [Epub ahead of print]

OBJECTIVES: The degree of abnormality of the gait pattern of children with bilateral spastic cerebral palsy (BSCP) can be reduced by lower limb orthopaedic surgery. However, little attention is paid to the effects of surgery on standing posture. Here, we investigated the abnormality of standing posture in young people with BSCP as well as the effects of surgery on standing posture. **METHODS:** We have developed an index of standing posture, the Standing Posture Score (SPS), which is similar in composition to the gait profile score (GPS). We applied SPS retrospectively to 32 typically developing children and 85 children with BSCP before and after surgery to the lower limbs aimed at improving gait. We investigated the relationship between SPS and GPS before surgery and also the relationship between changes in these variables before and after surgery. **RESULTS:** SPS is significantly higher in young people with BSCP. SPS reduces after surgery and this reduction is correlated with the reduction in GPS. **INTERPRETATION:** Successful surgery improves the alignment of the lower limbs in BSCP in standing and may have a positive impact on the activities of daily living which depend on a stable and efficient standing posture.

[PMID: 28371738](#)

5. **ACTIVLIM-CP a new Rasch-built measure of global activity performance for children with cerebral palsy.**

Bleyenheuft Y, Paradis J, Renders A, Thonnard JL, Arnould C.

Res Dev Disabil. 2017 Jan;60:285-294. doi: 10.1016/j.ridd.2016.10.005. Epub 2016 Oct 27.

OBJECTIVE: Children with cerebral palsy (CP) often have upper extremity (UE) and lower extremity (LE) impairments. While tools measuring separately UE and LE abilities are currently used, activities in which UE and LE are used in combination - numerous in everyday life - cannot be assessed because no instrument allows capturing global activity performance in children with CP. This study aimed to develop a clinical tool for measuring their global activity performance using the Rasch model. **STUDY DESIGN:** The caregivers of 226 children with CP (2-18 years old) answered a 154-item experimental questionnaire. Within 4-6 weeks, 129 of them filled in the questionnaire a second time. Responses were analyzed using the Rasch RUMM2020 software. **RESULTS:** The final 43 item scale presented a high reliability ($R=0.98$) and reproducibility ($R=0.97$). The item difficulty hierarchy was consistent over time and did not vary according to age, gender, or clinical form, allowing the follow-up of children from 2 to 18 years old. **CONCLUSIONS:** ACTIVLIM-CP is a unidimensional scale specifically developed to measure global activity performance in children with CP providing a reliable tool to follow children's evolution and document changes related to neurorehabilitation, especially where a combination of UE and LE is targeted. Its responsiveness is still to be tested.

[PMID: 28341237](#)

6. **Gait Training With Visual Feedback and Proprioceptive Input to Reduce Gait Asymmetry in Adults With Cerebral Palsy: A Case Series.**

Levin I, Lewek MD, Feasel J, Thorpe DE.

Pediatr Phys Ther. 2017 Apr;29(2):138-145. doi: 10.1097/PEP.0000000000000362.

PURPOSE: The purpose of this case series was to investigate the feasibility of using visual feedback on gait asymmetry during gait retraining and whether this leads to reduced asymmetry, improvement in gait speed, cost of walking, and dynamic balance in ambulant adults with cerebral palsy (CP). **METHODS:** Five adults with CP, who were ambulatory and had step length or stance time asymmetry, trained for 18 sessions on a split-belt treadmill with concurrent visual feedback from a virtual environment. Training also included overground gait training to encourage transfer of learning. **RESULTS:** All participants reduced gait asymmetry and improved on outcomes at posttest and follow-up. **CONCLUSIONS:** Outcome measures and training protocols were feasible in this sample of convenience of adults with CP who were ambulatory and who did not have visual impairment. The adults with CP in this study demonstrated individual improvements in gait and balance following training.

[PMID: 28350769](#)

7. **Commentary on "Gait Training With Visual Feedback and Proprioceptive Input to Reduce Gait Asymmetry in Adults With Cerebral Palsy: A Case Series".**

Johnson CC, Osborne MB.

Pediatr Phys Ther. 2017 Apr;29(2):145. doi: 10.1097/PEP.0000000000000374.

[No abstract available]

[PMID: 28350770](#)

8. Factors Influencing the Gross Motor Outcome of Intensive Therapy in Children with Cerebral Palsy and Developmental Delay.

Hong BY, Jo L, Kim JS, Lim SH, Bae JM.

J Korean Med Sci. 2017 May;32(5):873-879. doi: 10.3346/jkms.2017.32.5.873.

The study was designed to identify factors influencing the short term effect of intensive therapy on gross motor function in children with cerebral palsy or developmental delay. Retrospectively, total Gross Motor Function Measure-88 (GMFM-88) scores measured during the first and last weeks of intensive therapy were analyzed (n = 103). Good and poor responder groups were defined as those in the top and bottom 25% in terms of score difference, respectively. The GMFM-88 score increased to 4.67 ± 3.93 after 8 weeks of intensive therapy ($P < 0.001$). Gross Motor Function Classification System (GMFCS) level (I-II vs. IV-V; odds ratio [OR] = 7.763, 95% confidence interval [CI] = 2.177-27.682, $P = 0.002$) was a significant factor in a good response to therapy. Age (≥ 36 months; OR = 2.737, 95% CI = 1.003-7.471, $P = 0.049$) and GMFCS level (I-II vs. IV-V; OR = 0.189, 95% CI = 0.057-0.630, $P = 0.007$; and III vs. IV-V; OR = 0.095, 95% CI = 0.011-0.785, $P = 0.029$) were significantly associated with a poor response. GMFCS level is the most important prognostic factor for the effect of intensive therapy on gross motor function. In addition, age ≥ 36 months, is associated with a poor outcome.

[PMID: 2837856](#)

9. Active Video Gaming for Children with Cerebral Palsy: Does a Clinic-Based Virtual Reality Component Offer an Additive Benefit? A Pilot Study.

Levac D, McCormick A, Levin MF, Brien M, Mills R, Miller E, Sveistrup H.

