Cerebral palsy research news

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Interventions and Management

1. The Upper Extremity Flexion Synergy Is Minimally Expressed in Young Individuals With Unilateral Cerebral Palsy Following an Early Brain Injury
Nayo M Hill, Julius P A Dewald

Front Hum Neurosci. 2020 Oct 16;14:590198. doi: 10.3389/fnhum.2020.590198. eCollection 2020.

Hemiparetic stroke in adulthood often results in the grouped movement pattern of the upper extremity flexion synergy thought to arise from an increased reliance on cortico-reticulospinal pathways due to a loss of lateral corticospinal projections. It is well established that the flexion synergy induces reaching constraints in individuals with adult-onset hemiplegia. The expression of the flexion synergy in individuals with brain injuries onset earlier in the lifespan is currently unknown. An early unilateral brain injury occurring prior to six months post full-term may preserve corticospinal projections which can be used for independent joint control and thus minimizing the expression of the flexion synergy. This study uses kinematics of a ballistic reaching task to evaluate the expression of the flexion synergy in individuals with pediatric hemiplegia (PH) ages six to seventeen years. Fifteen individuals with brain injuries before birth (n = 8) and around full-term (n = 7) and nine age-matched controls with no known neurological impairment completed a set of reaches in an admittance controlled robotic device. Descending drive, and the possible expression of the upper extremity flexion synergy, was modulated by increasing shoulder abduction loading. Individuals with early-onset PH achieved lower peak velocities when reaching with the paretic arm compared to controls; however, no differences in reaching distance were found between groups. Relative maintenance in reaching seen in individuals with early brain injuries highlights minimal expression of the flexion synergy. We interpret this conservation of independent control of the paretic shoulder and elbow as the use of more direct corticospinal projections instead of indirect cortico-reticulospinal pathways used in individuals with adult-onset hemiplegia.

PMID: 33192425

2. Efficacy and safety of abobotulinumtoxinA for upper limb spasticity in children with cerebral palsy: a randomized repeat-treatment study
Mauricio R Delgado, Ann Tilton, Jorge Carranza-Del Río, Nigar Dursun, Marcin Bonikowski, Resa Aydin, Iwona Maciag-Tymecka, Joyce Oleszek, Edward Dabrowski, Anne-Sophie Grandoulier, Philippe Picaut, Dysport in PUL study group

Dev Med Child Neurol. 2020 Nov 18. doi: 10.1111/dmcn.14733. Online ahead of print.

Aim: To assess the efficacy and safety of repeat abobotulinumtoxinA injections in reducing upper limb spasticity in children with cerebral palsy (CP). Method: This was a double-blind, repeat-cycle study (NCT02106351) in children with CP (2-17y). Children were randomized to receive 2U/kg (control), 8U/kg, or 16U/kg abobotulinumtoxinA injections into the target muscle group (wrist or elbow flexors) and additional muscles alongside occupational therapy via a home-exercise therapy program (HETP; minimum five 15min sessions/wk). Children received 8U/kg or 16U/kg plus HETP in cycles 2 to 4. Results: During

cycle 1, 210 children (126 males, 84 females; mean age [SD] 9y [4y 5mo], range 2-17y; n=70/group) had at least one upper limb abobotulinumtoxinA injection and 209 complied with the HETP. At week 6 of cycle 1, children in the 8U/kg or 16U/kg groups had significantly lower Modified Ashworth scale scores versus the 2U/kg group (primary outcome: treatment differences of -0.4 [p=0.012] and -0.7 [p<0.001] respectively). All groups improved on Physician Global Assessment and children in all groups achieved their treatment goals at least as expected. Therapeutic benefits were sustained during cycles 2 to 4; muscular weakness was the only treatment-related adverse event reported in at least one child/group (4.3% and 5.7% vs 1.4% respectively). Interpretation: Treatment with 8U/kg or 16U/kg abobotulinumtoxinA significantly reduced upper limb spasticity versus the 2U/kg control dose. Therapeutic benefits of abobotulinumtoxinA plus HETP were sustained with repeat treatment cycles.

PMID: 33206382

3. Development and evaluation of a novel music-based therapeutic device for upper extremity movement training: A pre-clinical, single-arm trial
Nina Schaffert, Thenille Braun Janzen, Roy Ploigt, Sebastian Schlüter, Veronica Vuong, Michael H Thaut

PLoS One. 2020 Nov 19;15(11):e0242552. doi: 10.1371/journal.pone.0242552. eCollection 2020.

Restoration of upper limb motor function and patient functional independence are crucial treatment targets in neurological rehabilitation. Growing evidence indicates that music-based intervention is a promising therapeutic approach for the restoration of upper extremity functional abilities in neurologic conditions such as cerebral palsy, stroke, and Parkinson's Disease. In this context, music technology may be particularly useful to increase the availability and accessibility of music-based therapy and assist therapists in the implementation and assessment of targeted therapeutic goals. In the present study, we conducted a pre-clinical, single-arm trial to evaluate a novel music-based therapeutic device (SONATA) for upper limb extremity movement training. The device consists of a graphical user interface generated by a single-board computer displayed on a 32" touchscreen with built-in speakers controlled wirelessly by a computer tablet. The system includes two operational modes that allow users to play musical melodies on a virtual keyboard or draw figures/shapes whereby every action input results in controllable sensory feedback. Four motor tasks involving hand/finger movement were performed with 21 healthy individuals (13 males, aged 26.4 ± 3.5 years) to evaluate the device's operational modes and main features. The results of the functional tests suggest that the device is a reliable system to present pre-defined sequences of audiovisual stimuli and shapes and to record response and movement data. This preliminary study also suggests that the device is feasible and adequate for use with healthy individuals. These findings open new avenues for future clinical research to further investigate the feasibility and usability of the SONATA as a tool for upper extremity motor function training in neurological rehabilitation. Directions for future clinical research are discussed.

PMID: 33211773

4. A Pilot Study of Two Different Constraint-Induced Movement Therapy Interventions in Children With Hemiplegic Cerebral Palsy After Botulinum Toxin Injection During Preschool Education
Chin-Lung Wu, Su-Fen Liao, Chi-Hsin Liu, Yu-Ting Hsieh, Yi-Ru Lin

Front Pediatr. 2020 Oct 22;8:557. doi: 10.3389/fped.2020.00557. eCollection 2020.

Introduction: To establish a pilot study on applying two low dose (40 h) constraint-induced movement therapy (CIMT) interventions in children with hemiplegic cerebral palsy (CP) after botulinum toxin (BoNT-A) injection during preschool education. Methods: Five children with spastic CP (mean age: 5.31 years; Gross Motor Function Classification System level I and II) undergoing regular BoNT-A injections and rehabilitation programs were included. Participants were randomly allocated to one of two CIMT programs (40 h): a 2-week 4-hours/day CIMT program and a 4-week 2-hours/day CIMT program. One CIMT program was performed 1 month after a BoNT-A injection, and then the second program was implemented with the next injection. The outcomes were measured by changes in Goal Attainment Scaling (GAS), the grasp and Visual-Motor Integration (VMI) test in Peabody-Developmental Motor Scales (PDMS), the self-care scale on the Functional Skill Scale, and the Caregiver Assistance in Chinese Version of Pediatric Evaluation of Disability Inventory (PEDI-C), Anxiety and Oppositional Defiance Problems of Achenbach System of Empirically-Based Assessment before and after the CIMT interventions, and at every 2 months' follow-up thereafter. Results: The mean age of the participants was 5.31 years, BMI was 16.7 (kg/m2), VIQ was 86.4 ± 8.5, and dose of BoNT-A injection in the upper limb was 42 ± 26.6 units. Grasp, VMI, and self-care on the Functional Skill Scale were significantly better in the 4-week 2-hours/day CIMT program ($p < 0.001$, $p = 0.001$, $p < 0.001$). GAS, grasp, VMI, two 2 self-care scales of PEDI were significantly improved after the CIMT programs, and improvement

continued for up to 4 months after the programs. There was no clinical evidence showing changes in the scores for anxiety and oppositional defiance problems during the study period. Conclusions: The preliminary findings, although limited, suggest a potential therapeutic role for the school-based CIMT program after BoNT-A injection. The 4-week 2-hours/day CIMT program might be better than a 2-week 4-hours/day program in terms of self-care and hand function when performed in kindergarten in this pilot study. Furthermore, this pilot study provides valuable information; therefore, it is crucial to include more CP children and blinded assessors for hand function and ADL in the future study.

