NEWS
Cerebral Palsy Research

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Interventions and Management

1. Kinematic characteristics of arm and trunk when drinking from a glass in children with and without cerebral palsy.
Machado LR, Heathcock J, Carvalho RP, Pereira ND, Tudella E.

Clin Biomech (Bristol, Avon). 2019 Mar 19;63:201-206. doi: 10.1016/j.clinbiomech.2019.03.011. [Epub ahead of print]

BACKGROUND: Children with cerebral palsy (CP) often have difficulty with activities that require the upper extremities secondary to deficits in strength and range of motion, spasticity, and poor timing and coordination of movement. This study aimed to identify and compare timing and coordination of the trunk and upper extremity in children with and without CP during a functional task. METHODS: Eighteen children, N = 9 with CP and N = 9 with typical development were enrolled. Participants were seated in a standard chair and instructed to drink from a glass placed at a distance of 75% of available arm length. The task was divided into 3 Phases: 1) reaching to the glass, 2) transporting the glass to the mouth, and 3) returning the glass to the table. The spatiotemporal and angular variables were analyzed with 3D kinematics of movement using a 4-camera Qualysis Motion System. FINDINGS: Children with CP demonstrated poor upper extremity timing and coordination. Despite significant trunk displacement used as a compensation in Phase 1, children with CP demonstrated a significantly lower mean velocity and velocity peak during Phases 2 and 3; and demonstrated less straight motion which required more time and movement units in all phases. INTERPRETATION: Children with CP demonstrated poor upper extremity timing and coordination when drinking (even when they successfully completed the task) measured by more trunk displacement, slower, less straight movements, and more movement units. Current rehabilitation strategies could consider training speed and use functional tasks that require different strategies across multiple phases.

PMID: 30925379

2. Efficacy of transcutaneous electrical nerve stimulation combined with therapeutic exercise on hand function in children with hemiplegic cerebral palsy.
Alhusaini AA, Fallatah S, Melam GR, Buragadda S.

Somatosens Mot Res. 2019 Mar 26:1-7. doi: 10.1080/08990220.2019.1584555. [Epub ahead of print]

PURPOSE: Transcutaneous electrical nerve stimulation (TENS) is a nonpharmacological method used to reduce spasticity. It was also assumed that TENS reduces pain and therefore improves limb function. Most of the previous studies about the effect of TENS were done in the lower limb and in stroke patients. There is a lack of enough literature about the direct and indirect effects of TENS in the upper limb. Hence, our study aimed to determine whether TENS combined with therapeutic exercises helps to improves hand function by reducing spasticity in children with hemiplegic cerebral palsy (CP). MATERIALS AND METHODS: Twenty-nine children with hemiplegic CP were randomly assigned to the TENS group (n = 15) or the control group (n = 14). The TENS group received traditional physical therapy with the adjunct application of conventional TENS for 30 minutes (pulse duration, 250 µs; pulse rate, 100 Hz) on the wrist extensors, once daily, 3 days a week, for 8 weeks, while

the control group received traditional physical therapy. RESULTS: The results showed a significant intergroup difference in handgrip strength over the 8-week period. The time to accomplish the Jebsen Taylor Hand Function Test (JTHFT) task decreased by 48% and the ABILHAND-Kids questionnaire scores improved by 23% in the TENS group. CONCLUSIONS: The use of TENS in combination with therapeutic exercise may improve strength and hand function.

PMID: 30913943

3. Commentary on "Early Intervention and Postural Adjustments During Reaching in Infants at Risk of Cerebral Palsy".
Paleg G, Rodby-Bousquet E.

Pediatr Phys Ther. 2019 Apr;31(2):184. doi: 10.1097/PEP.0000000000000595.

Comment on Early Intervention and Postural Adjustments During Reaching in Infants at Risk of Cerebral Palsy. [Pediatr Phys Ther. 2019]

PMID: 30907835

4. Multilevel Surgery for Children With Cerebral Palsy: A Meta-analysis.
Amirmudin NA, Lavelle G, Theologis T, Thompson N, Ryan JM.

Pediatrics. 2019 Apr;143(4). pii: e20183390. doi: 10.1542/peds.2018-3390.

CONTEXT: Multilevel surgery (MLS) is standard care for reducing musculoskeletal disorders among children with spastic cerebral palsy (CP). OBJECTIVE: To summarize the literature examining effects of MLS and satisfaction with MLS for children with CP. DATA SOURCES: Medline, Embase, Cumulative Index to Nursing and Allied Health Literature, and Cochrane Central Register of Controlled Trials were searched. STUDY SELECTION: Studies in which authors reported effects of or satisfaction with MLS in children with CP were selected. DATA EXTRACTION: Two authors screened and extracted data on gross motor function, gait speed, gait (eg, Gait Profile Score), range of motion, strength, spasticity, participation, quality of life, satisfaction, and adverse events. RESULTS: Seventy-four studies (3551 participants) were identified. One was a randomized controlled trial (RCT) (n = 19); the remainder were cohort studies. Pooled analysis of cohort studies revealed that MLS did not have a long-term effect on gross motor function (standardized mean difference [SMD]: 0.38; 95% confidence interval [CI]: -0.25 to 1.01) or gait speed (SMD: 0.12; 95% CI: -0.01 to 0.25) but did improve gait (SMD: -0.80; 95% CI: -0.95 to -0.65). The RCT also revealed no effect of MLS on gross motor function but improvements in the Gait Profile Score at 1 year. Participation and quality of life were reported in only 5 studies, and adverse events were adequately reported in 17 studies. LIMITATIONS: Data were largely from cohort studies. CONCLUSIONS: Findings reveal that gait, but not gross motor function, improves after MLS. RCTs and improved reporting of studies of MLS are required.

PMID: 30918016

5. C-reactive protein: what to expect after bony hip surgery for nonambulatory children and adolescents with cerebral palsy.
Dick AG, Magill N, White TCH, Kokkinakis M, Norman-Taylor F.

J Pediatr Orthop B. 2019 Mar 28. doi: 10.1097/BPB.0000000000000634. [Epub ahead of print]

Bony hip reconstruction surgery in children with severe cerebral palsy is associated with high complication rates, usually postoperative chest and urinary tract infections. C-reactive protein (CRP) level is commonly used as an indication of infection; an understanding of its normal postoperative trends is crucial to allow early identification of abnormal levels and possible infection. Our aim was to describe the trends in CRP following bony hip surgery in children who had an uneventful postoperative course, on the basis that the children for whom CRP does not follow this course are likely to have a bacterial infection. A retrospective review was performed of 155 children with CP having bony hip surgery between 2012 and 2016. The median age was 9.9 years (interquartile range: 6.6-12.7). One hundred (64.5%) patients had a Gross Motor Function Classification System rating of V. All CRP levels measured in routine postoperative care were recorded, and medical records were examined for postoperative infective complications. The CRP levels of patients with clinically proven infections were excluded in order to describe what to expect in the absence of infection. Mean CRP peaked on the third postoperative day at 81

mg/l in those who had no postoperative infection. Twenty-five (16.1%) patients had a postoperative infection; their mean CRP was higher on all postoperative days and peaked at 128 mg/l on the third postoperative day. An understanding of the normal postoperative trends in CRP allows identification of those with abnormally raised levels. Postoperative CRP is consistently higher in children with an infective complication. We recommend that the CRP should be routinely checked following bony hip surgery in children with CP, and a careful search for infection undertaken in those with a raised level.

PMID: 30925527

6. Determining the most effective exercise for gluteal muscle activation in children with cerebral palsy using surface electromyography.
Daly C, Lafferty E, Joyce M, Malone A.