Phys Occup Ther Pediatr. 2017 Apr 4:1-14. doi: 10.1080/01942638.2017.1287810. [Epub ahead of print]

AIMS: To compare changes in gross motor skills and functional mobility between ambulatory children with cerebral palsy who underwent a 1-week clinic-based virtual reality intervention (VR) followed by a 6-week, therapist-monitored home active video gaming (AVG) program and children who completed only the 6-week home AVG program. METHODS: Pilot non-randomized controlled trial. Five children received 1 hour of VR training for 5 days followed by a 6-week home AVG program, supervised online by a physical therapist. Six children completed only the 6-week home AVG program. The Gross Motor Function Measure Challenge Module (GMFM-CM) and Six Minute Walk Test (6MWT) evaluated change. RESULTS: There were no significant differences between groups. The home AVG-only group demonstrated a statistically and clinically significant improvement in GMFM-CM scores following the 6-week AVG intervention (median difference 4.5 points, interquartile range [IQR] 4.75, $p = 0.042$). The VR + AVG group demonstrated a statistically and clinically significant decrease in 6MWT distance following the intervention (median decrease 68.2 m, IQR 39.7 m, $p = 0.043$). All 6MWT scores returned to baseline at 2 months post-intervention. CONCLUSION: Neither intervention improved outcomes in this small sample. Online mechanisms to support therapist-child communication for exercise progression were insufficient to individualize exercise challenge.

[PMID: 28375682](#)

10. Evidence for increasing physical activity in children with physical disabilities: a systematic review.

Bloemen M, Van Wely L, Mollema J, Dallmeijer A, de Groot J.

Dev Med Child Neurol. 2017 Apr 4. doi: 10.1111/dmcn.13422. [Epub ahead of print]

AIM: To summarize the best evidence of interventions for increasing physical activity in children with physical disabilities. METHOD: A systematic review was conducted using an electronic search executed in Academic Search Elite, Academic Search Premier, CINAHL, Embase, MEDLINE, PEDro, PsychINFO, and SPORTDiscus up to February 2016. The selection of articles was performed independently by two researchers according to predetermined eligibility criteria. Data extraction, methodological quality, and levels of evidence were independently assessed by two researchers using a data-collection form from the Cochrane Collaboration and according to the guidelines of the American Academy for Cerebral Palsy and Developmental Medicine. RESULTS: Seven studies were included. Five randomized controlled trials ranged from strong level I to weak level II studies, and two pre-post design studies were classified as level IV. There is level I evidence for no effect of

physical training on objectively measured physical activity, conflicting level II evidence for interventions with a behavioural component on the increase of objectively measured physical activity directly after the intervention, and level II evidence for no effect during follow-up. Results are limited to children with cerebral palsy as no other diagnoses were included.

INTERPRETATION: Increasing physical activity in children with physical disabilities is very complex and demands further development and research.

[PMID: 28374442](#)

11. The effect of continuous intrathecal baclofen therapy on ambulatory children with cerebral palsy.

Pruszczynski B, Sees J, Hulbert R, Church C, Henley J, Niiler T, Miller F.

J Pediatr Orthop B. 2017 Apr 4. doi: 10.1097/BPB.0000000000000462. [Epub ahead of print]

The effect of a continuous intrathecal infusion of baclofen (CITB) was retrospectively studied in 19 ambulatory children with cerebral palsy (aged 12.4±4.9 years at CITB initiation). The mean clinical follow-up was 5.1±2.4 years and the mean follow-up gait analysis was 2.8±1.9 years. Spastic cerebral palsy diagnosis [14 (74%)] was most frequent. Most patients [11 (58%)] were Gross Motor Function Classification System level III. CITB significantly improved muscle tone and knee flexion at initial contact ($P < 0.05$), but it did not lead to improved gait speed or gross motor function.

[PMID: 28379909](#)

12. Total Knee Arthroplasty in Patients With Cerebral Palsy: A Matched Cohort Study to Patients With Osteoarthritis.

Houdek MT, Watts CD, Wyles CC, Trousdale RT, Milbrandt TJ, Taunton MJ.

J Am Acad Orthop Surg. 2017 Apr 3. doi: 10.5435/JAAOS-D-16-00437. [Epub ahead of print]

INTRODUCTION: Currently, few data examine the use of total knee arthroplasty (TKA) in patients with cerebral palsy (CP). This study reviewed the outcomes of TKA in patients with CP compared with a matched cohort undergoing TKA for primary osteoarthritis. METHODS: Over a 28-year period, 15 TKAs in patients with a diagnosis of CP were identified. The cohort was 53% men, with a mean age of 58 years. Patients with CP were matched 1:2 based on age, sex, body mass index, and year of surgery with a group of patients undergoing TKA for osteoarthritis. RESULTS: No difference was reported in implant survival ($P = 0.27$) or revision surgery ($P = 0.79$) between groups. All patients were ambulatory postoperatively, and significant increases were noted in the Knee Society score ($P < 0.0001$) and functional assessment ($P = 0.003$). DISCUSSION: TKA is a safe, durable procedure in patients with CP to improve pain and function.

[PMID: 28379915](#)

13. Rectus Femoris Transfer Surgery Worsens Crouch Gait in Children With Cerebral Palsy at GMFCS Levels III and IV.

Sousa TC, Nazareth A, Rethlefsen SA, Mueske NM, Wren TA, Kay RM.

J Pediatr Orthop. 2017 Apr 3. doi: 10.1097/BPO.0000000000000988. [Epub ahead of print]

BACKGROUND: Previous study has shown that children with cerebral palsy (CP) functioning at Gross Motor Function Classification System (GMFCS) levels III and IV do not benefit from distal rectus femoris transfer (DRFT) due to lack of improvement in stance knee extension. The fate of knees in such subjects who do not undergo DRFT is unknown. The purpose of this study was to compare knee kinematic outcomes in patients with CP and stiff knee gait who underwent single-event multilevel surgery with and without DRFT. METHODS: Preoperative and postoperative gait analysis data were retrospectively reviewed for ambulatory (GMFCS levels I to IV) patients with CP with crouch and stiff knee gait whom underwent single-event multilevel surgery, including hamstring lengthening either with DRFT ($N=34$) or without DRFT ($N=40$). Statistical analyses included t tests and χ tests, and multiple regression analysis was performed to adjust for covariates. Data were stratified by GMFCS level groups I/II and III/IV. RESULTS: Improved maximum knee extension in stance was seen for both

the DRFT ($P=0.0002$) and no DRFT groups ($P\leq 0.0006$) at GMFCS levels I/II, and the no DRFT group at GMFCS levels III/IV ($P=0.02$). Excessive stance knee flexion persisted for those at GMFCS level III/IV after DRFT. Maximum knee flexion in swing was maintained after DRFT, but significantly decreased in the no DRFT group ($P<0.002$) for both GMFCS groups. Change in total knee range of motion improved after DRFT only in the GMFCS I/II group subjects with unilateral involvement ($P=0.01$). Timing of maximum knee flexion in swing improved for all patients regardless of DRFT or GMFCS level group ($P<0.0001$). **CONCLUSIONS:** In patients with CP functioning at GMFCS levels III and IV, DRFT results in persistent crouch postoperatively. Given the importance of maintaining upright posture in these patients, we do not recommend DRFT in patients functioning at GMFCS levels III and IV.

