Cerebral palsy research news

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Interventions and Management

1. Educating caregivers of persons with cerebral palsy in night-time postural care: A randomized trial comparing two online training programs
Jennifer Ann Hutson, James S Hodge, LeAnn Snow

Clin Rehabil. 2021 Apr 15;2692155211009484. doi: 10.1177/02692155211009484. Online ahead of print.

Objective: Compare effectiveness of two differently formatted training programs in educating night-time postural care implementers. Design: Mixed-methods parallel-group double-blind design with random assignment. Setting: United States academic institution. Participants: Thirty-eight adult caregivers/providers of children with cerebral palsy. Interventions: Both 2-hour online programs included content on night-time postural care evidence, risk-factor monitoring, sleep-system types, positioning methods, and assessments. Group A used interactive videos, Group B summary information with web-links. Main measures: We measured self-perceived competence via questionnaires (baseline, post-training, post-simulation) containing 4-point rating-scales of knowledge, ability, and confidence and measured positioning ability via a simulation observation instrument comprising 16 positioning-task ratings with space for describing performance. We recorded participant actions/statements using fieldnotes. Results: Thirty-eight completed training (19 per group). Group A (vs B) showed significantly greater self-perceived competence changes post-training (0.46 points (SE 0.17), P = 0.008). Thirty-seven positioned a standardized "client," with groups not differing significantly on total tasks completed correctly ($F(1, 92.32) = 1.91$, $P = 0.17$) averaging 11.85 (SE 0.83) and 12.60 (SE 0.84) of 16 tasks correct. Group A's post-positioning/simulation self-ratings were significantly associated with actual ability ($r = 0.53$, $P = 0.019$). In both groups ⩾47% of caregivers incorrectly completed the tasks of placing head and neck in neutral and snugging up all [positioning] parts. Conclusion: The sleep care positioning training program (interactive video-based format) is effective in building caregivers' self-perceived competence for night-time postural care. While the lesson was well-received by caregivers and considered a "match [to their] learning style," the lesson did not lead to greater improvement in actual ability to position the "client" compared to control training.

PMID: 33858230

2. Impact of tranexamic acid on blood loss and transfusion rate in children with cerebral palsy undergoing hip reconstruction with two or more osteotomies
Karim Z Masrouha, Zabrina M Shabin, Kiran Bhutada, Debra A Sala, David H Godfried, Mara S Karamitopoulos

Eur J Orthop Surg Traumatol. 2021 Apr 11. doi: 10.1007/s00590-020-02858-1. Online ahead of print.

Purpose: Tranexamic acid (TXA), a synthetic lysine analogue, has been used in orthopedic procedures to limit blood loss and prevent allogeneic blood transfusions. However, data are scarce on its use in hip reconstruction of patients with cerebral palsy (CP). This study examines the effect of TXA on patients with CP undergoing hip reconstruction with at least two osteotomies. Methods: This is a single-center, retrospective study of patients with CP who underwent hip reconstruction with two or more

osteotomies from January 2013 to April 2019. There were 43 patients, with a mean age of 9.9 years. Age, procedure, preoperative and postoperative hemoglobin/hematocrit, estimated blood loss (EBL), transfusions and length of stay were recorded. The patients were split into the following two groups: 24 patients who had received intraoperative TXA and 19 who had not. Results: Age, EBL, mean preoperative and postoperative hemoglobin or hematocrit, preoperative to postoperative hematocrit drop, and length of stay were similar for the two groups ($p > 0.05$). The risk for intraoperative transfusion (21 vs. 17%), postoperative transfusion (26 vs. 8%), and any transfusion (42 vs. 21%) appeared to be greater in the group that did not receive TXA, but this difference did not achieve statistical significance. Conclusion: This pilot study shows patients with CP undergoing hip reconstruction with two or more osteotomies; the use of TXA, while not statistically significant, shows a trend toward a decreased need for allogeneic blood transfusion.

PMID: 33839928

3. Pelvic obliquity associated with neuromuscular scoliosis in cerebral palsy: cause and treatment
Winston Yen, Ariella Gartenberg, Woojin Cho

Review Spine Deform. 2021 Apr 16. doi: 10.1007/s43390-021-00346-y. Online ahead of print.