PMID: 33194877

5. The Effect of the combination of active vestibular interventions and occupational therapy on Balance in Children with Bilateral Spastic Cerebral Palsy: A pilot randomized Controlled trial
Mehdi Rassafiani, Nazila Akbarfaimi, Seyed Ali Hosseini, Soheila Shahshahani, Masoud Karimlou, Farhad Tabatabai Ghomsheh

Iran J Child Neurol. Fall 2020;14(4):29-42.

Objective: The current study aimed to examine the effect of the combined administration of active vestibular interventions and occupational therapy on balance and the relationship between balance changes and Activity of Daily Living in school-aged children with cerebral palsy (CP). Materials & methods: Twenty-four children with Spastic CP, at the level I and II (according to the "Gross Motor Function Classification System) aged 7-12 years were enrolled and randomly assigned into control and intervention groups. Pediatric Balance Scales and Bruininks-Oseretsky Test of Motor Proficiency II were employed to assess the functional balance changes as well as Force Plate (eyes closed and open) to assess changes in the parameters of balance (e.g. center of pressure excursion). The activity of Daily Living was assessed by "Activity Scales for Kids (performance version)". Participants in the intervention group received active vestibular intervention for 20 min and a regular occupational therapy program for 25 min. The control group received a regular occupational therapy program for 45 min. Interventions were provided 3 d/week for 6 weeks in each group. The participants were assessed in three stages: baseline, immediately after, and eight weeks after the intervention. Data were analyzed by ANOVA and linear regression. Results: The results demonstrated that only functional balance, according to Pediatric Balance Scales scores, was significantly increased in the active vestibular interventions group ($p=0.02$). There was no significant association between functional balance and Activity of Daily Living ($P>0.05$). Conclusion: The combined administration of active vestibular interventions and occupational therapy could improve the functional balance in children with spastic CP. It may be related to the reorganization of the vestibular system with a controlled and precise application of stimuli.

PMID: 33193782

6. Is the Gothic Arch a reliable radiographic landmark for migration percentage in children with cerebral palsy?
Caesar Wek, Piyal Chowdhury, Christian Smith, Michail Kokkinakis

J Child Orthop. 2020 Oct 1;14(5):397-404. doi: 10.1302/1863-2548.14.200008.

Introduction: Reimers migration percentage (MP) is the gold standard for measuring hip displacement in children with cerebral palsy (CP). Hip surveillance registries proposed using the top of the Gothic arch (GA) as a modification in patients with acetabular dysplasia because the classical method (CM) described by Reimers may underestimate hip migration. The aim of this study is to assess the inter- and intra-observer reliability of the modified method (MM) versus the CM and identify their effect on the MP. Methods: We performed a retrospective review of 50 children with CP, who had a hip radiograph at our institution between 1st April 2014 and 28th February 2018. All hip radiographs were carefully selected to show the presence of a GA. Four observers measured the MP using the CM and MM for each patient. Interclass coefficient was used to estimate inter- and intra-observer reliability. Results: Inter-observer reliability was excellent for the CM with ICC 0.96 (95% CI 0.94 to 0.97) and good for the MM, ICC 0.78 (95% CI 0.51 to 0.89) $p < 0.001$. Intra-observer reliability was excellent for both methods raging from ICC 0.94 to 0.99 for the CM and ICC 0.89 to 0.95 for the MM. The mean MP was 19% for the CM and 28% for the MM ($p < 0.001$). Conclusion: The CM is more reliable than the MM to measure hip migration in children with CP. If the CM is used and acetabular dysplasia with a GA are present on the hip radiograph, then a 9% hip migration underestimation should be considered on decisions for both referral and surgical management. Level of evidence: II.

PMID: 33204347

7. The orthopaedic aspect of spastic cerebral palsy
Vasileios C Skoutelis, Anastasios D Kanellopoulos, Vasileios A Kontogeorgakos, Argirios Dinopoulos, Panayiotis J Papagelopoulos

Review J Orthop. 2020 Nov 4;22:553-558. doi: 10.1016/j.jor.2020.11.002. eCollection Nov-Dec 2020.

Spastic Cerebral Palsy (CP) is the most common form of CP, comprising of 80% of all cases. Spasticity is a type of hypertonia that clinically manifests as dynamic contractures. The dynamic contracture along with the reduced level of physical activity in a child with CP leads to secondary structural and morphological changes in spastic muscle, causing real musculotendinous shortening, known as fixed contractures. When fixed muscle contractures are not treated early, progressive musculoskeletal deformities develop. As a consequence, spastic CP from a static neurological pathology becomes a progressive orthopaedic pathology which needs to be managed surgically. Orthopaedic surgical management of CP has evolved from previous "multi-event single level" procedures to a "single event multilevel" procedures, with changes in selection and execution of treatment modalities. There is increasing evidence that multilevel surgery is an integral and essential part of therapeutic management of spastic CP, but more research is needed to ensure effectiveness of this intervention on all domains of physical disability in CP.

PMID: 33214743

8. Mechanically assisted walking training for walking, participation, and quality of life in children with cerebral palsy
Hsiu-Ching Chiu, Louise Ada, Theofani A Bania

Review Cochrane Database Syst Rev. 2020 Nov 18;11:CD013114. doi: 10.1002/14651858.CD013114.pub2.

Background: Cerebral palsy is the most common physical disability in childhood. Mechanically assisted walking training can be provided with or without body weight support to enable children with cerebral palsy to perform repetitive practice of complex gait cycles. It is important to examine the effects of mechanically assisted walking training to identify evidence-based treatments to improve walking performance. Objectives: To assess the effects of mechanically assisted walking training compared to control for walking, participation, and quality of life in children with cerebral palsy 3 to 18 years of age. Search methods: In January 2020, we searched CENTRAL, MEDLINE, Embase, six other databases, and two trials registers. We handsearched conference abstracts and checked reference lists of included studies. Selection criteria: Randomized controlled trials (RCTs) or quasi-RCTs, including cross-over trials, comparing any type of mechanically assisted walking training (with or without body weight support) with no walking training or the same dose of overground walking training in children with cerebral palsy (classified as Gross Motor Function Classification System [GMFCS] Levels I to IV) 3 to 18 years of age. Data collection and analysis: We used standard methodological procedures expected by Cochrane. Main results: This review includes 17 studies with 451 participants (GMFCS Levels I to IV; mean age range 4 to 14 years) from outpatient settings. The duration of the intervention period (4 to 12 weeks) ranged widely, as did intensity of training in terms of both length (15 minutes to 40 minutes) and frequency (two to five times a week) of sessions. Six studies were funded by grants, three had no funding support, and eight did not report information on funding. Due to the nature of the intervention, all studies were at high risk of performance bias. Mechanically assisted walking training without body weight support versus no walking training Four studies (100 participants) assessed this comparison. Compared to no walking, mechanically assisted walking training without body weight support increased walking speed (mean difference [MD] 0.05 meter per second [m/s] [change scores], 95% confidence interval [CI] 0.03 to 0.07; 1 study, 10 participants; moderate-quality evidence) as measured by the Biodex Gait Trainer 2™ (Biodex, Shirley, NY, USA) and improved gross motor function (standardized MD [SMD] 1.30 [postintervention scores], 95% CI 0.49 to 2.11; 2 studies, 60 participants; low-quality evidence) postintervention. One study (30 participants) reported no adverse events (low-quality evidence). No study measured participation or quality of life. Mechanically assisted walking training without body weight support versus the same dose of overground walking training Two studies (55 participants) assessed this comparison. Compared to the same dose of overground walking, mechanically assisted walking training without body weight support increased walking speed (MD 0.25 m/s [change or postintervention scores], 95% CI 0.13 to 0.37; 2 studies, 55 participants; moderate-quality evidence) as assessed by the 6-minute walk test or Vicon gait analysis. It also improved gross motor function (MD 11.90% [change scores], 95% CI 2.98 to 20.82; 1 study, 35 participants; moderate-quality evidence) as assessed by the Gross Motor Function Measure (GMFM) and participation (MD 8.20 [change scores], 95% CI 5.69 to 10.71; 1 study, 35 participants; moderate-quality evidence) as assessed by the Pediatric Evaluation of Disability Inventory (scored from 0 to 59), compared to the same dose of overground walking training. No study measured adverse events or quality of life. Mechanically assisted walking training with body weight support versus no walking training Eight studies (210 participants) assessed this comparison. Compared to no walking training, mechanically assisted walking training with body weight support increased walking speed (MD 0.07 m/s [change and postintervention scores], 95% CI 0.06 to 0.08; 7 studies, 161 participants; moderate-quality evidence) as assessed by the 10-meter or 8-meter walk test. There were no