[PMID: 28375967](#)

14. Antibody responses to botulinum neurotoxin type A of toxin-treated spastic equinus children with cerebral palsy: A randomized clinical trial comparing two injection schedules.

Oshima M, Deitiker P, Hastings-Ison T, Aoki KR, Graham HK, Atassi MZ.

J Neuroimmunol. 2017 May 15;306:31-39. doi: 10.1016/j.jneuroim.2017.02.014. Epub 2017 Feb 21.

We have conducted a 26-month-long comparative study involving young patients (2-6years old) with a clinical diagnosis of spastic equinus secondary to cerebral palsy who have been treated with BoNT/A (BOTOX®, Allergan) tri-annually or annually. Serum samples were obtained to determine the presence or absence of blocking antibodies (Abs) by a mouse protection assay (MPA) and levels of anti-BoNT/A Abs by radioimmune assay (RIA). HLA DQ alleles were typed using blood samples to determine the possible association of certain HLA type(s) with the disease or with the Ab status. Blocking Abs were detected in only two out of 18 serum samples of the tri-annual group, but none were found in 20 samples of the annual group. The MPA-positive serum samples gave in RIA significantly higher anti-BoNT/A Ab-binding levels than the MPA-negative samples. On the other hand, when two MPA-positive sample data were excluded, serum samples from tri-annual and annual groups showed similar anti-BoNT/A Ab levels. Linkage of the disorder with a particular HLA DQA1 and DQB1 allele types was not observed due to the small sample size. However, by combining results with other studies on BoNT/A-treated Caucasian patients with cervical dystonia (CD), we found that, among Caucasian patients treated with BoNT/A, DQA1*01:02 and DQB1*06:04 were higher in Ab-positive than in Ab-negative patients. The genetic linkage was on the threshold of corrected significance.

[PMID: 28385185](#)

15. Medial gastrocnemius and soleus muscle-tendon unit, fascicle, and tendon interaction during walking in children with cerebral palsy.

Barber L, Carty C, Modenese L, Walsh J, Boyd R, Lichtwark G.

Dev Med Child Neurol. 2017 Apr 1. doi: 10.1111/dmcn.13427. [Epub ahead of print]

AIM: This study investigates the in vivo function of the medial gastrocnemius and soleus muscle-tendon units (MTU), fascicles, and tendons during walking in children with cerebral palsy (CP) and an equinus gait pattern. **METHOD:** Fourteen children with CP (9 males, 5 females; mean age 10y 6mo, standard deviation [SD] 2y 11mo; GMFCS level I=8, II=6), and 10 typically developing (6 males, 4 females; mean age 10y, SD 2y 1mo) undertook full body 3D gait analysis and simultaneous B-mode ultrasound images of the medial gastrocnemius and soleus fascicles during level walking. Fascicle lengths were analysed using a semi-automated tracking algorithm and MTUs using OpenSim. Statistical parametric mapping (two-sample t-test) was used to compare differences between groups ($p<0.05$). **RESULTS:** In the CP group medial gastrocnemius fascicles lengthened during mid-stance gait and remained longer into late-stance compared to the typically developing group ($p<0.001$). CP medial gastrocnemius fascicles shortened less during stance (1.16mm [SD 1.47mm]) compared to the typically developing group (4.48mm [SD 1.94mm], $p<0.001$). In the CP group the medial gastrocnemius and soleus MTU and tendon were longer during early- and mid-stance ($p<0.001$). Ankle power during push-off ($p=0.015$) and positive work ($p<0.002$) and net work ($p<0.001$) were significantly lower in the CP group. **INTERPRETATION:** Eccentric action of the CP medial gastrocnemius muscle fascicles during mid-stance walking is consistent with reduced volume and neuromuscular control of impaired muscle. Reduced ankle push-off power and positive work in the children with CP may be attributed to reduced active medial gastrocnemius fascicle shortening. These findings suggest a reliance on passive force generation for forward propulsion during equinus gait.

[PMID: 28369824](#)

16. Segmental kinematic analysis of planovalgus feet during walking in children with cerebral palsy.

Kruger KM, Konop KA, Krzak JJ, Graf A, Altiok H, Smith PA, Harris GF.

Gait Posture. 2017 Mar 23;54:277-283. doi: 10.1016/j.gaitpost.2017.03.020. [Epub ahead of print]

Pes planovalgus (flatfoot) is a common deformity among children with cerebral palsy. The Milwaukee Foot Model (MFM), a multi-segmental kinematic foot model, which uses radiography to align the underlying bony anatomy with reflective surface markers, was used to evaluate 20 pediatric participants (30 feet) with planovalgus secondary to cerebral palsy prior to surgery. Three-dimensional kinematics of the tibia, hindfoot, forefoot, and hallux segments are reported and compared to an age-matched control set of typically-developing children. Most results were consistent with known characteristics of the deformity and showed decreased plantar flexion of the forefoot relative to hindfoot, increased forefoot abduction, and decreased ranges of motion during push-off in the planovalgus group. Interestingly, while forefoot characteristics were uniformly distributed in a common direction in the transverse plane, there was marked variability of forefoot and hindfoot coronal plane and hindfoot transverse plane positioning. The key finding of these data was the radiographic indexing of the MFM was able to show flat feet in cerebral palsy do not always demonstrate more hindfoot eversion than the typically-developing hindfoot. The coronal plane kinematics of the hindfoot show cases planovalgus feet with the hindfoot in inversion, eversion, and neutral. Along with other metrics, the MFM can be a valuable tool for monitoring kinematic deformity, facilitating clinical decision making, and providing a quantitative analysis of surgical effects on the planovalgus foot.

[PMID: 28384608](#)

17. Wheelchair appropriateness in children with cerebral palsy: A single center experience.

Ekiz T, Demir SÖ, Sümer HG, Özgirgin N.