Gait Posture. 2019 Mar 15;70:270-274. doi: 10.1016/j.gaitpost.2019.03.013. [Epub ahead of print]

BACKGROUND: Reduced lumbo-pelvic postural control is a common feature of gait in children with Cerebral Palsy (CP). These features are commonly attributed to insufficiency of the hip musculature as well as underlying bony geometry. Exercises aimed at strengthening the hip muscles are frequently prescribed in children with Cerebral Palsy (CP). There is a lack of evidence indicating the most effective exercises in targeting gluteal muscle activation in this population. RESEARCH QUESTION: To determine the most effective exercise for gluteal muscle activation in children with CP. METHODS: This was a cross-sectional study of children with CP. Surface EMG data from the gluteus medius (GMed) and maximus (GMax) on the more involved limb were recorded as participants completed 6 commonly prescribed gluteal strengthening exercises. EMG was assessed for peak activation, normalised to functional reference values. RESULTS: Data from ten children (5 males, 5 females; mean +- SD age, 13+-3 years) were included for final analysis. The single leg bridge and step up were the most effective exercises for gluteal muscle activation. Differences in activation were found to be statistically significant using Friedman's rank test (GMax $p = 0.0001$, GMed $p = 0.0023$). SIGNIFICANCE: This study is the first to show clear differences in activation across gluteal strengthening exercises in a CP population. Exercises which involve weight bearing through a single limb appear most effective in activating the target muscles i.e the single leg bridge and the step up. Exercises involving double limb support or open-chain movements were less effective. The results of this study indicate that careful exercise selection is required to achieve targeted muscle activation in a paediatric CP population. The results of this study will provide guidance for exercise prescription for gluteal strengthening in this population and will inform future research studies on the effectiveness hip muscle strengthening programmes in CP.

PMID: 30913506

7. The development of spasticity with age in 4,162 children with cerebral palsy: a register-based prospective cohort study.
Lindén O, Hägglund G, Rodby-Bousquet E, Wagner P.

Acta Orthop. 2019 Mar 25:1-10. doi: 10.1080/17453674.2019.1590769. [Epub ahead of print]

Background and purpose - Spasticity is often regarded as a major cause of functional limitation in children with cerebral palsy (CP). We analyzed the spasticity development with age in the gastrosoleus muscle in children with CP. Children and methods - This is a longitudinal cohort study of 4,162 children (57% boys) with CP born in 1990-2015, monitored using standardized follow-up examinations in the Swedish surveillance program for CP. The study is based on 57,953 measurements of spasticity of the gastrosoleus muscle assessed using the Ashworth scale (AS) in participants between 0 and 15 years of age. The spasticity was analyzed in relation to age, sex, and Gross Motor Function Classification System (GMFCS) levels using a linear mixed model. Development of spasticity with age was modeled as a linear spline. Results - The degree of spasticity increased in most children over the first 5 years of life. At 5 years of age, 38% had an AS level of ≥ 2. The spasticity then decreased for 65% of the children during the remaining study period. At 15 years of age only 22% had AS ≥ 2. The level of spasticity and the rate of increase and decrease before and after 5.5 years of age were higher in children at GMFCS IV-V. Interpretation - The degree of spasticity of the gastrosoleus muscle often decreases after 5 years of age, which is important for long-term treatment planning and should be considered in spasticity management.

PMID: 30907682

8. Management of the Knee Problems in Spastic Cerebral Palsy.
Ganjwala D, Shah H.

Indian J Orthop. 2019 Jan-Feb;53(1):53-62. doi: 10.4103/ortho.IJOrtho_339_17.

Two common knee problems in cerebral palsy are increased knee flexion during stance phase and reduced knee flexion during the swing phase of gait. We reviewed the recent literature and based on that, we formed this review. Hamstring spasticity, quadriceps weakness, soleus weakness, and lever-arm dysfunction are few factors which lead to increased knee flexion during stance phase. Rectus spasticity diminishes knee flexion in the swing. Resulting gait-stiff knee gait interferes with ground clearance. Both gait patterns result into esthetically poor gait and increased energy consumption. Knee flexion gait may lead to pain in the knee. Natural history of knee flexion gait suggests deterioration over time. In the early stage, these gait abnormalities are managed by nonoperative treatment. Cases in which nonoperative measures fail or advance cases need surgical treatment. Various variables which are taken into consideration before selecting a particular treatment option are described. We also present an algorithm for decision-making. Nonsurgical options and surgical procedures are discussed.

PMID: 30905982

9. Hamstring lengthening in females with cerebral palsy have greater effect than in males.
White H, Wallace J, Walker J, Augsburger S, Talwalkar VR, Muchow RD, Iwinski H.

J Pediatr Orthop B. 2019 Mar 28. doi: 10.1097/BPB.0000000000000633. [Epub ahead of print]

Children with spastic diplegia cerebral palsy often demonstrate crouched gait patterns, and typically undergo hamstring lengthenings. The objective of this retrospective study was to determine if the surgical response to medial and lateral hamstring lengthenings is different between males and females. Preoperative and postoperative kinematic data of 109 (71 males and 38 females) patients with cerebral palsy were evaluated. Females demonstrated larger decreases in popliteal angle, larger decreases in mid-stance knee flexion, and higher incidences of knee hyperextension postoperatively. Results indicate that females have larger responses to hamstring lengthenings than males.

PMID: 30925526

10. Impact of Ankle-Foot Orthosis on Gait efficiency in Ambulatory Children with Cerebral Palsy: A Systematic Review and Meta-Analysis.
Betancourt JP, Eleeh P, Stark S, Jain NB.

Am J Phys Med Rehabil. 2019 Mar 26. doi: 10.1097/PHM.0000000000001185. [Epub ahead of print]

OBJECTIVE: Children with cerebral palsy (CP) experience functional limitations because of excessive muscle weakness, spasticity, and impaired motor control. They are prescribed ankle foot orthoses (AFOs) to assist with ambulation. Our objective was to analyze stride length and dorsiflexion data comparing the effectiveness of "AFOs" with "barefoot or shoes only" on ambulatory children with CP. DESIGN: An electronic literature search was conducted. Studies were screened by two reviewers based on our inclusion criteria: prospective cohort study or randomized clinical trial (RCT), participants <18 years of age with a primary diagnosis of CP, AFOs with a control group, 20 combined participants in the experimental and control groups for cohort studies, and 10 participants for RCT's. RESULTS: Seventeen studies were selected. Pooled results of the meta-analyses showed that stride length was significantly better in the AFO group as compared with the control group (Mean difference between groups = 0.05m (95% CI = (0.04, 0.06)). The dorsiflexion angle (5 studies; 124 participants) was improved in patients with AFOs as compared with barefoot or shoes only (Mean difference between groups = 8.62 (95% CI = 8.05, 9.2)). CONCLUSION: Children with CP using AFOs had improved stride length and dorsiflexion angle during gait in a pooled meta-analyses of cohort studies and clinical trials.

PMID: 30920399

11. Host Mesh Fitting of a Generic Musculoskeletal Model of the Lower Limbs to Subject-Specific Body Surface Data: A Validation Study.
Oberhofer K, Lorenzetti S, Mithraratne K.

Appl Bionics Biomech. 2019 Feb 17;2019:8381351. doi: 10.1155/2019/8381351. eCollection 2019.

Challenges remain in accurately capturing the musculoskeletal geometry of individual subjects for clinical and biomechanical gait analysis. The aim of this study was to use and validate the Host Mesh Fitting (HMF) technique for fitting a generic anatomically based musculoskeletal model to 3D body surface data of individual subjects. The HMF technique is based on the free-form idea of deforming geometrically complex structures according to the deformation of a surrounding volumetric mesh. Using the HMF technique, an anatomically based model of the lower limbs of an adult female subject (29 years) was customized to subject-specific skin surface data of five typically developing children (mean age 10.2 years) and six children with Cerebral Palsy (CP) (mean age 9.6 years). The fitted lengths and volumes of six muscle-tendon structures were compared against measures from Magnetic Resonance (MR) images for validation purposes. The HMF technique resulted in accurate approximations of the lower limb shapes of all subjects in both study groups. The average error between the MR data and the fitted muscle-tendon lengths from HMF was 4 ± 4% in children without CP and 7 ± 5% in children with CP, respectively. The average error between the MR data and the fitted muscle volumes from HMF was 28 ± 19% in children without CP and 27 ± 28% in children with CP, respectively. This study presents a crucial step towards personalized musculoskeletal modelling for gait analysis by demonstrating the feasibility of fitting a generic anatomically based lower limb model to 3D body surface data of children with and without CP using the HMF technique. Additional improvements in the quality of fit are expected to be gained by developing age-matched generic models for different study groups, accounting for subject-specific variations in subcutaneous body fat, as well as considering supplementary data from ultrasound imaging to better capture physiological muscle tissue properties.