Objective: Review the etiology, clinical manifestations, diagnosis, and treatment of pelvic obliquity in cerebral palsy patients with neuromuscular scoliosis. Neuromuscular scoliosis (NMS) in cerebral palsy (CP) patients is rapidly progressive and often leads to an imbalance in musculoskeletal mechanics that extends to the pelvis. A horizontal misalignment of the pelvis in the frontal plane known as pelvic obliquity (PO) is a common finding in this population. When untreated, PO can exacerbate the back pain, postural strain, and walking difficulties experienced by these patients. Establishing the manifestation and treatment plan for PO in the setting of NMS can provide valuable insight for diagnosis and management. Methods: A comprehensive literature review was performed on the etiology, clinical manifestations, diagnosis, and treatment of pelvic obliquity in the setting of NMS in CP. The advantages and limitations of measurement and treatment options were evaluated. Results: PO is categorized into suprapelvic, infrapelvic, and intrapelvic causes, each presenting with a unique pattern of pathology. NMS in CP with hip contractures and structural deformities fall into these categories. The Maloney and O'Brien methods of pelvic measurement have demonstrated superior utility and are recommended for clinical diagnosis. The management of PO in NMS patients is focused on the cause of malalignment, with posterior fusion, contracture release, and osteotomy encompassing the mainstay of treatment. Conclusion: PO is commonly found in patients with NMS in cerebral palsy. There is currently no standard method for determining the PO angle. Interventions designed to reduce scoliotic curves and release tissue contractures can level the pelvis and restore proper alignment of the spine and sacrum in the coronal plane in these patients. Further understanding of the causes of PO in NMS, as well as the establishment of a standardized measuring technique and diagnostic parameters will allow for more effective treatment options and improve outcomes in patients with CP.

PMID: 33861427

4. Safety and efficacy of Botulinum toxin type A preparations in cerebral palsy - an evidence-based review
Marcin Bonikowski, Jarosław Sławek

Neurol Neurochir Pol. 2021 Apr 16. doi: 10.5603/PJNNS.a2021.0032. Online ahead of print.

The introduction of botulinum toxin more than 25 years ago for the management of paediatric lower and upper limb hypertonia has been a major advance. BoNT-A as a part of multimodal treatment supports motor development and improves function disturbed by spasticity or hypertonia. The aim of this paper was to compare the efficacy and safety of three major BoNT-A preparations present on the market: abo-, inco-, and onaobotulinumtoxin; A in the treatment of children with cerebral palsy. Based on an analysis of the available literature, all three preparations have been established to reduce hypertonia in the upper and lower extremities, with some conflicting evidence regarding function. There were no differences in treatment safety, with a low incidence of adverse events which were mostly temporary and mild. Any form of universal conversion ratio between all preparations is not recommended.

PMID: 33861462

5. Aponeurotic release of semimembranosus: A technical note to increase correction gained with hamstring lengthening surgery in cerebral palsy
Şenol Bekmez, Alper Yatağanbaba, Güney Yılmaz, Uğur Gonç, Tuna Karahan, Muharrem Yazıcı

Acta Orthop Traumatol Turc. 2021 Mar;55(2):177-180. doi: 10.5152/j.aott.2021.20184.

Objective: The aim of this study was to determine the intraoperative corrective effect of the aponeurotic release of semimembranosus (SM) as a single procedure or an adjunct procedure to distal myotendinous release of semitendinosus (ST) and myofascial release of SM lengthening in the correction of knee flexion deformity in cerebral palsy (CP). Methods: In this prospective study, 46 knees of 23 consecutive ambulatory patients (15 boys and 8 girls; mean age=8.33 years; age range=5-12 years) with spastic diplegic CP with a gross motor function classification system level (GMFCS) II or III were included. The patients were then divided into 2 groups. In group I, there were 10 patients (4 boys, 6 girls; mean age=8.6±2), and combined release of ST in the myotendinous junction and SM in the myofascial junction, followed by aponeurotic release of SM were carried out. In group II, there were 13 patients (2 girls, 11 boys; mean age=8±2.35), and aponeurotic release of SM was done first and followed by the combined release of ST in the distal myotendinous junction and the myofascial release of SM. Intraoperative popliteal angle (PA) measurements were recorded in each group. Results: PA was reduced from 58.1°±7.6° (range=46°-75°) to 41.2°±8.8° (range=20°-54°) in group 1 and from 59.1°±11.3° (range=40°-87°) to 42.7°±10.8° (range=24°-64°) in group 2. No significant difference was observed between the groups in terms of reduction in PA (p=0.867). In group 1, adding the aponeurotic release of SM further reduced the PA to 31.7°± 8.5° (range=14°-47°) (p=0.002). In group 2, adding the myotendinous release of ST and myofascial release of SM further reduced the PA to 32.9°±7.2° (range=16°-44°) (p=0.004). There was no significant difference between the final PA values in the 2 groups (p=0.662). There was no difference in terms of early complications. Conclusion: Aponeurotic release of SM is equally effective to reduce the intraoperative PA with combined myotendinous release of ST and myofascial release of SM. Combining all the 3 procedures provides a better correction without forceful manipulation or lengthening of the lateral hamstrings during the correction of knee flexion deformity in CP.

PMID: 33847582

6. Recurvatum of the Knee in Cerebral Palsy: A Review
David A Yngve

Review Cureus. 2021 Apr 10;13(4):e14408. doi: 10.7759/cureus.14408.