differences between groups in gross motor function (MD 1.09% [change and postintervention scores], 95% CI -0.57 to 2.75; 3 studies, 58 participants; low-quality evidence) as assessed by the GMFM; participation (SMD 0.33 [change scores], 95% CI -0.27 to 0.93; 2 studies, 44 participants; low-quality evidence); and quality of life (MD 9.50% [change scores], 95% CI -4.03 to 23.03; 1 study, 26 participants; low-quality evidence) as assessed by the Pediatric Quality of Life Cerebral Palsy Module (scored 0 [bad] to 100 [good]). Three studies (56 participants) reported no adverse events (low-quality evidence). Mechanically assisted walking training with body weight support versus the same dose of overground walking training Three studies (86 participants) assessed this comparison. There were no differences between groups in walking speed (MD -0.02 m/s [change and postintervention scores], 95% CI -0.08 to 0.04; 3 studies, 78 participants; low-quality evidence) as assessed by the 10-meter or 5-minute walk test; gross motor function (MD -0.73% [postintervention scores], 95% CI -14.38 to 12.92; 2 studies, 52 participants; low-quality evidence) as assessed by the GMFM; and participation (MD -4.74 [change scores], 95% CI -11.89 to 2.41; 1 study, 26 participants; moderate-quality evidence) as assessed by the School Function Assessment (scored from 19 to 76). No study measured adverse events or quality of life. Authors' conclusions: Compared with no walking, mechanically assisted walking training probably results in small increases in walking speed (with or without body weight support) and may improve gross motor function (with body weight support). Compared with the same dose of overground walking, mechanically assisted walking training with body weight support may result in little to no difference in walking speed and gross motor function, although two studies found that mechanically assisted walking training without body weight support is probably more effective than the same dose of overground walking training for walking speed and gross motor function. Not many studies reported adverse events, although those that did appeared to show no differences between groups. The results are largely not clinically significant, sample sizes are small, and risk of bias and intensity of intervention vary across studies, making it hard to draw robust conclusions. Mechanically assisted walking training is a means to undertake high-intensity, repetitive, task-specific training and may be useful for children with poor concentration. Trial registration: ClinicalTrials.gov NCT02359799.

PMID: 33202482

9. Indications for gastrocsoleus lengthening in ambulatory children with cerebral palsy: a Delphi consensus study
Erich Rutz, James McCarthy, Benjamin J Shore, M Wade Shrader, Matthew Veerkamp, Henry Chambers, Jon R Davids, Robert M Kay, Unni Narayanan, Tom F Novacheck, Kristan Pierz, Jason Rhodes, Jeffrey Shilt, Tim Theologis, Anja Van Campenhout, Thomas Dreher, Kerr Graham

J Child Orthop. 2020 Oct 1;14(5):405-414. doi: 10.1302/1863-2548.14.200145.

Purpose: Equinus is the most common deformity in cerebral palsy (CP) and gastrocsoleus lengthening (GSL) is the most commonly performed surgery to improve gait and function in ambulatory children with CP. Substantial variation exists in the indications for GSL and surgical technique. The purpose of this study was to review surgical anatomy and biomechanics of the gastrocsoleus and to utilize expert orthopaedic opinion through a Delphi technique to establish consensus for surgical indications for GSL in ambulatory children with CP. Methods: A 17-member panel, of Fellowship-trained paediatric orthopaedic surgeons, each with at least 9 years of clinical post-training experience in the surgical management of children with CP, was established. Consensus for the surgical indications for GSL was achieved through a standardized, iterative Delphi process. Results: Consensus was reached to support conservative Zone 1 surgery in diplegia and Zone 3 surgery (lengthening of the Achilles tendon) was contraindicated. Zone 2 or Zone 3 surgery reached general agreement as a choice in hemiplegia and under-correction was preferred to any degree of overcorrection. Agreement was reached that the optimum age for GSL surgery was 6 years to 10 years and should be avoided in children aged under 4 years. Physical examination measures with the child awake and under anaesthesia were important in decision making. Gait analysis was supported both for decision making and for assessing outcomes, in combination with patient reported outcomes (PROMS). Conclusions: The results from this study may encourage informed practice evaluation, reduce practice variability, improve clinical outcomes and point to questions for further research. Level of evidence: V.

PMID: 33204348

10. Anterior distal femoral hemiepiphysiodesis with and without patellar tendon shortening for fixed knee flexion contractures in children with cerebral palsy
Susan A Rethlefsen, Alison M Hanson, Tishya A L Wren, Oussama Abousamra, Robert M Kay

J Child Orthop. 2020 Oct 1;14(5):415-420. doi: 10.1302/1863-2548.14.200154.

Purpose: Surgery is often required for fixed knee flexion contractures in patients with neuromuscular conditions. Anterior distal

femoral hemiepiphysiodesis (ADFH) is an alternative to distal femoral extension osteotomy (DFEO) in skeletally immature patients. ADFH is typically not accompanied by patellar tendon shortening surgery (PTS). Our purpose was to compare ADFH alone versus ADFH with PTS for treatment of fixed knee flexion contractures and crouched gait in children with cerebral palsy (CP). Methods: Retrospective review of pre- and postoperative gait analysis data for children with CP who underwent ADFH alone, or ADFH with PTS. Data were analysed using linear mixed models to control for covariates. Results: In total, 25 participants (42 limbs) were included, 17 male and eight female, mean age at surgery 12.9 (sd 1.9) years. Both groups experienced significant improvement in popliteal angle, knee extension range of motion (ROM) and knee extension in stance phase. Greater improvement was seen for all variables in the ADFH/PTS group, mainly due to greater popliteal angle and knee flexion during gait preoperatively in that group ($p \leq 0.02$) rather than the procedure performed ($p \geq 0.19$). There was no difference between groups postoperatively. Rate of contracture resolution was 0.5° to 1.0° per month, faster in larger contractures ($p = 0.02$). Conclusions: ADFH with and without PTS is effective in improving knee extension in skeletally immature patients with CP, correcting contractures at a rate of 0.5° to 1.0° per month. Combined ADFH and PTS surgery may be preferable in patients with larger contractures of up to 30° to 35°. Level of evidence: III.

PMID: 33204349

11. Remodeling of Rat M. Gastrocnemius Medialis During Recovery From Aponeurotomy
Cintia Rivares, Reinald Brunner, Johan J M Pel, Guus C Baan, Peter A Huijing, Richard T Jaspers

Front Physiol. 2020 Oct 28;11:541302. doi: 10.3389/fphys.2020.541302. eCollection 2020.

Aponeurotomy is a surgical intervention by which the aponeurosis is transsected perpendicularly to its longitudinal direction, halfway along its length. This surgical principle of aponeurotomy has been applied also to intramuscular lengthening and fibrotomia. In clinics, this intervention is performed in patients with cerebral palsy in order to lengthen or weaken spastic and/or short muscles. If the aponeurotomy is performed on the proximal aponeurosis, as is the case in the present study, muscle fibers located distally from the aponeurosis gap that develops lose their myotendinous connection to the origin. During recovery from this intervention, new connective (scar) tissue repairs the gap in the aponeurosis, as well as within the muscle belly. As a consequence, the aponeurosis is longer during and after recovery. In addition, the new connective tissue is more compliant than regular aponeurosis material. The aim of this study was to investigate changes in muscle geometry and adaptation of the number of sarcomeres in series after recovery from aponeurotomy of the proximal gastrocnemius medialis (GM) aponeurosis, as well as to relate these results to possible changes in the muscle length-force characteristics. Aponeurotomy was performed on the proximal aponeurosis of rat muscle GM and followed by 6 weeks of recovery. Results were compared to muscles of a control group and those of a sham-operated group. After recovery from aponeurotomy, proximal and distal muscle fiber lengths were similar to that of the control group. The mean sarcomere length from fibers located proximally relative to the aponeurosis gap remained unchanged. In contrast, fibers located distally showed 16-20% lower mean sarcomere lengths at different muscle lengths. The number of sarcomeres in series within the proximal as well as distal muscle fibers was unchanged. After recovery, muscle length-force characteristics were similar to those of the control group. A reversal of proximal-distal difference of fibers mean sarcomere lengths within muscles during recovery from aponeurotomy is hypothesized to be responsible for the lack of an effect. These results indicate that after recovery from aponeurotomy, geometrical adaptations preserved the muscle function. Moreover, it seems that the generally accepted rules of adaptation of serial sarcomere numbers are not applicable in this situation.

PMID: 33192544

12. Rectus femoris transfer surgery in cerebral palsy: can causal inferences be made from observational data?
Steven M Day, Robert J Reynolds

Dev Med Child Neurol. 2020 Nov 18. doi: 10.1111/dmcn.14740. Online ahead of print.