PMID: 30906423

12. Proportional Joint-Moment Control for Instantaneously-Adaptive Ankle Exoskeleton Assistance.
Gasparri GM, Luque J, Lerner ZF.

IEEE Trans Neural Syst Rehabil Eng. 2019 Mar 19. doi: 10.1109/TNSRE.2019.2905979. [Epub ahead of print]

Lower-limb exoskeletons used to improve free-living mobility for individuals with neuromuscular impairment must be controlled to prescribe assistance that adapts to the diverse locomotor conditions encountered during daily life, including walking at different speeds and across varied terrain. The goal of this study was to design and establish clinical feasibility of an ankle exoskeleton control strategy that instantly and appropriately adjusts assistance to the changing biomechanical demand during variable walking. To accomplish this goal, we developed a proportional joint-moment control strategy that prescribes assistance as a function of the instantaneous estimate of the ankle joint moment and conducted a laboratory-based feasibility study. Four individuals with neuromotor impairment and one unimpaired individual completed exoskeleton-assisted slow and fast gait transition tasks that involved gait initiation and changing walking speed. We found that the controller was effective in instantaneously prescribing exoskeleton assistance that was proportional to the ankle moment with less than 14% root-mean-square error, on average. We also performed a three-subject pilot investigation to determine the ability of the proportional joint-moment controller to improve walking economy. Evaluated in two individuals with cerebral palsy and one unimpaired individual, metabolic cost of transport improved 17-27% during treadmill and over-ground walking with proportional control compared to wearing the exoskeleton unassisted. These preliminary findings support the continued investigation of proportional joint-moment control for assisting individuals with neuromuscular disabilities during walking in real-world settings.

PMID: 30908231

13. Distal Femoral Extension Osteotomy with 90° Pediatric Condylar Locking Compression Plate and Patellar Tendon Advancement for the Correction of Crouch Gait in Cerebral Palsy.
Aroojis A, Patel M, Shah A, Sarathy K, Vaidya S, Mehta R.

Indian J Orthop. 2019 Jan-Feb;53(1):45-52. doi: 10.4103/ortho.IJOrtho_410_17.

BACKGROUND: Various treatment modalities are available for the correction of crouch gait, ranging from hamstring lengthening to a combination of soft-tissue and bony procedures. We report the results of distal femoral extension osteotomy (DFEO) fixed with 90° pediatric condylar locking compression plate (LCP) and patellar tendon advancement (PTA) for crouch gait in children with cerebral palsy. MATERIALS AND METHODS: A total of 26 patients (52 knees) with a mean age of 14.36 years (range 11.6-20 years) who presented with crouch gait were treated with DFEO and PTA. Patients were analyzed prospectively using clinical (knee flexion deformity, knee range of motion, extensor lag), functional (modified Ashworth, Tardieu scores, muscle strength, gross motor functional classification system [GMFCS], functional mobility scale [FMS], gross motor functional measure [GMFM]) and radiological (Koshino Index) outcome measures and followed up at a mean of 22 months (range 12-53 months). RESULTS: There was an improvement in all outcome measures postoperatively, with improved function and independence. The mean knee flexion deformity improved significantly from 20.7° ± 6.59 to 0.67° ± 2.62, mean

muscle strength of quadriceps improved from 3.01 ± 0.5 to 3.5 ± 0.54 and mean extensor lag improved from 20° ± 7.14 to 4.13° ± 4.16. The mean Koshino Index improved from 1.4 ± 0.16 to 1.0 ± 0.08. The mean GMFM-D improved from 15.58 ± 6.2 to 26.31 ± 5.8 and mean FMS for 5 m improved from 2.9 ± 1.09 to 3.6 ± 0.84, indicating significant improvement in household ambulation. There were four complications; transient peroneal nerve palsy in 3 patients, which recovered completely and 1 superficial wound dehiscence. There was no loss of fixation, tendon pull-out or deep infection. CONCLUSION: The combined procedure of DFEO and PTA can correct knee flexion deformity, restore knee extensor strength, and improve function in patients with crouch gait. The pediatric condylar LCP provides stable fixation to allow early mobilization and faster rehabilitation.

PMID: 30905981

14. Learning new gait patterns is enhanced by specificity of training rather than progression of task difficulty.
Krishnan C, Dharia AK, Augenstein TE, Washabaugh EP, Reid CE, Brown SR, Ranganathan R.

J Biomech. 2019 Mar 18. pii: S0021-9290(19)30192-7. doi: 10.1016/j.jbiomech.2019.03.014. [Epub ahead of print]

The use of motor learning strategies may enhance rehabilitation outcomes of individuals with neurological injuries (e.g., stroke or cerebral palsy). A common strategy to facilitate learning of challenging tasks is to use sequential progression - i.e., initially reduce task difficulty and slowly increase task difficulty until the desired difficulty level is reached. However, the evidence related to the use of such sequential progressions to improve learning is mixed for functional skill learning tasks, especially considering situations where practice duration is limited. Here, we studied the benefits of sequential progression using a functional motor learning task that has been previously used in gait rehabilitation. Three groups of participants (N = 43) learned a novel motor task during treadmill walking using different learning strategies. Participants in the specific group (n = 21) practiced only the criterion task (i.e., matching a target template that was scaled-up by 30%) throughout the training. Participants in the sequential group (n = 11) gradually progressed to the criterion task (from 3% to 30% in increments of 3%), whereas participants in the random group (n = 11) started at 3% and progressed in random increments (involving both increases and decreases in task difficulty) to the criterion task. At the end of training, kinematic tracking performance on the criterion task was evaluated in all participants both with and without visual feedback. Results indicated that the tracking error was significantly lower in the specific group, and no differences were observed between the sequential and the random progression groups. The findings indicate that the amount of practice in the criterion task is more critical than the difficulty and variations of task practice when learning new gait patterns during treadmill walking.

PMID: 30905405

15. How normal is normal: Consequences of stride to stride variability, treadmill walking and age when using normative paediatric gait data.
Oudenhoven LM, Booth ATC, Buizer AI, Harlaar J, van der Krogt MM.

Gait Posture. 2019 Mar 22;70:289-297. doi: 10.1016/j.gaitpost.2019.03.011. [Epub ahead of print]

PMID: 30925353

16. Measurement of community-based walking activity in cerebral palsy.
Bjornson KF.

Dev Med Child Neurol. 2019 Mar 25. doi: 10.1111/dmcn.14226. [Epub ahead of print]

PMID: 30908594

17. Commentary on "Validity of the Early Activity Scale for Endurance and the 6-Minute Walk Test for Children With Cerebral Palsy".
Carey H, Lewis J.

Pediatr Phys Ther. 2019 Apr;31(2):164. doi: 10.1097/PEP.0000000000000597.

Comment on Validity of the Early Activity Scale for Endurance and the 6-Minute Walk Test for Children With Cerebral Palsy. [Pediatr Phys Ther. 2019]

PMID: 30907833

18. Commentary on "Functional Task Training Combined With Electrical Stimulation Improves Motor Capacity in Children With Unilateral Cerebral Palsy: A Single-Subject Design".
Hastings S, Bensinger-Brody Y.

Pediatr Phys Ther. 2019 Apr;31(2):216. doi: 10.1097/PEP.0000000000000593.

Comment on Functional Task Training Combined With Electrical Stimulation Improves Motor Capacity in Children With Unilateral Cerebral Palsy: A Single-Subject Design. [Pediatr Phys Ther. 2019]

PMID: 30907840

19. Effects of Exercise Interventions on Habitual Physical Activity and Sedentary Behavior in Adolescents With Cerebral Palsy.
Bar-Haim S, Aviram R, Shkedy Rabani A, Amro A, Nammourah I, Al-Jarrah M, Raanan Y, Loeppky JA, Harries N.