Recurvatum is defined as hyperextension of the knee in the stance phase of gait. Recurvatum knee is a naturally occurring common gait deviation in those with cerebral palsy, along with crouch knee, jump knee, and stiff knee gaits. Early and late recurvatum occur in the first and second halves of stance. Early recurvatum is associated with dynamic calf contraction that raises the heel and pushes the knee into hyperextension as the forefoot contacts the floor. Late recurvatum occurs after the foot is already flat on the floor. As the body weight comes forward over the foot, the tibia stops its forward motion too early as the ankle comes to its range-of-motion limit. The advancing body then moves forward over a hyperextending knee. Surgical hamstring lengthening can have recurvatum as a side effect. There are several strategies to decrease this risk. Medial hamstring lengthening may be safer than combined medial and lateral lengthening. The concept here is that less lengthening or less aggressive lengthening means less recurvatum risk. However, combined medial and lateral lengthening can be reasonably safe from the risk of causing recurvatum if the knee is showing enough preoperative flexion in stance to warrant the increased surgery. More flexion in stance relates to less risk, while less flexion in stance relates to more risk. Knee flexion in stance can be measured. This is done by measuring knee flexion at initial contact and knee flexion in stance in a gait lab or with stop-action video. If there is minimal knee flexion in stance, hamstring lengthening might not be advisable, even if the hamstrings are tight on popliteal angle testing. There are other factors that contribute to recurvatum risk, such as knee hyperextension on static exam, equinus contracture, and jump knee gait. For treatment of recurvatum, the mainstay is the use of ankle foot orthoses set in dorsiflexion. Surgical equinus correction in those with early stance recurvatum can be effective but it is not likely to be effective in those with late stance recurvatum.

PMID: 33859920

7. Postoperative changes in vertical ground reaction forces, walking barefoot and with ankle-foot orthoses in children with Cerebral Palsy
Ingrid Skaaret, Harald Steen, Sanyalak Niratisairak, David Swanson, Inger Holm

Clin Biomech (Bristol, Avon). 2021 Mar 23;84:105336. doi: 10.1016/j.clinbiomech.2021.105336. Online ahead of print.

Background: Children with cerebral palsy often have problems to support the body centre of mass, seen as increased ratio between excessive vertical ground reaction forces during weight acceptance and decreased forces below bodyweight in late stance. We aimed to examine whether increasing ankle range of motion through surgery and restraining motion with ankle-foot orthoses postoperatively would have impact on the vertical ground reaction force in weight acceptance and late stance.

Methods: Ground reaction forces were recorded from 24 children with bilateral and 32 children with unilateral cerebral palsy, each measured walking barefoot before and after triceps surae lengthening. Postoperatively, the children were also measured walking with ankle-foot orthoses. Changes in vertical ground reaction forces between the three conditions were evaluated with functional curve and descriptive peak analyses; accounting for repeated measures and within-subject correlation. Findings: After surgery, there were decreased vertical ground reaction forces in weight acceptance and increased forces in late stance. Additional significant changes with ankle-foot orthoses involved increased vertical forces in weight acceptance, and in late stance corresponding to bodyweight (bilateral, from 92% to 98% bodyweight; unilateral, from 94% to 103% bodyweight) postoperatively. Interpretation: Our findings confirmed that surgery affected vertical ground reaction forces to approach more normative patterns. Additional changes with ankle-foot orthoses indicated further improved ability to support bodyweight and decelerate centre of mass in late stance.

PMID: 33848706

8. Increased Ankle Plantar Flexor Stiffness Is Associated With Reduced Mechanical Response to Stretch in Adults With CP

Jakob Lorentzen, Rasmus Feld Frisk, Jens Bo Nielsen, Lee Barber

Front Bioeng Biotechnol. 2021 Mar 25;9:604071. doi: 10.3389/fbioe.2021.604071. eCollection 2021.

Hyperexcitable stretch reflexes are often not present despite of other signs of spasticity in people with brain lesion. Here we looked for evidence that increased resistance to length change of the plantar flexor muscle-fascicles may contribute to a reduction in the stretch reflex response in adults with cerebral palsy (CP). A total of 17 neurologically intact (NI) adults (mean age 36.1; 12 female) and 13 ambulant adults with CP (7 unilateral; mean age 33.1; 5 female) participated in the study. Subjects were seated in a chair with the examined foot attached to a foot plate, which could be moved by a computer-controlled electromotor. An ultrasound probe was placed over the medial aspect of the leg to measure the length of medial gastrocnemius muscle fascicles. Slow (7 deg/s) and fast (200 deg/s) stretches with amplitude 6 deg of the plantar flexors were applied over an ankle range of 70 deg at 10 deg intervals between 60 and 130 deg plantarflexion. It was checked by EMG electrodes that the slow stretches were sufficiently slow not to elicit any activity and that the fast stretches were sufficiently quick to elicit a maximal stretch reflex in both groups. The torque elicited by the stretches was measured together with changes in the length of medial gastrocnemius muscle fascicles. Muscle fascicles increased significantly in length with increasing dorsiflexion position in both populations ($p < 0.001$), but the fascicles were shorter in the CP population at all positions. Slow stretches elicited significantly larger torque and significantly smaller length change of muscle fascicles as the ankle joint position was moved more towards dorsiflexion in CP than in NI ($p < 0.001$). Fast stretches elicited larger torque responses at ankle joint positions of 80-100 deg in the NI than in the CP group ($p < 0.01$). A significant negative correlation was observed between the torque response and muscle fascicle length change to slow stretch in CP ($p < 0.05$), but not in NI. These findings support that increased passive resistance of the ankle plantar flexor muscle-tendon unit and development of contractures may conceal stretch reflex response in adults with CP. We argue that this should be taken into account in the neurological examination of spasticity.