PMID: 33206371

13. Balance confidence and physical activity participation of independently ambulatory youth with cerebral palsy: an exploration of youths' and parents' perspectives
Megan Towns, Sally Lindsay, Kelly Arbour-Nicitopoulos, Avril Mansfield, F Virginia Wright

Disabil Rehabil. 2020 Nov 13;1-12. doi: 10.1080/09638288.2020.1830191. Online ahead of print.

Aim: Youth with cerebral palsy generally participate in less physical activity than typically developing peers. In adults with physical disabilities, balance confidence is a strong predictor of participation and community re-integration. However, balance confidence has not been studied in youth with cerebral palsy. Method: Qualitative descriptive methodology with interviews of eight youth with cerebral palsy (9-17 years old, three girls) in Gross Motor Function Classification System Levels I-III, and eight parents (five mothers) of youth with cerebral palsy (9-17 years old, two girls) in Levels I-III. Results: Three themes arose: (1) youth in Gross Motor Function Classification System Levels I-II are more concerned about losing their balance during physical activities than those in Level III; (2) when balance is lost, embarrassment and frustration are more common than fear, especially for those in Levels I-II; and (3) social factors can create a favorable participation environment when balance confidence is low, especially for youth in Levels I-II. Conclusion: Balance confidence may have greater influence on physical activity participation for youth in Gross Motor Function Classification System Levels I-II than those in Level III. Youth in Levels I-II may draw greater benefit from interventions targeting balance confidence when addressing physical activity goals. IMPLICATIONS FOR REHABILITATION Balance confidence may have a greater influence on activity avoidance for youth with cerebral palsy in Gross Motor Function Classification System Levels I and II (who are independently ambulatory without walkers or cane(s)) than for those in Level II (who use walkers or cane(s) to ambulate). Youth who are independently ambulatory without walkers or cane(s) may benefit more from interventions directed at balance confidence (e.g., enactive mastery and verbal persuasion) to address their physical activity participation goals. For youth who are independently ambulatory without walkers or cane(s), addressing factors that could reduce the influence of balance confidence on physical activity participation, such as providing a positive and supportive social environment in which to participate, may be beneficial.

PMID: 33186057

14. Functioning of young patients with cerebral palsy: Rasch analysis of the pediatric evaluation of disability inventory computer adaptive test daily activity and mobility
Maíra Ferreira Amaral, Rosana Ferreira Sampaio, Wendy Jane Coster, Mariana Peixoto Souza, Marisa Cotta Mancini

Health Qual Life Outcomes. 2020 Nov 18;18(1):369. doi: 10.1186/s12955-020-01624-5.

Background: People with cerebral palsy experience limitations in performing activities of daily living. Rehabilitation practitioners seek valid instruments to measure changes in the performance of those activities. The Pediatric Evaluation of Disability Inventory Computer Adaptive Test (PEDI-CAT) is a new tool to assess functioning in children and youth with various health conditions. Its validity needs to be evaluated in a way that is consistent with the theoretical model on which it was based. We aimed to evaluate the fit of daily activity and mobility items and children with CP to the Rasch model and to compare the performance in daily activities and mobility of older children, adolescents, and young adults with CP based on manual function and gross motor function limitations. Methods: Eighty-three parents of children and youth of 8-20 years old (mean age: 11.6) with different severity levels of cerebral palsy participated in this study. Ninety-one items of the PEDI-CAT Daily Activities and Mobility domains were analyzed through Rasch analysis to evaluate relative item difficulty and participant ability. Participants were described according to the Manual Ability (MACS) (level I: 21.7%; II: 32.5%; III: 24.1%; IV: 7.2% and V: 3.6%) and the Gross Motor Function (GMFCS) (level I: 37.3%; II: 26.5%; III: 6%; IV: 18.1%; and V: 7.2%) classification systems levels. Results: Our data fit the Rasch Model. Parents had difficulty distinguishing some PEDI-CAT response categories. Participants from MACS and GMFCS levels IV and V showed lower ability to perform relatively more difficult items. There was a floor effect in both domains. Only 7.7% of the items presented differential item functioning when individuals with mild MACS and GMFCS levels (I, II) and moderate level (III) and individuals with moderate (III) and severe levels (IV, V) were compared. Conclusions: PEDI-CAT daily activities and mobility domains are valid to evaluate children, adolescents and youth with CP of different severities, but the addition of items to these domains is recommended in order to address their floor effect.

PMID: 33208162

15. Pattern and Predictors of Epilepsy among Children with Cerebral Palsy in Jos, Nigeria
E U Ejeliogu, A D Courage, E S Yiltok

West Afr J Med. 2020 Nov;37(6):703-708.

Background: Cerebral Palsy (CP) is a chronic motor disorder that results from a permanent injury to the developing brain. Co-morbidity of CP and epilepsy could be devastating to a child if not identified early and managed appropriately. Aim: To describe the pattern and predictors of epilepsy among children with CP in Jos, Nigeria. Methods: This cross sectional study was carried out in the pediatric neurology clinic of Jos University Teaching Hospital, Jos, Nigeria. Structured questionnaires and hospital records were used to document all relevant information of children with CP from January 2015 to December 2016. Results: A total of 162 subjects with CP were studied, epilepsy was seen in 75 (46.3%) of the subjects. The mean age at the onset of seizure was 1.52±0.43 years. Among those with epilepsy, 52 (69.3%) had their first seizure before 1 year of age while 26 (34.7%) had a history of neonatal seizures. The commonest type of epileptic seizure seen was generalized tonic-clonic seizures in 33 (44.0%) subjects, followed by focal seizures 30 (40.0%), myoclonic seizures 5 (6.7%) and epileptic spasms 3 (4.0%). Focal seizures were predominantly seen in spastic hemiplegic CP while generalized seizures predominated in other types of CP. Independent predictors of epilepsy were seizure in the first year of life, neonatal seizure and spastic CP (adjusted odds ratio 4.97, 2.45 and 8.85 respectively). Conclusion: Co-morbidity with epilepsy is common among children with CP. Children with CP should be properly evaluated for epilepsy and appropriate treatment commenced if indicated.

PMID: 33185270

16. Risk factors for gastrointestinal complications after spinal fusion in children with cerebral palsy
Bram P Verhofste, Jay G Berry, Patricia E Miller, Charis N Crofton, Brigid M Garrity, Nicholas D Fletcher, Michelle C Marks, Suken A Shah, Peter O Newton, Amer F Samdani, Mark F Abel, Paul D Sponseller, Harms Study Group; Michael P Glotzbecker

Spine Deform. 2020 Nov 17. doi: 10.1007/s43390-020-00233-y. Online ahead of print.

Design: Prospective cerebral palsy (CP) registry review. Objectives: (1) Evaluate the incidence/risk factors of gastrointestinal (GI) complications in CP patients after spinal fusion (SF); and (2) investigate the validity of the modified Clavien-Dindo-Sink classification. Background: Perioperative GI complications result in increased length of stay (LOS) and patient morbidity/mortality. However, none have analyzed the outcomes of GI complications using an objective classification system. Methods: A prospective/multicenter CP database identified 425 children (mean, 14.4 ± 2.9 years; range, 7.9-21 years) who underwent SF. GI complications were categorized using the modified Clavien-Dindo-Sink classification. Grades I-II were minor complications and grades III-V major. Patients with and without GI complications were compared. Results: 87 GI complications developed in 69 patients (16.2%): 39 minor (57%) and 30 major (43%). Most common were pancreatitis (n = 45) and ileus (n = 22). Patients with preoperative G-tubes had 2.2 × odds of developing a GI complication compared to oral-only feeders (OR 2.2; 95% CI 0.98-4.78; p = 0.006). Similarly, combined G-tube/oral feeders had 6.7 × odds compared to oral-only (OR 6.7; 95% CI 3.10-14.66; p < 0.001). The likelihood of developing a GI complication was 3.4 × with normalized estimated blood loss (nEBL) ≥ 3 ml/kg/level fused (OR 3.41; 95% CI 1.95-5.95; p < 0.001). Patients with GI complications had more fundoplications (29% vs. 17%; p = 0.03) and longer G-tube fasting periods (3 days vs. 2 days; p < 0.001), oral fasting periods (5 days vs. 2 days; p < 0.001), ICU admissions (6 days vs. 3 days; p = 0.002), and LOS (15 days vs. 8 days; p < 0.001). LOS correlated with the Clavien-Dino-Sink classification. Conclusion: Gastrointestinal complications such as pancreatitis and ileus are not uncommon after SF in children with CP. This is the first study to investigate the validity of the modified Clavien-Dindo -Sink classification in GI complications after SF. Our results suggest a correlation between complication severity grade and LOS. The complexity of perioperative enteral nutritional supplementation requires prospective studies dedicated to enteral feeding protocols. Level of evidence: Therapeutic-level III.