Pediatr Exerc Sci. 2019 Mar 28:1-9. doi: 10.1123/pes.2018-0254. [Epub ahead of print]

PURPOSE: Exercise interventions have been shown to increase motor capacities in adolescents with cerebral palsy; however, how they affect habitual physical activity (HPA) and sedentary behavior is unclear. The main objective was to correlate changes in HPA with changes in mobility capacity following exercise interventions. METHODS: A total of 54 participants (aged 12-20 y) with bilateral spastic cerebral palsy at Gross Motor Function Classification System (GMFCS) levels II and III received 4 months of group progressive resistance training or treadmill training. Mobility measurements and HPA (averaged over 96 h) were made before and after interventions. RESULTS: Averaged baseline mobility and HPA measures and improvements in each after both interventions were positively correlated in all participants. Percentage of sedentary/awake time decreased 2%, with significant increases in HPA measures of step count (16%), walk time (14%), and upright time (9%). Mobility measures and HPA changes were quite similar between Gross Motor Function Classification System levels, but improvement in HPA after group progressive resistance training was greater than after treadmill training (12% vs 4%) and correlated with mobility improvement. CONCLUSIONS: Mobility capacity improved after these interventions and was clearly associated with improved HPA. The group progressive resistance training intervention seems preferable to improve HPA, perhaps related to greater social interaction and motivation provided by group training.

PMID: 30922152

20. Commentary on "Effects of Adaptive Bungee Trampolining for Children With Cerebral Palsy: A Single-Subject Research Design".
Hedgecock JB, Miller KE.

Pediatr Phys Ther. 2019 Apr;31(2):174. doi: 10.1097/PEP.0000000000000596.

Comment on Effects of Adaptive Bungee Trampolining for Children With Cerebral Palsy: A Single-Subject Study. [Pediatr Phys Ther. 2019]

PMID: 30907834

21. Clinical Examination of Children with Cerebral Palsy.
Sarathy K, Doshi C, Aroojis A.

Indian J Orthop. 2019 Jan-Feb;53(1):35-44. doi: 10.4103/ortho.IJOrtho_409_17.

Cerebral palsy (CP), a heterogeneous disorder of movement and posture, is one of the most important causes of disability affecting children. With a wide variability in the clinical presentation and a paucity of reliable diagnostic tests, decision-making in CP is fraught with difficulties and challenges. The plethora of musculoskeletal manifestations includes poor muscle function, spasticity, rigidity, muscle weakness, poor selective motor control, soft-tissue and joint contractures, torsional malalignments, and lever arm dysfunctions. Children with CP are at a high risk of further worsening and progression of these musculoskeletal abnormalities with the natural course of the disease. A comprehensive assessment that includes a combination of detailed medical history, functional assessment, clinical examination, analysis of gait, and radiological assessment is required to provide a favorable treatment outcome in these children. A close surveillance is essential so as to identify risk factors for the development and progression of musculoskeletal problems so that early interventions can be carried out to circumvent them. This review article is to highlight the importance of clinical examination in the assessment of children with CP.

PMID: 30905980

22. Evidence-based Approach to Physical Therapy in Cerebral Palsy.
Das SP, Ganesh GS.

Indian J Orthop. 2019 Jan-Feb;53(1):20-34. doi: 10.4103/ortho.IJOrtho_241_17.

Physiotherapy plays a key role in the management of cerebral palsy (CP) and comprises of various therapeutic interventions in enhancing the various physiological and functional outcomes. Though physiotherapy is used widely and recommended by all members of the health-care team, the effectiveness of physiotherapy is inconsistent. The objective of this review was to summarize and evaluate the effectiveness of physiotherapy interventions in children with CP. PubMed and Cochrane database were searched from January 2006 to April 2017 using the Medical Subject Heading and general keywords. Only systematic reviews and meta-analysis on PT interventions in children diagnosed with CP were included. Two reviewers independently assessed the methodological quality and retrieved the results. Thirty-four systematic reviews were identified that distinguished 15 different interventions. Moderate evidence of effectiveness was found for constraint-induced movement therapy for upper limb recovery, goal-directed/functional training, and gait training to improve gait speed. Conflicting evidence was found for the role of exercises on strength training and cardiorespiratory training. Intervention such as neurodevelopmental therapy (NDT) was found ineffective. This review suffer from limitations such as including reviews that had small sample size and that had considered heterogeneity of treatment interventions. Hence, the effectiveness of most PT interventions is found to be limited. On the basis of the present evidence, functional goal-oriented approaches are found to be effective and future research is required to determine the best ways to improve functional outcomes in children with CP.

PMID: 30905979

23. An Assessment of the Applicability of Shriners Hospital Upper Extremity Evaluation as a Decision-making Tool and Outcome Measure in Upper Limb Cerebral Palsy in Indian Children.
Jose PS, Radhakrishna VN, Sahoo B, Madhuri V.

Indian J Orthop. 2019 Jan-Feb;53(1):15-19. doi: 10.4103/ortho.IJOrtho_395_16.

BACKGROUND: The aim of this study was to assess the applicability and performance of the Shriners Hospital Upper Extremity Evaluation (SHUEE) and to determine its usefulness in clinical decision-making and as an outcome measure with reference to Indian children suffering from cerebral palsy. MATERIALS AND METHODS: The SHUEE videos of 40 children with cerebral palsy with spastic hemiplegia or asymmetrical diplegia were analyzed and scored. Seven children had undergone upper extremity surgery based on a preoperative evaluation. All seven had a postoperative evaluation. Pre- and postoperative scores were compared. Intra- and interobserver reliability was assessed. The level of familiarity and comfort of the children with the assigned tasks was gauged. RESULTS: Analysis of the scores revealed that patients could be categorized into three discrete groups based on the modified House scores and Spontaneous Functional Analysis (SFA) scores, which helps in identifying the patients who would benefit from surgical intervention. In the seven children who were operated, there was a mean increase in the postoperative SFA (2.97, P = 0.259), Dynamic Positional Analysis (3.15, P = 0.229) and Grasp/Release Analysis (4.96, P = 0.334) scores, though the differences were not statistically significant. There was excellent intraobserver (r - 0.98) and interobserver reliability (r - 0.97, 0.96) based on the intraclass correlation coefficient. The children were familiar with the assigned tasks and were not duly uncomfortable while attempting to perform them. CONCLUSIONS: SHUEE is a useful modality to assess upper limb function in Indian children with cerebral palsy, and can be used as a decision-making tool and mode of documentation.

PMID: 30905978

24. Views of children with cerebral palsy and their parents on the effectiveness and acceptability of intensive speech therapy.
Pennington L, Rauch R, Smith J, Brittain K.

Disabil Rehabil. 2019 Mar 29:1-9. doi: 10.1080/09638288.2019.1577504. [Epub ahead of print]

PURPOSE: To understand children and parents' views of the effectiveness and acceptability of intensive dysarthria therapy. MATERIALS AND METHODS: Twenty-two children with cerebral palsy and dysarthria joined a pilot RCT comparing intensive therapy and usual care. Children (n = 11) allocated to dysarthria therapy comprising three 40-minute sessions per week for six weeks and their parents (n = 11) were interviewed two weeks before and six weeks after therapy. Interviews were transcribed verbatim and analysed thematically. RESULTS: Analysis revealed five themes: Motivations, My new voice; The new me; I can do more; Success rooted in therapy design. Children had received little therapy for speech and were keen to improve intelligibility. Overall, therapy was viewed as effective. Participants described changes in children's speech production, which they associated with increased speech intelligibility. Children were described as more confident following the therapy, to have more successful conversations, with a wider range of partners in more environments, thereby increasing their social participation. The programme was viewed as acceptable, despite its intensity, due to the short term commitment and wider benefits for the child. Parents valued the organised structure and individualisation of the programme and inclusion in the therapy process. CONCLUSION: Families found the intervention acceptable and effective. A definitive trial of its clinical effectiveness is warranted. Implications for rehabilitation Children with cerebral palsy who have dysarthria and their parents reported that intensive speech therapy focussing on creating a stronger voice and a steady speech rate increased the clarity of children's voice and the intelligibility of their speech. Therapy may have additional benefits for children's self-confidence and social participation. The programme of therapy comprising three sessions per week for six weeks was seen as manageable by families in view of the results achieved.