PMID: 33842442

9. Speech and Language in 5-year-olds with Different Neurological Disabilities and the Association between Early and Later Consonant Production

Anna Nyman, Sofia Strömbergsson, Katarina Lindström, Anette Lohmander, Carmela Miniscalco

Dev Neurorehabil. 2021 Apr 13;1-10. doi: 10.1080/17518423.2021.1899327. Online ahead of print.

The primary aim was to describe speech and language abilities in a clinical group of verbal 5-year-old children diagnosed with neurological disability (ND) in infancy, and the secondary aim was to trace precursors to consonant production at age 5 years (T2) in data from 12 to 22 months (T1). The participants (n = 11, with Down syndrome (DS), cerebral palsy, and chromosomal deletion syndromes) were tested with a battery of speech and language tests. Consonant production at T2 was compared to data on consonant use at T1. At T2, two participants had age appropriate speech and language and another three had age-appropriate speech, but low results on language tests. The remaining six participants had severe speech and language difficulties. Participants with DS had significantly lower results on consonant production measures. An association between consonant production at T1 and T2 for participants with DS indicates that number of different true consonants might be a predictive measure when evaluating young children with DS.

PMID: 33849395

10. Posterior drooling in children with cerebral palsy and other neurodevelopmental disorders
Corinne Pa Delsing, Stijn Bekkers, Corrie E Erasmus, Karen van Hulst, Frank Ja van den Hoogen

Dev Med Child Neurol. 2021 Apr 12. doi: 10.1111/dmcn.14888. Online ahead of print.

Aim: To evaluate the effect of botulinum neurotoxin A (BoNT-A) injections, submandibular gland excision (SMGE), and bilateral submandibular duct ligation (2DL) for the control of posterior drooling in children with neurological impairment. Method: In a retrospective cohort, children with neurological impairment (e.g. cerebral palsy) treated between 2000 and 2016 were identified. Mean age at time of surgery was 9 years (range 1-21y). The primary outcome was posterior drooling severity by a visual analogue scale (VAS; 0-10) at baseline, 8-weeks, and 32-weeks follow-up. The secondary outcome was lower respiratory tract infections during the follow-up period. Results: Ninety-two patients (out of 475; 47 males, 45 females) were identified. They were undergoing three different treatments: BoNT-A (n=63), SMGE (n=16), and 2DL (n=13). A significant reduction in VAS over time was observed in the total group of 92 patients. After SMGE, VAS decreased significantly from 6.82 (SD 3.40) at baseline to 2.29 (SD 1.93) at 8 weeks, and 2.17 (SD 2.58) at 32 weeks ($F[2.34]=11.618$, $p<0.001$). There was no significant decrease after both BoNT-A and 2-DL. Interpretation: Posterior drooling is an unfamiliar, potentially life-threatening condition that is treatable with medication, BoNT-A injections, or surgery. Although all treatments reduced signs and symptoms of posterior drooling, there is a greater effect after SMGE compared to BoNT-A and 2-DL.

PMID: 33844298

11. Intrathecal baclofen pumps in the management of hypertonia in childhood: a UK and Ireland wide survey
Rajib Lodh, Sam Amin, Amr Ammar, Lucy Bellis, Phillip Brink, Amedeo Calisto, Darach Crimmins, Paul Eunson, Rob J Forsyth, John Goodden, Margaret Kaminska, Joanne Kehoe, Martin Kirkpatrick, Ram Kumar, Jane Leonard, Alice Lording, Katherine Martin, Russell Miller, Santosh R Mordekar, Benedetta Pettorini, Martin Smith, Rachel Smith, Christine Sneade, Andrea Whitney, Michael Vloeberghs, Hesham Zaki, Daniel E Lumsden

Arch Dis Child. 2021 Apr 14;archdischild-2020-321487. doi: 10.1136/archdischild-2020-321487. Online ahead of print.