J Back Musculoskelet Rehabil. 2017 Mar 31. doi: 10.3233/BMR-150522. [Epub ahead of print]

BACKGROUND: Although wheelchair appropriateness has been studied in general wheelchair users and spinal cord injury patients, it has not been studied in children with cerebral palsy yet. **OBJECTIVE:** To describe the wheelchair appropriateness in children with cerebral palsy. **MATERIALS AND METHODS:** Thirty children with cerebral palsy were included. Demographical and clinical features of the children were noted. All wheelchair parts were evaluated by the same rehabilitation physician who has attended a wheelchair-training course. Overall, the wheelchair was accepted as inappropriate if at least three parts were inappropriate. **RESULTS:** There were 30 children (15 M, 15 F) with a mean age of 10.8 ± 3.5 years. Seat depth (n= 21, 70%), cushion (n= 17, 56.7%), seat height (n= 16, 53.3%), and footrest (n= 16, 53.3%) were the most common inappropriate parts. Overall, 24 (80%) of the children use inappropriate wheelchair. Two (6.7%) children obtained wheelchairs by prescription, 28 (93.3%) obtained without prescription. Twenty-nine wheelchairs were manual and one wheelchair was motorized. Among 30 children, five (16.7%) experienced at least one wheelchair-related fall. **CONCLUSION:** In the light of our results, 80% of the children with cerebral palsy seem to use inappropriate wheelchair. Individually designed wheelchairs should be maintained for these children.

[PMID: 28387656](#)

18. Recent perspectives of cerebral palsy (CP) in children: a review.

Qiu A, Yang Z, Li Z.

Minerva Pediatr. 2017 Mar 27. doi: 10.23736/S0026-4946.17.04880-0. [Epub ahead of print]

The movement and posture disorder of cerebral palsy (CP) is presumed to mainly be a consequence of the motor disorder, but accompanying disturbances with sensations and perception have also been suggested to influence motor function. The heterogeneous condition of cerebral palsy (CP) is caused by an injury to the immature brain affecting movement and posture development. The attainment of standing and walking can be difficult and an assistive device to accomplish the tasks may be required for some children with CP. In this review, we enlightened the role of possible sensory and perceptual disturbances for standing difficulties in children with CP.

[PMID: 28353322](#)

19. Anaerobic exercise testing in rehabilitation: A systematic review of available tests and protocols.

Krops LA, Albada T, van der Woude LH, Hijmans JM, Dekker R.

J Rehabil Med. 2017 Mar 28. doi: 10.2340/16501977-2213. [Epub ahead of print]

OBJECTIVE: Anaerobic capacity assessment in rehabilitation has received increasing scientific attention in recent years. However, anaerobic capacity is not tested consistently in clinical rehabilitation practice. This study reviews tests and protocols for anaerobic capacity in adults with various disabilities (spinal cord injury, cerebral palsy, cerebral vascular accident, lower-limb amputation(s)) and (able-bodied) wheelchair users. **DATA SOURCES:** PubMed, CINAHL and Web of Science. **STUDY SELECTION:** Papers were screened by 2 independent assessors, and were included when anaerobic exercise tests were performed on the above-selected subject groups. **DATA EXTRACTION:** Included articles were checked for methodological quality. **DATA SYNTHESIS:** A total of 57 papers was included. Upper-body testing [56 protocols] was conducted with arm crank [16] and wheelchair tests [40]. With a few [2] exceptions, modified Wingate (Wingate) protocols and wheelchair sprint tests dominated upper-body anaerobic testing. In lower-body anaerobic work [11], bicycle [3] and recumbent [1], and overground tests [7] were used, in which Wingate, sprint or jump protocols were employed. **CONCLUSION:** When equipment is available a Wingate protocol is advised for assessment of anaerobic capacity in rehabilitation. When equipment is not available a 20-45 s sprint test is a good alternative. Future research should focus on standardized tests and protocols specific to different disability groups.

[PMID: 28350415](#)

20. Cardiac Autonomic System Response to Submaximal Test in Children With Cerebral Palsy.

Amichai T, Eylon S, Dor-Haim H, Berger I, Katz-Leurer M.

Pediatr Phys Ther. 2017 Apr;29(2):125-128. doi: 10.1097/PEP.0000000000000368.

AIM: To describe the heart rate (HR) and heart rate variability at rest, during a submaximal treadmill test and at rest posttreadmill in children with cerebral palsy (CP). **METHODS:** Twenty children (6-11 years) with CP participated, who had Gross Motor Function Classification System levels I to III. The HR was monitored for 5 minutes seated, during a submaximal treadmill test, and after 5 minutes rest posttreadmill. Outcome variables were HR and the square root of the mean squared differences of successive differences between adjacent heart beats (RMSSD). **RESULTS:** HR increased during the last stage of the treadmill test compared with rest. RMSSD was reduced during the last 2 minutes of the treadmill test compared with rest. The HR and RMSSD mean value at the second minute posttest were not significantly different from the pretreadmill rest value. **INTERPRETATION:** The cardiac system in children with CP responded to the submaximal testing.

[PMID: 28350766](#)

21. Commentary on "Cardiac Autonomic System Response to Submaximal Test in Children With Cerebral Palsy".

Jackson-Coty JM, Penston J.

Pediatr Phys Ther. 2017 Apr;29(2):129. doi: 10.1097/PEP.0000000000000373.

[No abstract available].

[PMID: 28350767](#)

22. Response to "Developing a Clinical Protocol for Habitual Physical Activity Monitoring in Youth With Cerebral Palsy".

Bjornson K.

Pediatr Phys Ther. 2017 Apr;29(2):187-188. doi: 10.1097/PEP.0000000000000391.

[No abstract available].

[PMID: 28350779](#)

23. The functional muscle-bone unit in children with cerebral palsy.

Duran I, Schütz F, Hamacher S, Semler O, Stark C, Schulze J, Rittweger J, Schoenau E.

Osteoporos Int. 2017 Apr 1. doi: 10.1007/s00198-017-4023-2. [Epub ahead of print]

Our results suggest that the prevalence of bone health deficits in children with CP was overestimated, when using only age- and height-adjusted bone mineral content (BMC) and areal bone mineral density (aBMD). When applying the functional muscle-bone unit diagnostic algorithm (FMBU-A), the prevalence of positive results decreased significantly. We recommend applying the FMBU-A when assessing bone health in children with CP. **INTRODUCTION:** The prevalence of bone health deficits in children with cerebral palsy (CP) might be overestimated because age- and height-adjusted reference percentiles for bone mineral content (BMC) and areal bone mineral density (aBMD) assessed by dual-energy X-ray absorptiometry (DXA) do not consider reduced muscle activity. The aim of this study was to compare the prevalence of positive DXA-based indicators for bone health deficits in children with CP to the prevalence of positive findings after applying a functional muscle-bone unit diagnostic algorithm (FMBU-A) considering reduced muscle activity. **METHODS:** The present study was a monocentric retrospective analysis of 297 whole body DXA scans of children with CP. The prevalence of positive results of age- and height-adjusted BMC and aBMD defined as BMC and aBMD below the P3 percentile and of the FMBU-A was calculated. **RESULTS:** In children with CP, the prevalence of positive results of age-adjusted BMC were 33.3% and of aBMD 50.8%. Height-adjusted results for BMC and aBMD were positive in 16.8 and 36.0% of cases. The prevalence of positive results applying the FMBU-A regarding BMC and aBMD were significantly ($p < 0.001$) lower than using age- and height-adjusted BMC and aBMD (8.8 and 14.8%). **CONCLUSIONS:** Our results suggest that the prevalence of bone health deficits in children with CP was overestimated, when using age- and height-adjusted BMC and aBMD. When applying the FMBU-A, the prevalence decreased significantly. We recommend applying the FMBU-A when assessing bone health in children with CP.