PMID: 30925074

25. Surgical and therapeutic advances in the management of voice problems in children and young people.
Cavalli LJ, Cochrane LA.

Curr Opin Otolaryngol Head Neck Surg. 2019 Mar 27. doi: 10.1097/MOO.0000000000000533. [Epub ahead of print]

PURPOSE OF REVIEW: The current article reviews advances in both the assessment of paediatric voice disorders, as well as surgical, medical and therapeutic treatments. RECENT FINDINGS: It is important to evaluate the impact of a voice disorder from both the parent and child perspective. Outpatient laryngoscopy with stroboscopy is very possible even in young children; however, high-speed ultrasound is a plausible alternative. High-speed videolaryngoscopy, videokymography and dynamic computed tomography, offer potential for augmenting the assessment of vocal fold vibratory characteristics in children. The evidence to support the efficacy of both indirect and direct voice therapy interventions is growing. The management of vocal fold palsy has advanced to include laryngeal reinnervation. Intubation injury with/without surgical intervention offers challenge and gives rise to voice disorders that may be lifelong. SUMMARY: Although assessment and management practices of paediatric voice disorders closely follow those applied to adults, there are important differences and a developmental approach is required when considering both surgical and therapeutic management. Children can benefit from both indirect and direct therapy treatments following an ear, nose and throat assessment which utilizes paediatric instrumentation and considers the health of the entire airway. Underlying medical contributory factors should be explored and treated. Voice disorders due to congenital and acquired changes of the vocal tract may be amenable to surgery.

PMID: 30920984

26. Nutritional red flags in children with cerebral palsy.
Huysentruyt K, Geeraert F, Allemon H, Prinzie P, Roelants M, Ortibus E, Vandenplas Y, De Schepper J.

Clin Nutr. 2019 Mar 8. pii: S0261-5614(19)30094-9. doi: 10.1016/j.clnu.2019.02.040. [Epub ahead of print]

BACKGROUND & AIMS: Children with cerebral palsy (CP) are at risk for under-nutrition. The European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) guidelines identified anthropometric nutritional red flags for neurologically impaired children: weight for age z-score (WFA) < -2, triceps skinfold (TSF) or arm muscle area (AMA) < 10th centile and faltering weight. This study aimed to (1) evaluate the nutritional status of Flemish children and adolescents with CP using different anthropometric indicators; (2) assess the prevalence of nutritional red flags and (3) identify risk factors

for low anthropometric parameters. METHODS: This study was a prospective, longitudinal observational study recruiting children and adolescents with CP (2-20 years) in 9 specialized Flemish centres. Measurements were performed at baseline (t1, n = 325), after 6 (t2, total n = 268) and 12 months (t3, total n = 191). WFA z-scores were based on Flemish growth charts; TSF, subscapular skinfolds (SSF) and AMA compared with US reference data. Weight faltering was defined as ≥0.5 decrease in weight SDS at t2 or t3. RESULTS: At t1 50 patients (15.4%) were classified as gross motor function classification system (GMFCS) 1, 95 (29.2%) as GMFCS 2, 49 (15.1%) as GMFCS 3, 54 (16.6%) as GMFCS 4, and 77 (23.7%) as GMFCS 5. The overall median (Q1; Q3) age was 11.7 (8.2; 15.9) years; 61.5% were boys and 22 (6.8%) had a gastrostomy (17 (22.1%) of GMFCS 5 group). The median (Q1; Q3) WFA z-score was -1.13 (-2.6; -0.1); 71.4% of the GMFCS 5 children had a WFA z-score < -2. The median (Q1; Q3) MUAC z-score was 0.17 (-0.7; 1.0); 16.9% of the GFMCS 5 children had MUAC z-score < -2. Median (Q1; Q3) TSF and SSF z-scores were respectively -0.01 (-0.8; 0.9) and 0.27 (-0.3; 0.9). All anthropometric indices tended to decrease with increasing GMFCS ($p < 0.001$). At t1 42.1% had at least one nutritional red flag, at t2 40.3% and at t3 41.4%. Of those with at least one nutritional red flag at t1 or t2, respectively 14.7% and 18.8% suffered weight loss 6 months later. A GMFCS >2 and dysphagia were associated with a higher risk for lower scores of nearly all nutritional indices. CONCLUSIONS: Underweight was detected in almost three quarters of CP patients with GMFCS 5 classification, whereas deficits in subcutaneous fat and arm muscle reserve were observed in one fifth. Nutritional red flags, present in about 40% of the Flemish CP children, were apparently not successfully addressed in clinical practice, since up to one-fifth of CP patients with warning signs lost even further weight in the following 6 months. Beside a GMFCS >2, dysphagia was one of the most common conditions influencing the presence of low nutritional indices.

PMID: 30902487

27. Predictors of Emergency Room and Hospital Utilization Among Adults With Intellectual and Developmental Disabilities (IDD).
Blaskowitz MG, Hernandez B, Scott PW.

Intellect Dev Disabil. 2019 Apr;57(2):127-145. doi: 10.1352/1934-9556-57.2.127.

Emergency room (ER) and hospital utilization among people with intellectual and developmental disabilities (IDD) are significant contributors to rising healthcare costs. This study identifies predictors of utilization among 597 adults with IDD. Using a retrospective survey of medical charts, descriptive statistics and logistic regressions were conducted. Individual-level risk factors for ER utilization included age, number of chronic health conditions, a diagnosis of cerebral palsy or neurological disorder, mental illness, and polypharmacy. Environmental predictors included community-based supported living. Hospitalization predictors included age and number of chronic illnesses. People residing in group homes were less likely to be admitted. This study found risk factors unique to individuals with IDD that should be addressed with tailored interventions as states transition to Medicaid managed care.

PMID: 30920909

28. Attention and visuo-spatial function in children without cerebral palsy who were cooled for neonatal encephalopathy: a case-control study.
Tonks J, Cloke G, Lee-Kelland R, Jary S, Thoresen M, Cowan FM, Chakkarapani E.

Brain Inj. 2019 Mar 29:1-5. doi: 10.1080/02699052.2019.1597163. [Epub ahead of print]

OBJECTIVES: Dorsal-stream functions are vulnerable to early brain injury associated with neonatal encephalopathy (NE) following perinatal asphyxia, even in children not developing cerebral palsy (CP). Since therapeutic hypothermia (TH) became the standard treatment for NE, the incidence of CP is reduced but the impact on dorsal-stream functions is unknown. We aimed to compare dorsal-stream functions in TH-treated survivors of NE, without CP, with those of matched controls. METHODS: We administered tests of dorsal-stream function to 29 case children aged 6-to-8 years treated with TH for NE and without CP, and 20 age, sex and social class matched controls. We used the Conner's Continuous Performance Test (CPT) 2nd Edition to assess attentiveness, based upon Hit Reaction Time (HRT) percentile score and HRT standard error percentile, the CPT HRT block change measure to assess sustained attention and the NEPSY-II block construction and arrows tests to assess visuo-spatial performance and mental rotation. RESULTS: Case children performed significantly worse than controls on measures of attention and visuo-spatial function. CONCLUSIONS: Children given TH treatment for NE can have subtle attention difficulties with slower reaction times and reduced visuo-spatial processing. These findings illustrate the continued vulnerability of dorsal-stream functions following NE despite the use of TH.

PMID: 30924691

29. Bedside neurophysiological tests can identify neonates with stroke leading to cerebral palsy.
Nevalainen P, Metsäranta M, Toiviainen-Salo S, Lönnqvist T, Vanhatalo S, Lauronen L.