Background: Intrathecal baclofen (ITB) is a useful treatment for hypertonia where non-invasive treatments have been ineffective or poorly tolerated. There is an absence of national guidance on selection criteria and a lack of literature regarding patient characteristics and treatment details for children and young people (CYP) receiving ITB therapy in the UK and Ireland. We aimed to gather patient and treatment characteristics for CYP receiving ITB in the UK and Ireland. Methods: An electronic survey was sent to all paediatric ITB centres in the UK and Ireland. Anonymised data were returned between December 2019 and April 2020. CYP >16 years and those awaiting ITB pump removal were excluded from the dataset. Results: 176 CYP were identified as receiving ITB therapy across the UK and Ireland. The majority of CYP with ITB pumps were non-ambulant (93%) with a diagnosis of cerebral palsy (79%). Median age of ITB insertion was 9 years; median current age was 14 years. 79% of CYP had significant spasticity, 55% had significant dystonia. The most commonly used ITB dosing modes were continuous (73%) and flexible (23%). Conclusions: ITB pumps were most frequently used for non-ambulant CYP with cerebral palsy and existence of spasticity and/or dystonia in the UK and Ireland. Most CYP were receiving a continuous dose of ITB. There is significant variation in the number of paediatric ITB pumps across UK and Ireland. There is a need for development of nationally accepted paediatric referral criteria and clinical standards for ITB use.

PMID: 33853760

12. Effects of Peripheral Haptic Feedback on Intracortical Brain-Computer Interface Control and Associated Sensory Responses in Motor Cortex
Darrel R Deo, Paymon Rezaii, Leigh R Hochberg, Allison Okamura, Krishna Vaughn Shenoy, Jaimie M Henderson

IEEE Trans Haptics. 2021 Apr 12;PP. doi: 10.1109/TOH.2021.3072615. Online ahead of print.

Intracortical brain-computer interfaces (iBCIs) provide people with paralysis a means to control devices with signals decoded from brain activity. Despite recent impressive advances, these devices still cannot approach able-bodied levels of control. To achieve naturalistic control and improved performance of neural prostheses, iBCIs will likely need to include proprioceptive feedback. With the goal of providing proprioceptive feedback via mechanical haptic stimulation, we aim to understand how haptic stimulation affects motor cortical neurons and ultimately, iBCI control. We provided skin shear haptic stimulation as a

substitute for proprioception to the back of the neck of a person with tetraplegia. The neck location was determined via assessment of touch sensitivity using a monofilament test kit. The participant was able to correctly report skin shear at the back of the neck in 8 unique directions with 65% accuracy. We found motor cortical units that exhibited sensory responses to shear stimuli, some of which were strongly tuned to the stimuli and well modeled by cosine-shaped functions. We also demonstrated online iBCI cursor control with continuous skin-shear feedback driven by decoded command signals. Cursor control performance increased slightly but significantly when the participant was given haptic feedback, compared to the purely visual feedback condition.

PMID: 33844633

13. Effect of posture control training using a virtual reality program on sitting balance and trunk stability in children with cerebral palsy
Se-Hee Park, Sung-Min Son, Ji-Young Choi

NeuroRehabilitation. 2021 Apr 9. doi: 10.3233/NRE-201642. Online ahead of print.

Objective: We aimed to determine whether the posture control training in the sitting posture using virtual reality (VR) training program affects sitting balance and trunk stability in children with spastic cerebral palsy (CP). Methods: The experiment was conducted for 4 weeks by randomly allocating 20 children with CP. The experimental group (n = 10) performed balance training in the sitting position using a VR training program, and the control group (n = 10) performed arm reach training in the sitting position. To evaluate static and dynamic sitting balance and trunk stability, the Wii Balance Board and Balancia software, the modified functional reach test, and the Korean version of the Trunk Control Measurement Scale were used. Results: There were significant differences between the two groups in the changes in speed and postural swing distance before and after training ($p < 0.05$). The mFRT measurement showed significant differences in all directions before and after training between the two groups ($p < 0.05$). However, there was no significant difference between the two groups in the K-TCMS score. Conclusions: Posture control training in the sitting position using a VR training program was found to be more effective in improving the sitting balance and trunk stability of children with CP.

PMID: 33843705

14. Determinants of Manual Abilities of Children with Cerebral Palsy: A National Registry-Based Study
Sana M N Abu-Dahab, Nihad A Almasri, Maysoun Saleh, Somaya H Malkawi

Dev Neurorehabil. 2021 Apr 14;1-6. doi: 10.1080/17518423.2021.1914761. Online ahead of print.

Purpose: This cross-sectional study aimed to identify determinants of manual abilities of children with cerebral palsy (CP), as measured by the Manual Ability Classification System (MACS), in terms of intrinsic (child-related) and extrinsic (service-related) variables. Methods: The participants were 106 children with a confirmed diagnosis of CP (aged 4-16 years). Two ordinal logistic regression models were conducted to identify intrinsic and extrinsic determinants of manual abilities. Results: Four child-related (intrinsic) variables were found to be significant determinants of manual abilities: bimanual ability, ability to maintain and assume chair sitting, presence of seizures, and gross motor function, and only one service-related (extrinsic) significant variable was identified, which was receiving spasticity medications. Discussion: The results highlight several determinants that should be considered when assessing and intervening to improve manual abilities of children with CP. The findings are discussed in relation to the intervention approach, contextual modification, and assistive device prescription.

PMID: 33852816

15. Need to create networks of international cerebral palsy surveillance programs
H Arabi

Arch Pediatr. 2021 Apr 10;S0929-693X(21)00045-2. doi: 10.1016/j.arcped.2021.03.007. Online ahead of print.