PMID: 33201495

17. The respiratory disease burden of non-traumatic fractures for adults with cerebral palsy
Jonathan P Etter, Sanjana Kannikeswaran, Edward A Hurvitz, Mark D Peterson, Michelle S Caird, Karl J Jepsen, Daniel G Whitney

Bone Rep. 2020 Oct 27;13:100730. doi: 10.1016/j.bonr.2020.100730. eCollection 2020 Dec.

Background: Individuals with cerebral palsy (CP) are vulnerable to non-trauma fracture (NTFx) and premature mortality due to respiratory disease (RD); however, very little is known about the contribution of NTFx to RD risk among adults with CP. The purpose of this study was to determine if NTFx is a risk factor for incident RD and if NTFx exacerbates RD risk in the adult CP

population. Methods: Data from 2011 to 2016 Optum Clinformatics® Data Mart and a random 20% sample Medicare fee-for-service were used for this retrospective cohort study. Diagnosis codes were used to identify adults (18+ years) with and without CP, NTFx, incident RD at 3-, 6-, 12-, and 24-month time points (pneumonia, chronic obstructive pulmonary disease, interstitial/pleura disease), and comorbidities. Crude incidence rates per 100 person years of RD were estimated. Cox regression estimated hazard ratios (HR and 95% confidence interval [CI]) for RD measures, comparing: (1) CP and NTFx (CP + NTFx); (2) CP without NTFx (CP w/o NTFx); (3) without CP and with NTFx (w/o CP + NTFx); and (4) without CP and without NTFx (w/o CP w/o NTFx) after adjusting for demographics and comorbidities. Results: The crude incidence rate was elevated for CP + NTFx vs. CP w/o NTFx and w/o CP + NTFx for each RD measure. After adjustments, the HR was elevated for CP + NTFx vs. CP w/o NTFx for pneumonia and interstitial/pleura disease at all time points (all $P < 0.05$), but not chronic obstructive pulmonary disease (e.g., 24-month HR = 1.07; 95%CI = 0.88-1.31). The adjusted HR was elevated for CP + NTFx vs. w/o CP + NTFx for pneumonia at all time points, interstitial/pleura disease at 12- and 24-month time points, and chronic obstructive pulmonary disease at 24-months (all $P < 0.05$). There is evidence of a time-dependent effect of NTFx on pneumonia and interstitial/pleura disease for CP + NTFx as compared to CP w/o NTFx. Conclusions: Study findings suggest that NTFx is a risk factor for incident RD, including pneumonia and interstitial/pleura disease, among adults with CP and that NTFx exacerbates RD risk for adults with vs. without CP.

PMID: 33195765

18. Application of vocal organ correction combined with language training in the rehabilitation of children with cerebral palsy and language disorder
Jinjun Xue, Youfang Mo

Transl Pediatr. 2020 Oct;9(5):645-652. doi: 10.21037/tp-20-223.

Background: To explore the effect of vocal organ correction combined with language training on the rehabilitation of children with cerebral palsy (CP) and language disorder.

Methods: A total of 98 children with CP and language disorder were divided into two groups (49 cases in each group) using a random number table: the control group and the test group. The control group was given language training alone, while the test group received vocal organ correction combined with language training. The changes in language function classification, efficacy, and family satisfaction before and after the treatments were compared. Results: A significant difference was identified in language function classification between the two groups before and after treatment ($P<0.05$). The language function classification of the two groups was also significantly different after treatment ($P<0.05$), as was the distribution of clinical efficacy between the two groups ($P<0.05$). The total effective rate for the test group was 91.84%, which was higher than the 73.47% for the control group ($P<0.05$). Family satisfaction between the two groups differed significantly ($P<0.05$), and the total satisfaction rate of families in the test group was 87.76%, which was higher than the 69.39% in the control group ($P<0.05$). Conclusions: Vocal organ correction combined with language training can improve the language function of children with CP and language disorder, has ideal efficacy, and can also enhance family satisfaction during rehabilitation.

PMID: 33209727

19. Complex dystonias: an update on diagnosis and care
Rebecca Herzog, Anne Weissbach, Tobias Bäumer, Alexander Münchau

Review J Neural Transm (Vienna). 2020 Nov 13. doi: 10.1007/s00702-020-02275-y. Online ahead of print.

Complex dystonias are defined as dystonias that are accompanied by neurologic or systemic manifestations beyond movement disorders. Many syndromes or diseases can present with complex dystonia, either as the cardinal sign or as part of a multi-systemic manifestation. Complex dystonia often gradually develops in the disease course, but can also be present from the outset. If available, the diagnostic workup, disease-specific treatment, and management of patients with complex dystonias require a multi-disciplinary approach. This article summarizes current knowledge on complex dystonias with a particular view of recent developments with respect to advances in diagnosis and management, including causative treatments.

PMID: 33185802

20. A classification and calibration procedure for gesture specific home-based therapy exercise in young people with cerebral palsy
A MacIntosh, N Vignais, Eric Desailly, E Biddiss, V Vigneron

IEEE Trans Neural Syst Rehabil Eng. 2020 Nov 18;PP. doi: 10.1109/TNSRE.2020.3038370. Online ahead of print.

Movement-based video games can provide engaging practice for repetitive therapeutic gestures towards improving manual ability in youth with cerebral palsy (CP). However, home-based gesture calibration and classification is needed to personalize therapy and ensure an optimal challenge point. Nineteen youth with CP controlled a video game during a 4-week home-based intervention using therapeutic hand gestures detected via electromyography and inertial sensors. The in-game calibration and classification procedure selects the most discriminating, person-specific features using random forest classification. Then, a support vector machine is trained with this feature subset for in-game interaction. The procedure uses features intended to be sensitive to signs of CP and leverages directional statistics to characterize muscle activity around the forearm. Home-based calibration showed good agreement with video verified ground truths (0.86±0.11, 95%CI=0.93-0.97). Across participants, classifier performance (F1-score) for the primary therapeutic gesture was 0.90±0.05 (95%CI=0.87-0.92) and, for the secondary gesture, 0.82±0.09 (95%CI=0.77-0.86). Features sensitive to signs of CP were significant contributors to classification and correlated to wrist extension improvement and increased practice time. This study contributes insights for classifying gestures in people with CP and demonstrates a new gesture controller to facilitate home-based therapy gaming.

PMID: 33206605

21. Autism and attention-deficit/hyperactivity disorder in children with cerebral palsy: high prevalence rates in a population-based study
Magnus Påhlman, Christopher Gillberg, Kate Himmelmann

Dev Med Child Neurol. 2020 Nov 18. doi: 10.1111/dmcn.14736. Online ahead of print.

Aim: To assess a total population of school-age children with cerebral palsy (CP) for autism and attention-deficit/hyperactivity disorder (ADHD) with a view to determining their prevalence and to relate findings to motor function, intellectual disability, and other associated impairments. Method: Of 264 children, born between 1999 and 2006, from the CP register of western Sweden, 200 children (109 males, 91 females, median age at assessment 14y, range 7-18y) completed comprehensive screening and further neuropsychiatric clinical assessments. Results: Ninety children (45%) were diagnosed with autism, ADHD, or both, 59 (30%) were diagnosed with autism, and 60 (30%) were diagnosed with ADHD. Intellectual disability was present in 51%. Two-thirds had autism, ADHD, and/or intellectual disability. In regression models, autism was mainly predicted by intellectual disability (odds ratio [OR]=4.1) and ADHD (OR=3.2), and ADHD was predicted by intellectual disability (OR=2.3) and autism (OR=3.0). Autism was more common in children born preterm (OR=2.0). Gross motor function was not associated with autism. ADHD prevalence was low in children with severe motor impairment, possibly due to diagnostic limitations. Interpretation: Autism and ADHD were common in this population of children with CP and were mainly independent of motor severity and CP type. The strongest predictor of autism/ADHD was intellectual disability. Assessment for autism and ADHD is warranted as part of the evaluation in CP.

PMID: 33206380

22. Safe and effective medication utilization in pediatric patients requiring rehabilitation services during the Coronavirus pandemic of 2019
Matthew McLaughlin

J Pediatr Rehabil Med. 2020 Oct 30. doi: 10.3233/PRM-200026. Online ahead of print.

The role of pediatric rehabilitation providers during the Coronavirus Disease 2019 (COVID) pandemic of 2020 highlighted the need for improved knowledge about medications utilized in pediatric patients. Pediatric patients with cerebral palsy who were previously receiving botulinum toxin injections on a regular basis went prolonged periods of time between injections, and patients who have intrathecal baclofen pumps were called in to get refills with different intervals. The medically complex

patients treated by rehabilitation providers were limited in the type and scope of care they received, and some may have developed adverse outcomes related to this delay in care. As a Pediatric Physiatrist who has advanced training and significant research experience within the realm of Clinical Pharmacology, I have seen this pandemic demonstrate the Sisyphean challenge of continuing appropriate tone management in patients with cerebral palsy while ensuring those patients with neuromuscular conditions maintain their highest level of function. Both of these clinical problems received significant attention within this issue, which I hope allows providers taking care of these populations a reference point to take to the bedside.