Clin Neurophysiol. 2019 Mar 15;130(5):759-766. doi: 10.1016/j.clinph.2019.02.017. [Epub ahead of print]

OBJECTIVE: The unspecific symptoms of neonatal stroke still challenge its bedside diagnosis. We studied the accuracy of routine electroencephalography (EEG) and simultaneously recorded somatosensory evoked potentials (EEG-SEP) for diagnosis and outcome prediction of neonatal stroke. METHODS: We evaluated EEG and EEG-SEPs from a hospital cohort of 174 near-term neonates with suspected seizures or encephalopathy, 32 of whom were diagnosed with acute ischemic or hemorrhagic stroke in MRI. EEG was scored for background activity and seizures. SEPs were classified as present or absent. Developmental outcome of stroke survivors was evaluated from medical records at 8- to 18-months age. RESULTS: The combination of continuous EEG and uni- or bilaterally absent SEP (n = 10) was exclusively seen in neonates with a middle cerebral artery (MCA) stroke (specificity 100%). Moreover, 80% of the neonates with this finding developed with cerebral palsy. Bilaterally present SEPs did not exclude stroke, but predicted favorable neuromotor outcome in stroke survivors (positive predictive value 95%). CONCLUSIONS: Absent SEP combined with continuous EEG background in near-term neonates indicates an MCA stroke and a high risk for cerebral palsy. SIGNIFICANCE: EEG-SEP offers a bedside method for diagnostic screening and a reliable prediction of neuromotor outcome in neonates suspected of having a stroke.

PMID: 30904770

30. Outcomes of Extremely Preterm Infants With Birth Weight Less Than 400 g.
Brumbaugh JE, Hansen NI, Bell EF, Sridhar A, Carlo WA, Hintz SR, Vohr BR, Colaizy TT, Duncan AF, Wyckoff MH, Baack ML, Rysavy MA, DeMauro SB, Stoll BJ, Das A, Higgins RD; National Institute of Child Health and Human Development Neonatal Research Network.

JAMA Pediatr. 2019 Mar 25. doi: 10.1001/jamapediatrics.2019.0180. [Epub ahead of print]

IMPORTANCE: Birth weight (BW) is an important predictor of mortality and morbidity. At extremely early gestational ages (GAs), BW may influence decisions regarding initiation of resuscitation. OBJECTIVE: To characterize outcomes of liveborn infants with a BW less than 400 g. DESIGN, SETTING, AND PARTICIPANTS: This retrospective multicenter cohort study analyzed extremely preterm infants born between January 2008 and December 2016 within the National Institute of Child Health and Human Development Neonatal Research Network. Infants with a BW less than 400 g and a GA of 22 to 26 weeks were included. Active treatment was defined as the provision of any potentially lifesaving intervention after birth. Survival was analyzed for the entire cohort; neurodevelopmental impairment (NDI) was examined for those born between January 2008 and December 2015 (birth years with outcomes available for analysis). Neurodevelopmental impairment at 18 to 26 months' corrected age (CA) was defined as a Bayley Scales of Infant and Toddler Development, Third Edition, cognitive composite score less than 85, a motor composite score less than 85, moderate or severe cerebral palsy, gross motor function classification system score of 2 or greater, bilateral blindness, and/or hearing impairment. Data were analyzed from September 2017 to October 2018. EXPOSURES: Birth weight less than 400 g. MAIN OUTCOMES AND MEASURES: The primary outcome was survival to discharge among infants who received active treatment. Analysis of follow-up data was limited to infants born from 2008 to 2015 to ensure children had reached assessment age. Within this cohort, neurodevelopmental outcomes were assessed for infants who survived to 18 to 26 months' CA and returned for a comprehensive visit. RESULTS: Of the 205 included infants, 121 (59.0%) were female, 133 (64.9%) were singletons, and 178 (86.8%) were small for gestational age. Almost half (101 of 205 [49.3%]) received active treatment at birth. A total of 26 of 205 infants (12.7%; 95% CI, 8.5-18.9) overall survived to discharge, and 26 of 101 actively treated infants (25.7%; 95% CI, 17.6-35.4) survived to discharge. Within the subset of infants with a BW less than 400 g and a GA of 22 to 23 weeks, 6 of 36 actively treated infants (17%; 95% CI, 6-33) survived to discharge. Among infants born between 2008 and 2015, 23 of 90 actively treated infants (26%; 95% CI, 17-36) survived to discharge. Two infants died after discharge, and 2 were lost to follow-up. Thus, 19 of 90 actively treated infants (21%; 95% CI, 13-31) were evaluated at 18 to 26 months' CA. Moderate or severe NDI occurred in 14 of 19 infants (74%). CONCLUSIONS AND RELEVANCE: Infants born with a BW less than 400 g are at high risk of mortality and significant morbidity. Although 21% of infants survived to 18 to 26 months' CA with active treatment, NDI was common among survivors.

PMID: 30907941

31. Effectiveness and safety of warm needle acupuncture on children with cerebral palsy: Protocol for a systematic review and meta-analysis.
Chen LA, Liu HT, Huang C, Zhang L, Zeng F, Xie B.

Medicine (Baltimore). 2019 Mar;98(13):e14959. doi: 10.1097/MD.0000000000014959.

BACKGROUND: Warm needle acupuncture (WNA) is an integral part of the acupuncture therapy, which combines acupuncture and moxibustion. Children with cerebral palsy (CP) is a common disease in children, which seriously affects children's growing development, physical and mental health. The clinical practice indicates that WNA has a therapeutic effect on children with CP. Here we will provide a protocol to explore the effectiveness and safety of WNA for children with CP. METHODS: We will search the randomized controlled trails (RCT) literatures of WNA for children with CP in 5 English databases [PubMed, Web of Science, EMBASE, the Cochrane Central Register of Controlled Trials (Cochrane Library), and WHO International Clinical Trials Registry Platform (ICTRP)] and 4 Chinese databases [Chinese National Knowledge Infrastructure (CNKI), Chinese VIP Information, Wanfang Database, and Chinese Biomedical Literature Database (CBM)]. Activity of Daily Living Scales (ADL) of the patient will be considered as the primary outcome and the secondary outcome will include 88 items of gross motor function scale (GMFM-88), Gesell Growth Table (GGT), Criteria for judging efficacy and adverse events caused by WNA such as dizziness, nausea, vomiting, weariness, etc. The selection of the studies will be performed by EndnoteX7 software. And we will conduct all analyses with RevMan software V5.3. RESULT: This study will provide a rational synthesis of current evidences for WNA on children with CP. CONCLUSION: The conclusion of this study will provide evidence to judge the effectiveness and safety of WNA on children with CP. REGISTRATION: PROS-PERO CRD42019122034.

PMID: 30921197

32. Clinical and neurodevelopmental features in children with cerebral palsy and probable congenital Zika.
Carvalho A, Brites C, Mochida G, Ventura P, Fernandes A, Lage ML, Taguchi T, Brandi I, Silva A, Franceschi G, Lucena P, Lucena R.

Brain Dev. 2019 Mar 23. pii: S0387-7604(18)30433-9. doi: 10.1016/j.braindev.2019.03.005. [Epub ahead of print]

OBJECTIVE: To describe the neurological and neurodevelopmental features at 1 year of age in children with cerebral palsy (CP) related to probable congenital Zika (CZ), followed in a referral neurorehabilitation hospital. METHODS: Data on 82 children with CP associated with probable CZ, who consecutively attended the neurodevelopmental and neurological assessment around one year of age, were collected. For neurodevelopmental evaluation, Bayley-III Scales of Infant and Toddler Development was used. Descriptive statistical analysis was performed. RESULTS: The children were admitted into the rehabilitation program at a young age (mean age: 4.8 months, SD 3.1), followed beyond the first year of life (mean age of follow up: 13.2 months, SD 2.1), born to young mothers (mean age: 28.1 years, SD 5.9), in their first pregnancy (62.2%). The majority had severe congenital microcephaly (62.0%), spastic CP (96.3%), epilepsy (63.4%), absent expected postural reactions (93.2%), abnormal persistence of primitive reflexes (94.7%), and severe neuroimaging abnormalities, predominantly calcifications (97.6%). Extremely low performances on cognitive (95.1%), language (97.6%) and motor (97.6%) developmental composite scores were observed. There was a correlation between the cognitive score with the birth head circumference (HC) ($r = 0.3$, $p = 0.01$) and with the follow up HC ($r = 0.4$, $p < 0.01$), as well as between the follow up HC with the motor score ($r = 0.2$, $p = 0.03$). CONCLUSION: Congenital Zika may be associated with a severe form of CP, mainly bilateral spastic, with a severe global neurodevelopmental impairment and early signs of a poor prognosis for independent walking. Head circumference may be a prognostic marker among those children. These results may help establish goals for the rehabilitation program and identify priority health services.