PMID: 33849773

16. Effectiveness of Treatment in Children With Cerebral Palsy
Syed Faraz Ul Hassan Shah Gillani, Akkad Rafique, Muhammad Taqi, Muhammad Ayaz Ul Haq Chatta, Faisal Masood, Tauseef Ahmad Blouch, Syed Muhammad Awais

Cureus. 2021 Mar 7;13(3):e13754. doi: 10.7759/cureus.13754.

Objective: The objective of this study was to assess the effectiveness of conservative and surgical treatment in cerebral palsy children by evaluating the Medical Research Council (MRC) grading system, modified Ashworth scale, and Barthel Activities of Daily Life (ADL) scale. Method: This prospective case series was performed using a non-probability consecutive sampling technique at the Department of Orthopedic Surgery and Traumatology, King Edward Medical University/Mayo Hospital, Lahore from October 2011 to November 2013. Two hundred children of all ages, having cerebral palsy diagnosed on history and clinical examination were enrolled in the study. Children were treated with conservative and surgical treatment. Pre- and post-treatment, all children were classified based on movement disorder (spastic, athetoid, ataxic, and mixed), parts of the body involved (paraplegic, tetraplegic, diplegic, hemiplegic, monoplegic, double hemiplegic, and triplegic), and gross motor function (GMFCS level I-IV). Their muscle power and tone were assessed using the MRC grading system and modified Ashworth scale, respectively. Assessment of disability and daily function was done by ranking disability grading and Barthel ADL, respectively. The range of motion (ROM) of each joint was assessed clinically. Children were divided based on the treatment method as non-surgical versus surgical treatment. Results: Out of a total of 200 children, the mean age of the children was 7.86±4.17year. There were 134 (67.0%) males and 66 (33.0%) female children. Classification on basis of movement disorder, body part involved, and gross motor function at three-month intervals till twelve months was performed. From the first presentation of children till the last follow-up time period, i.e., 12th month there was no change in the movement disorder (a type of CP, body parts involved, and GMFCS). The final rating of overall treatment results shows that there were 84 (42%) patients who had a poor outcome, and only 35 (17.50%) patients had a fair treatment outcome and 81 (40.50%) patients had good treatment outcomes. Conclusion: The conservative and surgical management showed no effect on movement disorder of the child although, on the final rating scale fair to good treatment outcome was observed in all children. There was an improvement in muscle power grading on the ADL, but no significant improvement was seen on the improvement of type, parts of the body involved, gross motor function classification, modified Ashworth, and ranking disability grading of the children.

PMID: 33842131

17. Commentary on Stability of the Gross Motor Function Classification System in Children with Cerebral Palsy Living in Stockholm and Factors Associated with Change
Andrea Burgess, Leanne Sakzewski, Roslyn N Boyd, Mark D Chatfield

Phys Occup Ther Pediatr. 2021 Apr 15;1-3. doi: 10.1080/01942638.2021.1909981. Online ahead of print.

PMID: 33858298

18. Evidence Based Position Paper on Physical and Rehabilitation Medicine professional practice for persons with cerebral palsy
Karol Hornáček, Jolanta Kujawa, Enrique Varela Donoso, Fitnat Dincer, Elena Ilieva, Peter Takáč, Ivana Petronic Markovic, Jiří Votava, Anita Vetra, Dejan Nikolic, Nicolas Christodoulou, Mauro Zampolini, Carlotte Kiekens

Eur J Phys Rehabil Med. 2021 Apr 16. doi: 10.23736/S1973-9087.21.06983-5. Online ahead of print.

Introduction: Cerebral palsy (CP) is a group of the most common developmental disorders affecting movement and posture of the body, causing activity limitations and participation restrictions. The motor disorders of persons with CP are often accompanied by disturbances of sensation, cognition, communication and perception. The symptoms of CP are very diverse and persons with CP are usually presented with a mixed type of symptoms. The non-progressive disturbances can be attributed to disorders that were developed during pregnancy, birth and/or infant stage. Aim: The aim of this study was to improve Physical and Rehabilitation Medicine physician´s professional practice for persons with cerebral palsy in order to improve their functionality, social and community integration, and to reduce activity limitations and/or participation restrictions. Material and methods: A systematic review of the literature including an eighteen-year period and consensus procedure by means of a Delphi process was performed and involved the delegates of all European countries represented in the Union of European Medical Specialists Physical and Rehabilitation Medicine (UEMS PRM) Section. Results: As the result of a Consensus Delphi procedure process 74 recommendations are presented together with the systematic literature review. Conclusions: The PRM physician´s role for persons with cerebral palsy is to lead and coordinate the multiprofessional team, working in an

interdisciplinary way. They should propose and manage the complex but individual PRM programme developed in conjunction with other health professionals, medical specialists and importantly in agreement with the patient, their family and care giver. This should be, according to the specific medical diagnosis to improve patients´ health, functioning, social and education status, considering all impairments, comorbidities and complications, activity limitations and participation restrictions.