PMID: 33185613

23. Clinical practice of health professionals working in early detection for infants with or at risk of cerebral palsy across New Zealand
Sîan A Williams, Anna Mackey, Alexandra Sorhage, Malcolm Battin, Nichola Wilson, Alicia Spittle, N Susan Stott

J Paediatr Child Health. 2020 Nov 20. doi: 10.1111/jpc.15263. Online ahead of print.

Aim: A diagnosis of cerebral palsy (CP) can, and should, be made as early as possible. This work describes current clinical practice around the awareness and use of diagnostic tools for the detection of CP in New Zealand (NZ). Methods: A purpose-developed survey distributed electronically to NZ clinicians working with young children with or at risk of CP. Results: A total of 159 clinicians (including paediatricians, physiotherapists and occupational therapists) participated in this cross-sectional study. Ninety-six percent were aware that a diagnosis of CP can be made by 12 months of age, with high levels of awareness of the use of magnetic resonance imaging (94%), Prechtl's qualitative assessment of general movements (GMs) (70%) and Hammersmith Infant Neurological Examination (HINE) (77%). Only 40% were aware of the HINE optimality scoring. Fifty-four clinicians provided a diagnosis of CP as part of their role: 48% never used the GMs or HINE to assess children <1 year, and 57% never used the HINE for children between 1 and 2 years. Clinicians not providing a diagnosis within their professional role (n = 104) also indicated infrequent use of assessment tools with 74% and 54% never using the GM's or HINE (respectively) in their assessment of children at risk of CP. Barriers to use included lack of time and funding, lack of clear pathways and management support. Conclusion: Despite high awareness, current use of international best practice tools in NZ clinical practice appears low. Multiple barriers are reported to the use of these tools, which need to be addressed to improve the timeliness of diagnosis.

PMID: 33217101

24. A Life Course Perspective on Growing Older With Cerebral Palsy
Amanda Carroll, Dara Chan, Deborah Thorpe, Ilana Levin, Nancy Bagatell

Qual Health Res. 2020 Nov 19;1049732320971247. doi: 10.1177/1049732320971247. Online ahead of print.

Despite most children with cerebral palsy (CP) now living within typical life spans, little is known about how the effects of CP unfold across the life course and impact participation in everyday life during adulthood. In this study, we explored the experiences of 38 adults growing older with CP. Data were gathered using semi-structured interviews focused on participants' engagement in activities in their community and analyzed using a life course perspective to deepen our understanding of the experiences of our participants. We found that individual agency, family and social contexts, as well as larger sociocultural contexts all shaped participants' experiences as they grew older. The findings highlight the usefulness of the life course perspective for understanding how the effects of a diagnosis of CP unfold over time. Further use of this perspective can better inform health care services to meet the needs of adults with CP aging with a lifelong disability.

PMID: 33213304

25. Disease Acceptance and Eudemonic Well-Being Among Adults With Physical Disabilities: The Mediator Effect of Meaning in Life
Małgorzata Szcześniak, Agata H Świątek, Małgorzata Cieślak, Daria Świdurska

Front Psychol. 2020 Oct 22;11:525560. doi: 10.3389/fpsyg.2020.525560. eCollection 2020.

The acceptance of disability is recognized as one of the most frequently mentioned factors that plays a particularly significant role in subjective well-being. However, so far, only a very small amount of research has been undertaken to clarify how and why acceptance of illness relates to eudemonic well-being. Hence, comprehension of the direct and indirect effects underlying this relationship seems essential for interventions that increase the recovery of people with impairments and enhance their quality of life. The current research was aimed at investigating the association between acceptance of illness, meaning in life, and eudemonic well-being, as well as the possible mediatory effect of meaning in life on the relationship between acceptance of illness and well-being. The sample consisted of 102 participants (71% women) aged between 20 and 64 years. The respondents had a range of different impairments (e.g., cerebral palsy, neurological disorders, spinal muscular atrophy, and sight defects). The Acceptance of Illness Scale, the Meaning in Life Questionnaire, and the Ryff Scales of Psychological Well-Being were used. It was confirmed that acceptance of illness correlated positively and significantly with the presence of meaning, self-acceptance, positive relations, environmental mastery, personal growth, general well-being, cohesion, flexibility, communication, and family satisfaction. The presence of meaning mediated the relationship between acceptance of illness and general well-being with its four other dimensions: self-acceptance, environmental mastery, purpose in life, and personal growth. Conversely, the search for meaning did not have any mediatory effect on this relationship.

PMID: 33192766

26. The use and perception of support walkers for children with disabilities: a United Kingdom survey
Ciaran George, Wendy Levin, Jennifer M Ryan

BMC Pediatr. 2020 Nov 18;20(1):528. doi: 10.1186/s12887-020-02401-5.

Background: Support walkers are a type of assistive device that may enable non-ambulant children with disabilities to walk independently and promote improvements in bowel function, bone mineral density (BMD), mobility, independence, participation and social function. However, there is little evidence to support these benefits and there is a lack of research describing the use of support walkers in clinical practice. This study aimed to examine the use of support walkers for children with disabilities in clinical practice. Method: A survey was distributed via professional organisations, charities and schools associated with paediatric disabilities in the UK. Participants were recruited between January and March 2018. Populations of interest were those who prescribe support walkers to children with disabilities and those who work with children who use them. Results: In total, 125 people were included in the analysis; 107 responders prescribed support walkers and 18 responders worked with children who used support walkers. The population of children who use support walkers ranged from 6 months to 18 years and included children with cerebral palsy, chromosomal abnormalities and other medical conditions. Use of these devices was also reported in schools, at home and in the community for varying lengths of time. Numerous perceived benefits were noted, most frequent of which were increases in physical activity and enjoyment. By comparison, fewer perceived problems were identified but centred on lack of space and difficulty with transfers. Conclusions: This study provides insight into the use of support walkers in the UK, particularly surrounding current practices, which may help to improve consistency in clinical settings. Perceived benefits and problems may provide a basis for identification of appropriate outcome measures to monitor effectiveness. These results should also provide a basis for designing future studies to examine effectiveness of support walkers for paediatric disabilities.

PMID: 33203414

27. Unmasking the Enigma of Cerebral Palsy: A Traditional Review
Bryan A Ikeudenta, Ian H Rutkofsky

Review Cureus. 2020 Oct 17;12(10):e11004. doi: 10.7759/cureus.11004.

Cerebral palsy is a group of neuromuscular diseases that is primarily common in the pediatric population and is the most common cause of neurological and motor disability in children. Cerebral palsy is comprised of various subtypes with the most common type being spastic cerebral palsy. It is highly associated with prematurity and affects nerve function, motor function, and intellectual capacity. It is also associated with nutritional deficiencies and gastrointestinal dysfunction. Cerebral palsy is diagnosed via clinical evaluation and does not have specific laboratory or image findings, but certain imaging findings are positively correlated with it. There are numerous interventions and treatment modalities that are aimed at ensuring the highest

quality of life for the patient and their families. This article was compiled with peer-reviewed publications from the PubMed database in which various keywords were utilized in the search engine. These peer-reviewed articles were selected without geographical restrictions and selected based on the use of the English language. These articles were also selected on the restriction of publication within the last 10 years. This review article on cerebral palsy will serve as a medium of education for the physician, healthcare team, and family involved in the management of children or adults with cerebral palsy. It is important because it discusses the possible etiologies, diagnostic and assessment techniques, prevention methods, and possible rehabilitation interventions. This article aims to broaden the reader's understanding of cerebral palsy and answer any questions that may arise during the management of this disease. The management of cerebral palsy is often plagued with frustration, depression, and anxiety. The main goal of treatment is to attain the highest quality of life for the family and the child.

PMID: 33209560

28. Intra-operative diabetes insipidus associated with cervical spine traction during staged scoliosis surgery
T Kong Kam Wa, K F McCarthy

Case Reports Anaesth Rep. 2020 Oct 16;8(2):123-126. doi: 10.1002/anr3.12068. eCollection Jul-Dec 2020.