[PMID: 28365851](#)

24. Pediatric Rehabilitation Services for Children With Cerebral Palsy: What Can Existing Data Sources Tell Us?

Gannotti ME, Bailes A, Bjornson K, O'Neil M, Grant-Buettler M, Dusing S.

Pediatr Phys Ther. 2017 Apr;29(2):179-186. doi: 10.1097/PEP.0000000000000377.

Knowledge about associated service utilization patterns and positive outcomes in children with cerebral palsy (CP) of varying levels of severity is a national priority. Families, clinicians, program directors, and policy makers need this information for clinical decision-making and service planning. Existing data sources in the United States that contain information about children with CP, their health, function, well being, and utilization of health services may add to our existing knowledge. We provide a summary of fourteen national, state, and local sources' data: where the data come from, challenges and/or specific considerations when using or accessing information, and specific data elements included. Currently available sources of data can provide meaningful information for policy, practice, and program development. We propose questions for future inquiry and suggest elements that may be useful for when developing data sources specific to physical therapy and individuals with CP. A physical therapy specific registry is warranted.

[PMID: 28350778](#)

25. Meropenem-induced low valproate levels in a cerebral palsy child.

Okumura LM, Andreolio C, Di Giorgio C, Carvalho PR, Piva JP.

Braz J Infect Dis. 2017 Mar 23. pii: S1413-8670(16)30723-1. doi: 10.1016/j.bjid.2017.01.010. [Epub ahead of print]

[No abstract available]

[PMID: 28343819](#)

26. Reflections of Malaysian parents of children with developmental disabilities on their experiences with AAC.

Joginder Singh S, Hussein NH, Mustaffa Kamal R, Hassan FH.

Augment Altern Commun. 2017 Apr 7:1-11. doi: 10.1080/07434618.2017.1309457. [Epub ahead of print]

Parents play an important role in the successful implementation of AAC. Previous research has indicated that parents in different countries have varying perceptions about the use of AAC and face different challenges in its implementation. To date, there is limited information about the use of AAC by children in Malaysia or parents' views about its use. The aim of this study was to explore Malaysian parents' perception of AAC and their experience when supporting their children who use AAC. For this study, 12 parents of children with autism spectrum disorder and cerebral palsy were involved in semi-structured individual interviews. Qualitative content analysis was used to analyze interview data. Following analysis, three themes were identified: (a) impact of the use of AAC, (b) challenges faced, and (c) hopes and expectations. Participants reported that the use of AAC had a positive impact on their children, but that they faced challenges related to the child, the settings, and the system itself, as well as a lack of time and support. Findings from this study provide an insight for Malaysian speech therapists about the challenges faced by parents when supporting their children who use AAC, and how important it is to overcome these challenges to ensure successful implementation of AAC.

[PMID: 28387140](#)

27. Presurgical Concerns of Primary Family Caregivers of Children With Cerebral Palsy.

Yu LC, Chen LC, Lin HC, Lin YE, Chang CH, Chen SC.

Orthop Nurs. 2017 Mar/Apr;36(2):140-146. doi: 10.1097/NOR.0000000000000328.

BACKGROUND: Primary family caregivers (PFCs) of children with cerebral palsy have many worries and concerns when their children face orthopedic surgery. Levels of PFC stress about the upcoming surgery is related to the child's level of gross motor function as well as the support they receive from medical professionals. **PURPOSE:** The purposes of the present study were to (1) explore the levels of concern about orthopedic surgery; and (2) explore the predictive factors associated with concerns about orthopedic surgery among PFCs of children with cerebral palsy during the preoperative period. **METHODS:** A cross-sectional, correlational study was conducted. Primary family caregivers were assessed preoperatively using the Single-event Multilevel Surgery Scale, Social Support Scale, Gross Motor Function Classification System-Expanded and Revised, and background information form. Primary family caregivers were recruited from the outpatient department of orthopedic surgery and pediatric rehabilitation of a medical center in northern Taiwan. Data were analyzed by descriptive analysis, Pearson product-moment correlation, and multiple regression analysis. **RESULTS:** A total of 63 eligible subjects were enrolled in this study. Primary family caregivers had moderate levels of concern and mild-to-moderate levels of social support. The higher severity of motor function impairment in children with cerebral palsy, prior caregiving by PFCs for another family member, and PFCs' lower level of social support from healthcare providers were associated with higher levels of PFC concern. **CONCLUSIONS:** Concerns about orthopedic surgery is an overlooked issue that needs more attention from healthcare providers. This study determined that PFCs who perceived a lack of social support from their healthcare providers and those with children who had limited gross motor function were more concerned and anxious about their children's upcoming orthopedic surgery. Health professionals should provide adequate health education and counseling to help PFCs of children with cerebral palsy in the decision-making process prior to orthopedic surgery.

[PMID: 28358778](#)

28. Risk Factors for Malnutrition Among Children With Cerebral Palsy in Botswana.

Johnson A, Gambrah-Sampanye C, Khurana E, Baier J, Baranov E, Monokwane B, Bearden DR.

Pediatr Neurol. 2017 Feb 14. pii: S0887-8994(16)30921-3. doi: 10.1016/j.pediatrneurol.2017.02.003. [Epub ahead of print]

BACKGROUND: Children with cerebral palsy in low-resource settings are at high risk of malnutrition, which further increases their risk of poor health outcomes. However, there are few available data on specific risk factors for malnutrition among children with cerebral palsy in the developing world. **METHODS:** We performed a case-control study among children with cerebral palsy receiving care at a tertiary care hospital in Gaborone, Botswana. Children with cerebral palsy and malnutrition

were identified according to World Health Organization growth curves and compared with subjects with cerebral palsy without malnutrition. Risk factors for malnutrition were identified using multivariable logistic regression models. These risk factors were then used to generate a Malnutrition Risk Score, and Receiver Operating Characteristic curves were used to identify optimal cutoffs to identify subjects at high risk of malnutrition. **RESULTS:** We identified 61 children with cerebral palsy, 26 of whom (43%) met criteria for malnutrition. Nonambulatory status (odds ratio 13.8, 95% confidence interval [CI] 3.8-50.1, $P < 0.001$) and a composite measure of socioeconomic status (odds ratio 1.6, 95% CI 1.0-2.5, $P = 0.03$) were the strongest risk factors for malnutrition. A Malnutrition Risk Score was constructed based on these risk factors, and receiver operating characteristic curve analysis demonstrated excellent performance characteristics of this score (area under the curve 0.92, 95% CI 0.89-0.94). **CONCLUSIONS:** Malnutrition is common among children with cerebral palsy in Botswana, and a simple risk score may help identify children with the highest risk. Further studies are needed to validate this screening tool and to determine optimal nutritional interventions in this population.