PMID: 33861040

19. Can spatial filtering separate voluntary and involuntary components in children with dyskinetic cerebral palsy?
Cassie N Borish, Matteo Bertucco, Denise J Berger, Andrea d'Avella, Terence D Sanger

PLoS One. 2021 Apr 14;16(4):e0250001. doi: 10.1371/journal.pone.0250001. eCollection 2021.

The design of myocontrolled devices faces particular challenges in children with dyskinetic cerebral palsy because the electromyographic signal for control contains both voluntary and involuntary components. We hypothesized that voluntary and involuntary components of movements would be uncorrelated and thus detectable as different synergistic patterns of muscle activity, and that removal of the involuntary components would improve online EMG-based control. Therefore, we performed a synergy-based decomposition of EMG-guided movements, and evaluated which components were most controllable using a Fitts' Law task. Similarly, we also tested which muscles were most controllable. We then tested whether removing the uncontrollable components or muscles improved overall function in terms of movement time, success rate, and throughput. We found that removal of less controllable components or muscles did not improve EMG control performance, and in many cases worsened performance. These results suggest that abnormal movement in dyskinetic CP is consistent with a pervasive distortion of voluntary movement rather than a superposition of separable voluntary and involuntary components of movement.

PMID: 33852638

20. Deletion in COL4A2 is associated with a three-generation variable phenotype: from fetal to adult manifestations
Moran Hausman-Kedem, Liat Ben-Sira, Debora Kidron, Shay Ben-Shachar, Rachel Straussberg, Daphna Marom, Penina Ponger, Anat Bar-Shira, Gustavo Malinger, Aviva Fattal-Valevski

Eur J Hum Genet. 2021 Apr 9. doi: 10.1038/s41431-021-00880-3. Online ahead of print.

Genetic alterations in COL4A2 are less common than those of COL4A1 and their fetal phenotype has not been described to date. We describe a three-generation family with an intragenic deletion in COL4A2 associated with a prenatal diagnosis of recurrent fetal intracerebral hemorrhage (ICH), and a myriad of cerebrovascular manifestations. Exome sequencing, co-segregation analysis, and imaging studies were conducted on eight family members including two fetuses with antenatal ICH. Histopathological evaluation was performed on the terminated fetuses. An intragenic heterozygous pathogenic in-frame deletion; COL4A2, c.4151_4168del, (p.Thr1384_Gly1389del) was identified in both fetuses, their father with hemiplegic cerebral palsy (CP), as well as other family members. Postmortem histopathological examination identified microscopic foci of heterotopias and polymicrogyria. The variant segregated in affected individuals demonstrating varying degrees of penetrance and a wide phenotypic spectrum including periventricular venous hemorrhagic infarction causing hemiplegic CP, polymicrogyria, leukoencephalopathy, and lacunar stroke. We present radiographic, pathological, and genetic evidence of prenatal ICH and show, for what we believe to be the first time, a human pathological proof of polymicrogyria and heterotopias in association with a COL4A2 disease-causing variant, while illustrating the variable phenotype and partial penetrance of this disease. We highlight the importance of genetic analysis in fetal ICH and hemiplegic CP.

PMID: 33837277

21. Early Moves: a protocol for a population-based prospective cohort study to establish general movements as an early biomarker of cognitive impairment in infants
Catherine Elliott, Caroline Alexander, Alison Salt, Alicia J Spittle, Roslyn N Boyd, Nadia Badawi, Catherine Morgan, Desiree Silva, Elizabeth Geelhoed, Robert S Ware, Alishum Ali, Anne McKenzie, David Bloom, Mary Sharp, Roslyn Ward, Samudragupta Bora, Susan Prescott, Susan Woolfenden, Vuong Le, Sue-Anne Davidson, Ashleigh Thornton, Amy Finlay-Jones, Lynn Jensen, Natasha Amery, Early Moves Clinical Working Group; Jane Valentine

BMJ Open. 2021 Apr 9;11(4):e041695. doi: 10.1136/bmjopen-2020-041695.

Introduction: The current diagnostic pathways for cognitive impairment rarely identify babies at risk before 2 years of age. Very early detection and timely targeted intervention has potential to improve outcomes for these children and support them to reach their full life potential. Early Moves aims to identify early biomarkers, including general movements (GMs), for babies at risk of cognitive impairment, allowing early intervention within critical developmental windows to enable these children to have the best possible start to life. Method and analysis: Early Moves is a double-masked prospective cohort study that will recruit 3000 term and preterm babies from a secondary care setting. Early Moves will determine the diagnostic value of abnormal GMs (at writhing and fidgety age) for mild, moderate and severe cognitive delay at 2 years measured by the Bayley-4. Parents will use the Baby Moves smartphone application to video their babies' GMs. Trained GMs assessors will be masked to any risk factors and assessors of the primary outcome will be masked to the GMs result. Automated scoring of GMs will be developed through applying machine-based learning to the data and the predictive value for an abnormal GM will be investigated. Screening algorithms for identification of children at risk of cognitive impairment, using the GM assessment (GMA), and routinely collected social and environmental profile data will be developed to allow more accurate prediction of cognitive outcome at 2 years. A cost evaluation for GMA implementation in preparation for national implementation will be undertaken including exploring the relationship between cognitive status and healthcare utilisation, medical costs, health-related quality of life and caregiver burden. Ethics and dissemination: Ethics approval has been granted by the Medical Research Ethics Committee of Joondalup Health Services and the Health Service Human Research Ethics Committee (1902) of Curtin University (HRE2019-0739). Trial registration number: ACTRN12619001422112.