A 15-year-old boy with cerebral palsy and epilepsy presented for a posterior spinal fusion as part of staged repair of thoracolumbar scoliosis. Total intravenous anaesthesia was induced and maintained with propofol, remifentanil and ketamine. Following prone positioning, cervical traction was applied. Polyuria developed intra-operatively, from 4 to 18 ml.kg-1.h-1. There was a corresponding rise in plasma sodium concentration from 132 to 145 mmol.l-1. Haemodynamic stability was maintained with boluses of Hartmann's solution and a noradrenaline infusion. Given the possibility of diabetes insipidus due to reduced cerebral perfusion pressure, the cervical traction was removed. This initially showed a good response with a transient reduction in polyuria to 3 ml.kg-1.h-1 before rising to 8 ml.kg-1.h-1. Subsequently, a vasopressin infusion was started with normalisation of diuresis and plasma sodium concentration by the end of surgery. Diabetes insipidus is an endocrine disorder related to lack of production or insensitivity to vasopressin. In the peri-operative period, it is mainly associated with pituitary surgery and rarely with spinal surgery. To the authors' knowledge, this is only the second report of diabetes insipidus associated with staged scoliosis surgery. Cervical traction should be considered as a potential cause of intra-operative diabetes insipidus.

PMID: 33210088

29. Hospital Burdens of Patients With Cerebral Palsy Undergoing Posterior Spinal Fusion for Scoliosis
Albert T Anastasio, Ndeye F Guisse, Kevin X Farley, John M Rhee

Global Spine J. 2020 Nov 18;2192568220968542. doi: 10.1177/2192568220968542. Online ahead of print.

Study design: Retrospective cohort study. Objectives: Many patients undergoing posterior spinal fusion (PSF) for scoliosis have concurrent cerebral palsy (CP), which is associated with many medical comorbidities and inherent operative risk. We aimed to quantify the contribution of CP to increased cost, length of stay (LOS), and complication rates in patients with scoliosis undergoing PSF. Methods: Using the National Inpatient Sample database, we collected data regarding patient demographics, hospital characteristics, comorbidities, in-hospital complications, and mortality. Primary outcomes included complications, hospital LOS, and total hospital costs. Multivariate regression models assessed the contribution of CP to in-hospital complications, discharge status, and mortality. Linear regression identified the contribution of a diagnosis of CP on hospital LOS and inflation-adjusted cost. Results: Cerebral palsy was an independent predictor of several complications. The most striking differences were seen for mortality (odds ratio [OR]: 3.40, $P < .001$), a postoperative requirement for total parenteral nutrition (OR: 3.16, $P < .001$), urinary tract infection (OR: 2.75, $P < .001$), surgical site infection (OR: 2.67, $P < .001$), and pneumonia (2.21, $P < .001$). Patients with CP ultimately cost an additional $13 482 ($P < .001$) with a 2.07-day greater LOS ($P < .001$) than patients without CP. Conclusion: Most complications were seen in higher rates in the CP cohort, with higher cost and LOS in patients with CP versus those with idiopathic scoliosis (IS). Our findings represent important areas of emphasis during preoperative consultations with patients with CP and their families. Extra care in patient selection and multifaceted treatment protocols should continue to be implemented with further investigation on how to mitigate common complications.

PMID: 33203253

30. First-trimester maternal serum biomarkers and the risk of cerebral palsy
Monique Peris, Susan M Reid, Stephen Dobie, Leo Bonacquisto, Daisy A Shepherd, David J Amor

Dev Med Child Neurol. 2020 Nov 18. doi: 10.1111/dmcn.14732. Online ahead of print.

Aim: To investigate whether combined first-trimester screening (cFTS) biomarkers are associated with cerebral palsy (CP) and to identify CP characteristics associated with abnormal biomarker levels. Method: In this retrospective case-control data linkage study, we matched mothers of 435 singletons with CP from a population register to their cFTS records and selected 10 singleton pregnancy controls per case. We compared mean and abnormal levels (expressed as multiples of the median [MoMs]) of pregnancy-associated plasma protein-A (PAPP-A), beta subunit of human chorionic gonadotrophin (β-hCG), and nuchal translucency between cases and controls and between CP subgroups. Results: Compared with control pregnancies, CP pregnancies had lower mean levels of PAPP-A (0.95 vs 1.01 MoM, p=0.02) and β-hCG (0.93 vs 0.99 MoM, p=0.02). Biomarker levels in CP pregnancies were 1.8 times more likely to be associated with abnormally low levels of PAPP-A (p<0.01), 1.4 times for β-hCG (p=0.12), and 2.6 times for low PAPP-A and β-hCG together (p=0.04). In cases with CP, an abnormally low PAPP-A level was associated with moderate preterm birth, low Apgar scores, and Gross Motor Function Classification System level V. Low β-hCG was associated with very low birthweight. Interpretation: Low first-trimester biomarker levels suggest a role for early pregnancy factors in some causal pathways to CP.

PMID: 33206412

31. Comparison of different protein concentrations of human milk fortifier for promoting growth and neurological development in preterm infants
Chang Gao, Jacqueline Miller, Carmel T Collins, Alice R Rumbold

Review Cochrane Database Syst Rev. 2020 Nov 20;11:CD007090. doi: 10.1002/14651858.CD007090.pub2.

Background: Human milk alone may provide inadequate amounts of protein to meet the growth requirements of preterm infants because of restrictions in the amount of fluid they can tolerate. It has become common practice to feed preterm infants with breast milk fortified with protein and other nutrients but there is debate about the optimal concentration of protein in commercially available fortifiers. Objectives: To compare the effects of different protein concentrations in human milk fortifier, fed to preterm infants, on growth and neurodevelopment. Search methods: We used the standard search strategy of Cochrane Neonatal to search CENTRAL (2019, Issue 8), Ovid MEDLINE and CINAHL on 15 August 2019. We also searched clinical trials databases and the reference lists of retrieved articles for randomised controlled trials and quasi-randomised trials. Selection criteria: We included all published and unpublished randomised, quasi-randomised and cluster-randomised trials comparing two different concentrations of protein in human milk fortifier. We included preterm infants (less than 37 weeks' gestational age). Participants may have been exclusively fed human milk or have been supplemented with formula. The concentration of protein was classified as low (< 1g protein/100 mL expressed breast milk (EBM)), moderate (≥ 1g to < 1.4g protein/100 mL EBM) or high (≥ 1.4g protein/100 mL EBM). We excluded trials that compared two protein concentrations that fell within the same category. Data collection and analysis: We undertook data collection and analyses using the standard methods of Cochrane Neonatal. Two review authors independently evaluated trials. Primary outcomes included growth, neurodevelopmental outcome and mortality. Data were synthesised using risk ratios (RR), risk differences and mean differences (MD), with 95% confidence intervals (CI). We used the GRADE approach to assess the certainty of the evidence. Main results: We identified nine trials involving 861 infants. There is one trial awaiting classification, and nine ongoing trials. The trials were mostly conducted in infants born < 32 weeks' gestational age or < 1500 g birthweight, or both. All used a fortifier derived from bovine milk. Two trials fed infants exclusively with mother's own milk, three trials gave supplementary feeds with donor human milk and four trials supplemented with preterm infant formula. Overall, trials were small but generally at low or unclear risk of bias. High versus moderate protein concentration of human milk fortifier There was moderate certainty evidence that a high protein concentration likely increased in-hospital weight gain compared to moderate concentration of human milk fortifier (MD 0.66 g/kg/day, 95% CI 0.51 to 0.82; trials = 6, participants = 606). The evidence was very uncertain about the effect of high versus moderate protein concentration on length gain (MD 0.01 cm/week, 95% CI -0.01 to 0.03; trials = 5, participants = 547; very low certainty evidence) and head circumference gain (MD 0.00 cm/week, 95% CI -0.01 to 0.02; trials = 5, participants = 549; very low certainty evidence). Only one trial reported neonatal mortality, with no deaths in either group (participants = 45). Moderate versus low protein concentration of human milk fortifier A moderate versus low protein concentration fortifier may increase weight gain (MD 2.08 g/kg/day, 95% CI 0.38 to 3.77; trials = 2, participants = 176; very low certainty evidence) with little to no effect on head circumference gain (MD 0.13 cm/week, 95% CI 0.00 to 0.26; I^2 = 85%; trials = 3, participants = 217; very low certainty evidence), but the evidence is very uncertain. There was low certainty evidence that a moderate protein concentration may increase length gain (MD 0.09 cm/week, 95% CI 0.05 to 0.14; trials = 3, participants

= 217). Only one trial reported mortality and found no difference between groups (RR 0.48, 95% CI 0.05 to 5.17; participants = 112). No trials reported long term growth or neurodevelopmental outcomes including cerebral palsy and developmental delay. Authors' conclusions: Feeding preterm infants with a human milk fortifier containing high amounts of protein (≥ 1.4g/100 mL EBM) compared with a fortifier containing moderate protein concentration (≥ 1 g to < 1.4 g/100 mL EBM) results in small increases in weight gain during the neonatal admission. There may also be small increases in weight and length gain when infants are fed a fortifier containing moderate versus low protein concentration (< 1 g protein/100 mL EBM). The certainty of this evidence is very low to moderate; therefore, results may change when the findings of ongoing studies are available. There is insufficient evidence to assess the impact of protein concentration on adverse effects or long term outcomes such as neurodevelopment. Further trials are needed to determine whether modest increases in weight gain observed with higher protein concentration fortifiers are associated with benefits or harms to long term growth and neurodevelopment.