[PMID: 28363511](#)

Prevention and Cure

29. Susceptibility-Weighted Imaging Identifies Iron-Oxide-Labeled Human Neural Stem Cells: Automated Computational Detection.

Baghchechi M, Plaia A, Hamer M, Ghosh N, Ashwal S, Obenaus A.

Dev Neurosci. 2017 Mar 25. doi: 10.1159/000455837. [Epub ahead of print]

Neonatal hypoxic-ischemic brain injury (HII) can lead to devastating neurological outcomes such as cerebral palsy, epilepsy, and mental retardation. Human neural stem cell (hNSC) therapy provides new hope for the treatment of neonatal HII. These multipotent cells can aid in HII recovery by activating multiple reparative mechanisms including secretion of neurotrophic factors that enhance brain repair and plasticity. For clinical use of implanted hNSCs, methods are required to identify, quantify, track, and visualize migration and replication in an automated and reproducible fashion. In the current study, we used a model of unilateral HII in 10-day-old rat pups that were implanted with 250,000 Feridex-labeled hNSCs into the contralateral ventricle 3 days after HII. In addition to standard noninvasively acquired serial magnetic resonance imaging (MRI) sequences (11.7 and 4.7 T) that included diffusion-weighted imaging and T2-weighted imaging, we also acquired susceptibility-weighted imaging (SWI) 1-90 days after hNSC implantation. SWI is an advanced MRI method that enhances the visualization of iron-oxide-labeled hNSCs within affected regions of the injured neonatal brain. hNSC contrast was further enhanced by creating minimal intensity projections from the raw SWI magnitude images combined with phase information. Automated computational analysis using hierarchical region splitting (HRS) was applied for semiautomatic detection of hNSCs from SWI images. We found hNSCs in the ipsilateral HII lesion within the striatum and cortex adjacent to the lesion that corresponded to histological staining for iron. Quantitative phase values (radians) obtained from SWI revealed temporally evolving increased phase which reflects a decreased iron oxide content that is possibly related to cell division and the replicative capacity of the implanted hNSCs. SWI images also revealed hNSC migration from the contralateral injection site towards the ipsilateral HII lesion. Our results demonstrate that MRI-based SWI can monitor iron-labeled hNSCs in a clinically relevant manner and that automated computational methods such as HRS can rapidly identify iron-oxide-labeled hNSCs.

[PMID: 28343216](#)

30. A de novo deletion in a boy with cerebral palsy suggests a refined critical region for the 4q21.22 microdeletion syndrome.

Zarrei M, Merico D, Kellam B, Engchuan W, Scriver T, Jokhan R, Wilson MD, Parr J, Lemire EG, Stavropoulos DJ, Scherer SW.

Am J Med Genet A. 2017 Apr 3. doi: 10.1002/ajmg.a.38176. [Epub ahead of print]

We present an 18-year-old boy with cerebral palsy, intellectual disability, speech delay, and seizures. He carries a likely pathogenic 1.3 Mb de novo heterozygous deletion in the 4q21.22 microdeletion syndrome region. He also carries a 436 kb maternally-inherited duplication impacting the first three exons of CHRNA7. The majority of previously published cases with 4q21.22 syndrome shared common features including growth restriction, muscular hypotonia, and absent or severely delayed 11

speech. Using copy number variation (CNV) data available for other subjects, we defined a minimal critical region of 170.8 kb within the syndromic region, encompassing HNRNPD. We also identified a larger 2 Mb critical region encompassing ten protein-coding genes, of which six (PRKG2, RASGEF1B, HNRNPDL, HNRNPD, LIN54, COPS4) have a significantly low number of truncating loss-of-function mutations. Long-range chromatin interaction data suggest that this deletion may alter chromatin interactions at the 4q21.22 microdeletion region. We suggest that the deletion or misregulation of these genes is likely to contribute to the neurodevelopmental and neuromuscular abnormalities in 4q21.22 syndrome.

[PMID: 28371330](#)

31. Spinal cord injury in hypertonic newborns after antenatal hypoxia-ischemia in a rabbit model of cerebral palsy.

Drobyshevsky A, Quinlan KA.

Exp Neurol. 2017 Mar 24;293:13-26. doi: 10.1016/j.expneurol.2017.03.017. [Epub ahead of print]

While antenatal hypoxia-ischemia (H-I) is a well-established cause of brain injury, the effects of H-I on the spinal cord remain undefined. This study examined whether hypertonia in rabbits was accompanied by changes in spinal architecture. Rabbit dams underwent global fetal H-I at embryonic day 25 for 40min. High resolution diffusion tensor imaging was performed on fixed neonatal CNS. Fractional anisotropy (FA) and regional volumetric measurements were compared between kits with and without hypertonia after H-I and sham controls using Tract Based Spatial Statistics. Hypertonic kits showed evidence of damage from hypoxia not only in the brain, but in spinal cord as well. Hypertonic kits showed reduced FA and thickness in corticospinal tracts, external capsule, fimbria, and in white and gray matter of both cervical and lumbar spinal cord. Dorsal white matter of the spinal cord was the exception, where there was thickening and increased FA in hypertonic kits. Direct damage to the spinal cord was demonstrated in a subset of dams imaged during H-I with a 3T magnetic resonance scanner, where apparent diffusion coefficient in fetal spinal cords acutely decreased during hypoxia. Hypertonic kits showed subsequent decreases in lumbar motoneuron counts and extensive TUNEL- and Fluoro-Jade C-positive labeling was present in the spinal cord 48h after H-I, demonstrating spinal neurodegeneration. We speculate that global H-I causes significant loss of both spinal white and gray matter in hypertonic newborns due to direct H-I injury to the spinal cord as well as due to upstream brain injury and consequent loss of descending projections.