PMID: 30914212

33. Very Preterm Infants with Technological Dependence at Home: Impact on Resource Use and Family.
Nassel D, Chartrand C, Doré-Bergeron MJ, Lefebvre F, Ballantyne M, Van Overmeire B, Luu TM; on behalf of the Canadian Neonatal Network and the Canadian Neonatal Follow-Up Network.

Neonatology. 2019 Mar 25;115(4):363-370. doi: 10.1159/000496494. [Epub ahead of print]

OBJECTIVE: To examine the impact of medical complexity among very preterm infants on health care resource use, family, and neurodevelopmental outcomes at 18 months' corrected age. METHODS: This observational cohort study of Canadian infants born < 29 weeks' gestational age in 2009-2011 compared infants with and those without medical complexity defined as discharged home with assistive medical technology. Health care resource use and family outcomes were collected. Children were assessed for cerebral palsy, deafness, blindness, and developmental delay at 18 months. Logistic regression analysis was performed for group comparisons. RESULTS: Overall, 466/2,337 infants (20%) needed assistive medical technology at home including oxygen (79%), gavage feeding (21%), gastrostomy or ileostomy (20%), CPAP (5%), and tracheostomy (3%).

Children with medical complexity were more likely to be re-hospitalized (OR 3.6, 95% CI 3.0-4.5) and to require ≥2 outpatient services (OR 4.4, 95% CI 3.5-5.6). Employment of both parents at 18 months was also less frequent in those with medical complexity compared to those without medical complexity (52 vs. 60%, $p < 0.01$). Thirty percent of children with medical complexity had significant neurodevelopmental impairment compared to 13% of those without medical complexity ($p < 0.01$). Lower gestational age, lower birth weight, bronchopulmonary dysplasia, sepsis, and surgical necrotizing enterocolitis were associated with a risk of medical complexity. CONCLUSION: Medical complexity is common following very preterm birth and has a significant impact on health care use as well as family employment and is more often associated with neurodevelopmental disabilities. Efforts should be deployed to facilitate care coordination upon hospital discharge and to support families of preterm children with medical complexity.

PMID: 30909270

34. Stress and perceived stigma among parents of children with epilepsy.
Rani A, Thomas PT.

Neurol Sci. 2019 Mar 22. doi: 10.1007/s10072-019-03822-6. [Epub ahead of print]

PURPOSE: The present study aimed at understanding the stress and perceived stigma among parents of children with epilepsy seeking treatment at a tertiary referral center for neurology in South India. MATERIALS AND METHODS: Parents of sixty children suffering from epilepsy in the age group of 4-15 years were interviewed to explore parental stress and perceived stigma. They were recruited consecutively over a period of 6 months in 2015. Tools administered were Childhood-Illness related Parenting Stress Inventory (Manford in J Neurol 264(8):1811-24, 2017) and the Parent Stigma Scale (Baca et al. in Value Health 13(6):778-786, 2010). RESULTS: The mean age of parents was 37.2 years, and the majority of parents who used to bring their child to the hospital were male (71.7%) and educated up to the secondary/intermediate level (36%) and were from lower socio-economic status. The mean age of children with epilepsy was 8.4 years with the majority of them being male (66.7%), affected with chronic seizures (58.3%) with most commonly occurring seizure type being generalized seizures (50%), with a co-morbid diagnosis of cerebral palsy (26.7%). A significant number of parents reported difficulty in communicating with medical team (58.3%) and significant others (51.7%) about their child's seizures and difficulty in making decisions related to their child's medical care (43.3%) which strained their financial resources and created difficulty in adequate role functioning. Findings indicated that most of the parents of children with chronic seizures perceived reactions of others to be negative (53.3%) and would limit family social interaction which resulted into emotional reaction in the form of anger, guilt, fear, anxiety, and depression. CONCLUSION: Parents are important figures in the process by which children with epilepsy came to acknowledge themselves being different from other children. Parents often feared divulging their child's epilepsy to their friends and relatives because they experienced a sense of shame, self-blame, and rejection which also increased their stress.

PMID: 30903416

35. Effects of Dopamine on Motor Recovery and Training in Adults and Children With Nonprogressive Neurological Injuries: A Systematic Review.
Bradley CL, Damiano DL.

Neurorehabil Neural Repair. 2019 Mar 27:1545968319837289. doi: 10.1177/1545968319837289. [Epub ahead of print]

BACKGROUND: The strong link between dopamine and motor learning has been well-established in the animal literature with similar findings reported in healthy adults and the elderly. OBJECTIVE: We aimed to conduct the first, to our knowledge, systematic review of the literature on the evidence for the effects of dopaminergic medications or genetic variations in dopamine transmission on motor recovery or learning after a nonprogressive neurological injury. METHODS: A PubMed search was conducted up until April 2018 for all English articles including participants with nonprogressive neurological injury such as cerebral palsy, stroke, spinal cord injury, and traumatic brain injury; quantitative motor outcomes; and assessments of the dopaminergic system or medications. RESULTS: The search yielded 237 articles, from which we identified 26 articles meeting all inclusion/exclusion criteria. The vast majority of articles were related to the use of levodopa poststroke; however, several studies assessed the effects of different medications and/or were on individuals with traumatic brain injury, spinal cord injury or cerebral palsy. CONCLUSIONS: The evidence suggests that a brain injury can decrease dopamine transmission and that levodopa may have a positive effect on motor outcomes poststroke, although evidence is not conclusive or consistent. Individual variations in genes related to dopamine transmission may also influence the response to motor skill training during neurorehabilitation and the extent to which dopaminergic medications or interventions can augment that response. More rigorous safety and efficacy studies of levodopa and dopaminergic medications in stroke and particularly other neurological injuries including genetic analyses are warranted.

PMID: 30913975

36. A Compound Heterozygote for GCH1 Mutation Represents a Case of Atypical Dopa-Responsive Dystonia.
Giri S, Naiya T, Roy S, Das G, Wali GM, Das SK, Ray K, Ray J.

J Mol Neurosci. 2019 Mar 25. doi: 10.1007/s12031-019-01301-3. [Epub ahead of print]

Dopa-responsive dystonia (DRD), a movement disorder, is characterized by young onset dystonia and dramatic response to levodopa treatment. However, the wide range of phenotypic spectrum of the disease often leads to misdiagnosis. DRD is usually caused by mutation in GCH1 gene coding for GTP cyclohydrolase 1 (GTPCH1) enzyme, which is involved in biosynthesis of tetrahydrobiopterin (BH4) and dopamine. In this study, the entire GCH1 gene was screened in 14 Indian DRD patients and their family members. A family was identified where the proband was found to be a compound heterozygote for GCH1 (p.R184H and p.V204I) variants; the former variant being inherited from the father and the latter from the mother. All other family members harboring one of these GCH1 variants were asymptomatic except for one (heterozygous for p.R184H) who was diagnosed with DRD. In silico analyses predicted these two variants to be pathogenic and disruptive to GCH1enzymatic activity. This proband was misdiagnosed as cerebral palsy and remained untreated for 25 years. He developed retrograde movements and gait problems in lower limbs, deformity in upper limbs, and difficulty in swallowing, and became mute. However, most of his symptoms were alleviated upon levodopa administration. Our study confirms the variability of DRD phenotype and the reduced penetrance of GCH1 mutations. It also emphasizes the need of molecular diagnostic test and L -dopa trial especially for those with atypical DRD phenotype.