PMID: 33215474

32. Cytokine dysregulation in children with cerebral palsy
Zunera Zareen, Tammy Strickland, Lida Fallah, Victoria McEneaney, Lynne Kelly, Denise McDonald, Eleanor J Molloy

Dev Med Child Neurol. 2020 Nov 13. doi: 10.1111/dmcn.14724. Online ahead of print.

Aim: To examine pro- and anti-inflammatory cytokines in children with cerebral palsy (CP) at baseline and in response to endotoxin (lipopolysaccharide), and correlate outcomes compared with age-matched comparisons, to evaluate their ability to mount an immune response. Method: Serum cytokines were assessed in 12 children (eight males, four females; mean age 10y 1mo [SD 1y 8mo], 6-16y) with CP against 12 age-matched comparisons (eight males, four females; mean age 9y 1mo [SD 1y 1mo]). Pro- and anti-inflammatory cytokines (interleukin-1β, interleukin-2, interleukin-6, interleukin-8, interleukin-10, interleukin-18, tumour necrosis factor [TNF]-α, TNF-β, interferon-γ, granulocyte-macrophage colony-stimulating factor [GM-CSF], vascular endothelial growth factor [VEGF], erythropoietin, and interleukin-1 receptor antagonist) were measured at baseline and in response to in vitro simulation with lipopolysaccharide by multiplex enzyme-linked immunosorbent assay. Results: Significantly higher erythropoietin was found at baseline in children with CP compared with the comparison group. There was a strong response to lipopolysaccharide for interleukin-8, VEGF, TNF-α, and GM-CSF in both children with CP and the comparison group; however, there was significant lipopolysaccharide hyporesponsiveness in children with CP compared with the comparison group for interleukin-1α, interleukin-1β, interleukin-2, and interleukin-6. Interpretation: Altered cytokine responses in children with CP compared with the comparison group demonstrate an altered inflammatory state that may contribute to ongoing sequelae and could be a target for therapy.

PMID: 33185287

33. Neurodevelopmental Outcomes After Bevacizumab Treatment for Retinopathy of Prematurity-A Meta-Analysis
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Objective: To evaluate neurodevelopmental outcomes after intravitreal bevacizumab (IVB) in retinopathy of prematurity (ROP) infants compared to those not exposed to IVB. Clinical relevance: The primary concern regarding IVB treatment of ROP is the potential systemic side effects, especially the risk of causing severe neurodevelopmental impairment (sNDI). Results regarding neurodevelopmental outcomes after IVB are conflicting. Methods: We conducted a meta-analyses and searched PubMed, Embase, and Web of Science for related publications from inception to March 12, 2020. The eligibility criteria were as follows: comparative studies of ROP patients that (1) included IVB as a treatment arm; (2) included a control group without bevacizumab treatment; and (3) reported on at least one neurodevelopmental outcome, such as sNDI, Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III) composition scores, or cerebral palsy (CP). The Newcastle-Ottawa Scale was employed for risk-of-bias assessment. The primary outcome was sNDI, with the odds ratio (OR) calculated. Secondary outcomes were mean differences (MDs) for cognitive, language, and motor scores (Bayley-III) and OR for CP. The quality of evidence was assessed using the GRADE approach. Results: Eight studies, namely 6 including laser-controlled ROP infants and 2 including ROP infants not requiring treatment, were included. The weighted OR for sNDI in the IVB group was 1.39 (95% confidence interval [CI]: 0.98 to 1.97). The weighted MDs were -2.10 (95% CI: -4.94 to 0.74), -1.32 (95% CI: -4.65 to 1.99), and -3.66 (95% CI: -6.79 to -0.54) for cognitive, language, and motor scores in Bayley-III, respectively. The OR for CP was 1.20 (95% CI: 0.56 to 2.55). No differences were observed between the preset subgroups comprising laser-controlled ROP infants and ROP infants not requiring treatment. The current quality of evidence was rated as

low (sNDI and all Bayley-III scores) to very low (CP). Conclusion: sNDI risk was not increased in ROP patients after IVB treatment. Bayley-III scores were similar in the IVB and control groups, except for a minor difference in motor performance. These findings suggest that the risk of additional sNDI after IVB treatment is low. Randomized trials are warranted to provide a higher quality of evidence.

PMID: 33212122

34. Intrapartum Asphyxiated Newborns Without Fetal Heart Rate and Cord Blood Gases Abnormalities: Two Case Reports of Shoulder Dystocia to Reflect Upon
Gina Ancora, Claudio Meloni, Silvia Soffritti, Fabrizio Sandri, Emanuela Ferretti

Case Reports Front Pediatr. 2020 Oct 27;8:570332. doi: 10.3389/fped.2020.570332. eCollection 2020.

Our report covers two cases of severe hypoxic-ischemic encephalopathy in newborns whose birth was complicated by shoulder dystocia. In both cases, there were inconsistencies observed among cardiotocographic traces, baby's clinical conditions at birth, and umbilical cord blood gases. Namely, normal cardiotocographic monitoring and cord pH > 7, in spite of the fact that the newborns were severely depressed at birth and their blood gases evaluated within 1 h from birth showed a severe metabolic acidosis. Moreover, one of the two newborns displayed moderately low hemoglobin levels. Metabolic and infectious causes were ruled out. Both newborns developed severe hypoxic-ischemic encephalopathy and received therapeutic hypothermia for 72 h. Both survived, one with a severe dystonic cerebral palsy whereas the other developed only a mild developmental delay in language. Cardiac asystole theory could explain these two cases, reinforcing the need for specific resuscitation guidelines for infants experiencing a birth complicated by shoulder dystocia.

PMID: 33194898

35. Proteomic changes in the hippocampus and motor cortex in a rat model of cerebral palsy: Effects of topical treatment
Tao Wang, Yusheng Zhang, Weiwu Chen, Jin Tao, Qiao Xue, Wei Ge, Wanchen Dou, Chao Ma

Biomed Pharmacother. 2020 Nov 11;133:110844. doi: 10.1016/j.biopha.2020.110844. Online ahead of print.

Cerebral palsy (CP) is a non-progressive motor-impairment disorder related to brain injury early in development. To gain new insights into the mechanisms of CP and the therapeutic efficacy of Baimai ointment, we used a high-throughput quantitative proteomic approach to evaluate proteomic changes in the hippocampus and motor cortex in a rat model of CP induced by lipopolysaccharide (LPS) combined with hypoxia/ischemia (H/I). More than 2000 proteins were identified in each brain region with high confidence. Quantitative analysis demonstrated profound disturbances in the proteomes of the hippocampus and motor cortex after LPS + H/I, in addition to the disruption of the motor system. In contrast, the topical application of Baimai ointment not only alleviated the motor deficit in the CP model rats, but also restored the proteomes in the brain cortex. Furthermore, astrocytes in the hippocampus were strongly activated in the Baimai-treated CP rat brains, associated with an increase in neurotrophic factors. Proteomic analysis demonstrated that the CP model induced neuroinflammatory responses in the brain which were reversed by the topical application of Baimai ointment. This study highlights the unexpected roles of hippocampus and motor cortex neurons in CP progress and treatment, thus providing potentially novel therapeutic targets for CP.

PMID: 33186793

Prevention and Cure

36. [Magnesium sulphate treatment decreases the risk of cerebral palsy after preterm birth][Article in Danish]
Hanne Trap Wolf, Tine Brink Henriksen, Mads Langager Larsen, Anja Pinborg, Hanne Kristine Hegaard, Jesper Sune Brok, Lene Drasbek Huusom

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Children born preterm have an increased risk of severe morbidity, e.g. cerebral palsy (CP), compared to children born at term. CP cannot be treated, which is why a prophylactic approach is essential, as argued in this review. Six randomised controlled trials (RCTs) have provided data on MgSO4 treatment as CP neuroprotection in preterm birth, including a new RCT from Denmark. Recently, an updated meta-analysis with trial sequential analysis detected a significant neuroprotective effect of MgSO4 treatment in preterm birth. There is now sufficient evidence, that MgSO4 treatment should be used as neuroprotection in preterm birth.

PMID: 33215580