[PMID: 28347765](#)

32. Association Between Early Low-Dose Hydrocortisone Therapy in Extremely Preterm Neonates and Neurodevelopmental Outcomes at 2 Years of Age.

Baud O, Trousson C, Biran V, Leroy E, Mohamed D, Alberti C; PREMILOC Trial Group.

JAMA. 2017 Apr 4;317(13):1329-1337. doi: 10.1001/jama.2017.2692.

IMPORTANCE: Dexamethasone to prevent bronchopulmonary dysplasia in very preterm neonates was associated with adverse neurodevelopmental events. Early low-dose hydrocortisone treatment has been reported to improve survival without bronchopulmonary dysplasia but its safety with regard to neurodevelopment remains to be assessed. **OBJECTIVE:** To assess whether early hydrocortisone therapy in extremely preterm infants is associated with neurodevelopmental impairment at 2 years of age. **DESIGN, SETTING, AND PARTICIPANTS:** An exploratory secondary analysis of the PREMILOC (Early Low-Dose Hydrocortisone to Improve Survival without Bronchopulmonary Dysplasia in Extremely Preterm Infants) randomized clinical trial conducted between 2008 and 2014 in 21 French neonatal intensive care units. Randomization was stratified by gestational age groups. Neurodevelopmental assessments were completed from 2010 to 2016. **INTERVENTIONS:** After birth, patients were randomly assigned to receive placebo or hydrocortisone (0.5 mg/kg twice per day for 7 days, followed by 0.5 mg/kg per day for 3 days). **MAIN OUTCOMES AND MEASURES:** The prespecified exploratory secondary outcome of neurodevelopmental impairment was based on a standardized neurological examination and the revised Brunet-Lézine scale (global developmental quotient score and subscores; mean norm, 100 [SD, 15]). The minimal clinically important difference on the global developmental quotient was 5 points. **RESULTS:** Of 1072 neonates screened, 523 were assigned to hydrocortisone (n = 256) or placebo (n = 267) and 406 survived to 2 years of age. A total of 379 patients (93%; 46% female) were evaluated (194 in the hydrocortisone group and 185 in the placebo group) at a median corrected age of 22 months (interquartile range, 21-23 months). The distribution of patients without neurodevelopmental impairment (73% in the hydrocortisone group vs 70% in the placebo group), with mild neurodevelopmental impairment (20% in the hydrocortisone group vs 18% in the placebo group), or with moderate to severe neurodevelopmental impairment (7% in the hydrocortisone group vs 11% in the placebo group) was not statistically significantly different between groups (P = .33). The mean global developmental quotient score was not statistically significantly different between groups (91.7 in the hydrocortisone group vs 91.4 in the placebo group; between-

group difference, 0.3 [95% CI, -2.7 to 3.4]; $P = .83$). The incidence of cerebral palsy or other major neurological impairments was not significantly different between groups. **CONCLUSIONS AND RELEVANCE:** In this exploratory analysis of secondary outcomes of a randomized clinical trial of extremely preterm infants, early low-dose hydrocortisone was not associated with a statistically significant difference in neurodevelopment at 2 years of age. Further randomized studies are needed to provide definitive assessment of the neurodevelopmental safety of hydrocortisone in extremely preterm infants.

[PMID: 28384828](#)

33. Repeated lumbar or ventricular punctures in newborns with intraventricular haemorrhage.

Whitelaw A, Lee-Kelland R.

Cochrane Database Syst Rev. 2017 Apr 6;4:CD000216. doi: 10.1002/14651858.CD000216.pub2. [Epub ahead of print]

BACKGROUND: Although in recent years the percentage of preterm infants who suffer intraventricular haemorrhage (IVH) has reduced, posthaemorrhagic hydrocephalus (PHH) remains a serious problem with a high rate of cerebral palsy and no evidence-based treatment. Survivors often have to undergo ventriculoperitoneal shunt (VPS) surgery, which makes the child permanently dependent on a valve and catheter system. This carries a significant risk of infection and the need for surgical revision of the shunt. Repeated removal of cerebrospinal fluid (CSF) by either lumbar puncture, ventricular puncture, or from a ventricular reservoir in preterm babies with IVH has been suggested as a treatment to reduce the risk of PHH development. **OBJECTIVES:** To determine the effect of repeated cerebrospinal fluid (CSF) removal (by lumbar/ventricular puncture or removal from a ventricular reservoir) compared to conservative management, where removal is limited to when there are signs of raised intracranial pressure (ICP), on reduction in the risk of permanent shunt dependence, neurodevelopmental disability, and death in neonates with or at risk of developing posthaemorrhagic hydrocephalus (PHH). **SEARCH METHODS:** We used the standard search strategy of Cochrane Neonatal to search the Cochrane Central Register of Controlled Trials (CENTRAL; 2016, Issue 3), MEDLINE via PubMed (1966 to 24 March 2016), Embase (1980 to 24 March 2016), and CINAHL (1982 to 24 March 2016). We also searched clinical trials databases, conference proceedings, and the reference lists of retrieved articles for randomised controlled trials (RCTs) and quasi-RCTs. **SELECTION CRITERIA:** RCTs and quasi-RCTs that compared serial removal of CSF (via lumbar puncture, ventricular puncture, or from a ventricular reservoir) with conservative management (removing CSF only when there were symptoms of raised ICP). Trials also had to report on at least one of the specified outcomes of death, disability, or shunt insertion. **DATA COLLECTION AND ANALYSIS:** We extracted details of the participant selection, participant allocation and the interventions. We assessed the following outcomes: VPS, death, death or shunt, disability, multiple disability, death or disability, and CSF infection. We assessed the quality of the evidence using the GRADE approach. **MAIN RESULTS:** Four trials (five articles) met the inclusion criteria of this review; three were RCTs and one was a quasi-RCT; and included a total of 280 participants treated in neonatal intensive care units in the UK. The trials were published between 1980 and 1990. The studies were sufficiently similar regarding the research question they asked and the interventions that we could combine the trials to assess the effect of the intervention. Meta-analysis showed that the intervention produced no significant difference when compared to conservative management for the outcomes of: placement of hydrocephalus shunt (typical risk ratio (RR) 0.96, 95% confidence interval (CI) 0.73 to 1.26; 3 trials, 233 infants; I^2 statistic = 0%; moderate quality evidence), death (RR 0.88, 95% CI 0.53 to 1.44; 4 trials, 280 infants; I^2 statistic = 0%; low quality evidence), major disability in survivors (RR 0.98, 95% CI 0.81 to 1.18; 2 trials, 141 infants; I^2 statistic = 11%; high quality evidence), multiple disability in survivors (RR 0.9, 95% CI 0.66 to 1.24; 2 trials, 141 infants; I^2 statistic = 0%; high quality evidence), death or disability (RR 0.99, 95% CI 0.86 to 1.14; 2 trials, 180 infants; I^2 statistic = 0%; high quality evidence), death or shunt (RR 0.91, 95% CI 0.75 to 1.11; 3 trials, 233 infants; I^2 statistic = 0%; moderate quality evidence), and infection of CSF presurgery (RR 1.73, 95% CI 0.53 to 5.67; 2 trials, 195 infants; low quality evidence). We assessed the quality of the evidence as high for the outcomes of major disability, multiple disability, and disability or death. We rated the evidence for the outcomes of shunt insertion, and death or shunt insertion as of moderate quality as one included trial used an alternation method of randomisation. For the outcomes of death and infection of CSF presurgery, the quality of the evidence was low as one trial used an alternation method, the number of participants was too low to assess the objectives with sufficient precision, and there was inconsistency regarding the findings in the included trials regarding the outcome of infection of CSF presurgery. **AUTHORS' CONCLUSIONS:** There was no evidence that repeated removal of CSF via lumbar puncture, ventricular puncture or from a ventricular reservoir produces any benefit over conservative management in neonates with or at risk for developing PHH in terms of reduction of disability, death, or need for placement of a permanent shunt.