PMID: 30911941

37. Genetic mimics of cerebral palsy.
Pearson TS1, Pons R2, Ghaoui R3, Sue CM4.

Mov Disord. 2019 Mar 26. doi: 10.1002/mds.27655. [Epub ahead of print]

The term "cerebral palsy mimic" is used to describe a number of neurogenetic disorders that may present with motor symptoms in early childhood, resulting in a misdiagnosis of cerebral palsy. Cerebral palsy describes a heterogeneous group of neurodevelopmental disorders characterized by onset in infancy or early childhood of motor symptoms (including hypotonia, spasticity, dystonia, and chorea), often accompanied by developmental delay. The primary etiology of a cerebral palsy syndrome should always be identified if possible. This is particularly important in the case of genetic or metabolic disorders that have specific disease-modifying treatment. In this article, we discuss clinical features that should alert the clinician to the possibility of a cerebral palsy mimic, provide a practical framework for selecting and interpreting neuroimaging, biochemical, and genetic investigations, and highlight selected conditions that may present with predominant spasticity, dystonia/chorea, and ataxia. Making a precise diagnosis of a genetic disorder has important implications for treatment, and for advising the family regarding prognosis and genetic counseling.

PMID: 30913345

38. Electrode Placement in Transcranial Direct Current Stimulation-How Reliable Is the Determination of C3/C4?
Rich TL, Gillick BT.

Brain Sci. 2019 Mar 22;9(3). pii: E69. doi: 10.3390/brainsci9030069.

The 10/20 electroencephalogram (EEG) measurements system often guides electrode placement for transcranial direct current stimulation (tDCS), a form of non-invasive brain stimulation. One targeted region of the brain is the primary motor cortex (M1) for motor recovery after stroke, among other clinical indications. M1 is identified by C3 and C4 of the 10/20 EEG system yet the reliability of 10/20 EEG measurements by novice research raters is unknown. We investigated the reliability of the 10/20 EEG measurements for C3 and C4 in 25 adult participants. Two novice raters were assessed for inter-rater reliability. Both raters received two hours of instruction from a registered neurodiagnostic technician. One of the raters completed the measurements across two testing days for intra-rater reliability. Relative reliability was determined using the intraclass coefficient (ICC) and absolute reliability. We observed a low to fair inter and intra-rater ICC for motor cortex measurements. The absolute reliability was <1.0 cm by different novice raters and on different days. Although a low error was observed, consideration of the integrity of the targeted region of the brain is critical when designing tDCS interventions in clinical populations who may have compromised brain structure, due to a lesion or altered anatomy.

PMID: 30909374

39. Neonatal Functional and Structural Connectivity Are Associated with Cerebral Palsy at Two Years of Age.
Merhar SL, Gozdas E, Tkach JA, Parikh NA, Kline-Fath BM, He L, Yuan W, Altaye M, Leach JL, Holland SK.

Am J Perinatol. 2019 Mar 27. doi: 10.1055/s-0039-1683874. [Epub ahead of print]

OBJECTIVE: The accuracy of structural magnetic resonance imaging (MRI) to predict later cerebral palsy (CP) in newborns with perinatal brain injury is variable. Diffusion tensor imaging (DTI) and task-based functional MRI (fMRI) show promise as predictive tools. We hypothesized that infants who later developed CP would have reduced structural and functional connectivity as compared with those without CP. STUDY DESIGN: We performed DTI and fMRI using a passive motor task at 40 to 48 weeks' postmenstrual age in 12 infants with perinatal brain injury. CP was diagnosed at age 2 using a standardized examination. RESULTS: Five infants had CP at 2 years of age, and seven did not have CP. Tract-based spatial statistics showed a widespread reduction of fractional anisotropy (FA) in almost all white matter tracts in the CP group. Using the median FA value in the corticospinal tracts as a cutoff, FA was 100% sensitive and 86% specific to predict CP compared with a sensitivity of 60 to 80% and a specificity of 71% for structural MRI. During fMRI, the CP group had reduced functional connectivity from the right supplemental motor area as compared with the non-CP group. CONCLUSION: DTI and fMRI obtained soon after birth are potential biomarkers to predict CP in newborns with perinatal brain injury.

PMID: 30919395

40. Characterisation of the Corticospinal Tract Using Diffusion Magnetic Resonance Imaging in Unilateral and Bilateral Cerebral Palsy Patients.
Samsir S, Zakaria R, Razak SA, Ismail MS, Rahim MZA, Lin CS, Osman NMFN, Asri MA, Ahmad AH.

Malays J Med Sci. 2018 Sep;25(5):68-78. doi: 10.21315/mjms2018.25.5.7. Epub 2018 Oct 30.

BACKGROUND: Neuroimaging is increasingly used to locate the lesion that causes cerebral palsy (CP) and its extent in the brains of CP patients. Conventional structural magnetic resonance imaging (MRI) does not indicate the connectional pattern of white matter; however, with the help of diffusion MRI, fibre tracking of white matter can be done. METHODS: We used diffusion MRI and probabilistic tractography to identify the putative white matter connectivity in the brains of 10 CP patients. We tracked the corticospinal tract (CST) of the patients' upper and lower limbs and calculated the white matter connectivity, as indexed by streamlines representing the probability of connection of the CST. RESULTS: Our results show that diffusion MRI with probabilistic tractography, while having some relation with the clinical diagnosis of CP, reveals a high degree of individual variation in the streamlines representing the CST for upper and lower limbs. CONCLUSION: Diffusion MRI with probabilistic tractography provides the state of connectivity from lesioned areas to other parts of the brain and is potentially beneficial to be used as an adjunct to the clinical management of CP, providing a means to monitor intervention outcomes.

PMID: 30914864

41. Chorioamnionitis in Rats Precipitates Extended Postnatal Inflammatory Lymphocyte Hyperreactivity.
Yellowhair TR, Noor S, Mares B, Jose C, Newville JC, Maxwell JR, Northington FJ, Milligan ED, Robinson S, Jantzie LL.

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Preterm birth is an important cause of perinatal brain injury (PBI). Neurological injury in extremely preterm infants often begins in utero with chorioamnionitis (CHORIO) or inflammation/infection of the placenta and concomitant placental insufficiency. Studies in humans have shown dysregulated inflammatory signaling throughout the placental-fetal brain axis and altered peripheral immune responses in children born preterm with cerebral palsy (CP). We hypothesized that peripheral immune responses would be altered in our well-established rat model of CP. Specifically, we proposed that isolated peripheral blood mononuclear cells (PBMCs) would be hyperresponsive to a second hit of inflammation throughout an extended postnatal time course. Pregnant Sprague-Dawley dams underwent a laparotomy on embryonic day 18 (E18) with occlusion of the uterine arteries (for 60 min) followed by intra-amniotic injection of lipopolysaccharide (LPS, 4 μg/sac) to induce injury in utero. Shams underwent laparotomy only, with equivalent duration of anesthesia. Laparotomies were then closed, and the rat pups were born at E22. PBMCs were isolated from pups on postnatal day 7 (P7) and P21, and subsequently stimulated in vitro with LPS for 3 or 24 h. A secreted inflammatory profile analysis of conditioned media was performed using multiplex electrochemiluminescent immunoassays, and the composition of inflammatory cells was assayed with flow cytometry (FC). Results indicate that CHORIO PBMCs challenged with LPS are hyperreactive and secrete significantly more tumor necrosis factor α (TNFα) and C-X-C chemokine ligand 1 at P7. FC confirmed increased intracellular TNFα in CHORIO pups at P7

following LPS stimulation, in addition to increased numbers of CD11b/c immunopositive myeloid cells. Notably, TNFα secretion was sustained until P21, with increased interleukin 6, concomitant with increased expression of integrin β1, suggesting both sustained peripheral immune hyperreactivity and a heightened activation state. Taken together, these data indicate that in utero injury primes the immune system and augments enhanced inflammatory signaling. The insidious effects of primed peripheral immune cells may compound PBI secondary to CHORIO and/or placental insufficiency, and thereby render the brain susceptible to future chronic neurological disease. Further understanding of inflammatory mechanisms in PBI may yield clinically important biomarkers and facilitate individualized repair strategies and treatments.

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