[PMID: 28384379](#)

34. Developmental profile of motor cortex transcallosal inhibition in children and adolescents.

Ciechanski P, Zewdie E, Kirton A.

J Neurophysiol. 2017 Apr 5;jn.00076.2017. doi: 10.1152/jn.00076.2017. [Epub ahead of print]

Transcallosal fibers facilitate interhemispheric networks involved in motor tasks. Despite their clinical relevance, interhemispheric motor control systems have not been completely defined in the developing brain. The objective of this study was to examine the developmental profile of transcallosal inhibition in healthy children and adolescents. Nineteen typically-developing right-handed participants were recruited. Two transcranial magnetic stimulation (TMS) paradigms assessed transcallosal inhibition: ipsilateral silent periods (iSP) and paired-pulse interhemispheric inhibition (IHI). TMS was applied to the motor hotspot of the first dorsal interosseous muscle. Resting motor threshold (RMT), iSP latency, duration and suppression strength, and paired-pulse IHI were measured from both hemispheres. The Purdue Pegboard Test assessed unimanual motor function. Hemispheric differences were evident for RMT and iSP latency and suppression strength, where the left hemisphere had a lower RMT, prolonged latency and greater suppression strength. iSP duration showed hemispheric symmetry. RMT and iSP latency decreased with age, whereas iSP suppression strength increased. Females showed shorter iSP latency. Children typically displayed IHI, although hemispheric differences were observed. iSP suppression strength was uniquely associated with IHI within individuals. iSP duration correlated with motor performance. TMS can characterize transcallosal inhibition in normal children and adolescents with effects of age, directionality, gender, and motor performance. Establishing this developmental profile of interhemispheric interactions will advance understanding and therapeutic strategies for pediatric motor disorders such as cerebral palsy.

[PMID: 28381485](#)

35. Long-Term Neurodevelopmental and Growth Outcomes of Premature Infants Born at <29 week Gestational Age with Post-Hemorrhagic Hydrocephalus Treated with Ventriculo-Peritoneal Shunt.

Diwakar K, Hader WJ, Soraisham A, Amin H, Tang S, Bullivant K, Kamaluddeen M, Lodha A.

Indian J Pediatr. 2017 Apr 3. doi: 10.1007/s12098-017-2319-z. [Epub ahead of print]

OBJECTIVE: To compare long-term neurodevelopmental and growth (NDG) outcomes at 3 y corrected gestational age (GA) in premature infants with grade \geq III intraventricular hemorrhage (IVH) and post-hemorrhagic hydrocephalus who were treated with ventriculo-peritoneal shunt with those who were not treated with shunt. **METHODS:** In a retrospective cohort study, NDG outcomes were compared between preterm infants of <29 wk GA with IVH treated with shunt (IVHS) and IVH with no shunt (IVHNS). This was a single centre study. The primary outcome was moderate to severe cerebral palsy (CP). **RESULTS:** Of 1762 preterm infants who survived to discharge, 90 had grade \geq III IVH. Infants in IVHS group had more grade IV IVH than IVHNS ($p < 0.05$). Seventy percent of the patients in IVHNS groups had no hydrocephalus. IVHS group had increased CP (76% vs. 30%; $p 0.003$), and higher odds of CP after controlling for GA and IVH grade [odds ratio (OR); 4.23 (1.38 to 13.00)]. Growth delay was not different between groups. **CONCLUSIONS:** Infants with IVHS are at increased risk of CP but not growth delay.

[PMID: 28367615](#)

36. Neurologic Correlates of Gait Abnormalities in Cerebral Palsy: Implications for Treatment.

Zhou J, Butler EE, Rose J.

Front Hum Neurosci. 2017 Mar 17;11:103. doi: 10.3389/fnhum.2017.00103. eCollection 2017.

Cerebral palsy (CP) is the most common movement disorder in children. A diagnosis of CP is often made based on abnormal muscle tone or posture, a delay in reaching motor milestones, or the presence of gait abnormalities in young children. Neuroimaging of high-risk neonates and of children diagnosed with CP have identified patterns of neurologic injury associated with CP, however, the neural underpinnings of common gait abnormalities remain largely uncharacterized. Here, we review the nature of the brain injury in CP, as well as the neuromuscular deficits and subsequent gait abnormalities common among children with CP. We first discuss brain injury in terms of mechanism, pattern, and time of injury during the prenatal, perinatal,

or postnatal period in preterm and term-born children. Second, we outline neuromuscular deficits of CP with a focus on spastic CP, characterized by muscle weakness, shortened muscle-tendon unit, spasticity, and impaired selective motor control, on both a microscopic and functional level. Third, we examine the influence of neuromuscular deficits on gait abnormalities in CP, while considering emerging information on neural correlates of gait abnormalities and the implications for strategic treatment. This review of the neural basis of gait abnormalities in CP discusses what is known about links between the location and extent of brain injury and the type and severity of CP, in relation to the associated neuromuscular deficits, and subsequent gait abnormalities. Targeted treatment opportunities are identified that may improve functional outcomes for children with CP. By providing this context on the neural basis of gait abnormalities in CP, we hope to highlight areas of further research that can reduce the long-term, debilitating effects of CP.

[PMID: 28367118](#)