PMID: 33837094

22. Cerebral Oxygenation and Perfusion When Positioning Preterm Infants: Clinical Implications
Pranav R Jani, Krista Lowe, Aldo Perdomo, Lorraine Wakefield, Murray Hinder, Claire Galea, Traci-Anne Goyen, Robert Halliday, Karen Ann Waters, Nadia Badawi, Mark Tracy

J Pediatr. 2021 Apr 12;S0022-3476(21)00329-2. doi: 10.1016/j.jpeds.2021.04.008. Online ahead of print.

Objectives: To evaluate cerebral oxygenation (cTOI) and cerebral perfusion in preterm infants in supine versus prone positions. Study design: Sixty preterm infants, born before 32 weeks gestation, were enrolled; 30 had bronchopulmonary dysplasia (BPD, defined as the need for respiratory support and/or supplemental oxygen at 36 weeks post menstrual age). Cerebral perfusion, cTOI and polysomnography was measured in both the supine and prone position with the initial position being randomized. Infants with a major intra-ventricular hemorrhage or major congenital abnormality were excluded. Results: Cerebral perfusion was unaffected by position or BPD status. In the BPD group, the mean cTOI was higher in the prone position as compared with the supine position by a difference of 3.27% (P = .03; 95% CI: 6.28 to 0.25) with no difference seen in the no-BPD group. For the BPD group, the burden of cerebral hypoxemia (cumulative time spent with cTOI < 55%) was significantly lower in the prone position (23%) compared with the supine position (29%) ($p < 0.001$). In those without BPD, position had no effect on cTOI. Conclusions: In preterm infants with BPD, the prone position improved cerebral oxygenation and reduced cerebral hypoxemia. These findings may have implications for positioning practices. Further research will establish the impact of position on short and long-term developmental outcomes.

PMID: 33857466

23. The use of proteomics for blood biomarker research in premature infants: a scoping review
Natasha Letunica, Tengyi Cai, Jeanie L Y Cheong, Lex W Doyle, Paul Monagle, Vera Ignjatovic

Review Clin Proteomics. 2021 Apr 14;18(1):13. doi: 10.1186/s12014-021-09316-y.

Over the last decade, the use of proteomics in the setting of prematurity has increased and has enabled researchers to successfully identify biomarkers for an array of associated morbidities. The objective of this scoping review was to identify the existing literature, as well as any knowledge gaps related to proteomic biomarker discoveries in the setting of prematurity. A scoping review was conducted using PubMed, Embase and Medline databases following the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines. The study selection process yielded a total of 700 records, of which 13 studies were included in this review. Most studies used a tandem Mass Spectrometry (MS/MS) proteomics approach to identify key biomarkers. The corresponding studies identified proteins associated with retinopathy of prematurity (ROP), bronchopulmonary dysplasia (BPD), necrotising enterocolitis (NEC), late onset sepsis (LOS) and gestational age. This scoping review demonstrates the limited use of proteomics to identify biomarkers associated with severe complications of prematurity. Further research is warranted to identify biomarkers of other important morbidities associated with prematurity, such as intraventricular haemorrhage (IVH) and cerebral palsy, and to investigate the mechanisms associated with these outcomes.

PMID: 33853516

24. Predicting the developmental outcomes of very premature infants via ultrasound classification: A CONSORT - clinical study
Xue-Hua Zhang, Wen-Juan Chen, Xi-Rong Gao, Ya Li, Jing Cao, Shi-Jun Qiu

Medicine (Baltimore). 2021 Apr 16;100(15):e25421. doi: 10.1097/MD.0000000000025421.

Objective: This study aimed to assess the accuracy of ultrasonic grading in determining brain injury in very premature infants and analyze the affecting factors of these neonatal morbidity and mortality, and to investigate the relationship between serial cranial ultrasound (cUS) classification and Mental Developmental Index (MDI)/Psychomotor Developmental Index (PDI) in premature infants. Methods: A total of 129 very preterm infants (Gestational Age ≤ 28 weeks) were subjected to serial cUS until 6 months or older and classified into 3 degrees in accordance with classification standards. The MDI and PDI (Bayley test) of the infants were measured until the infants reached the age of 24 months or older. The consistency between Term Equivalent Age (TEA)-cUS and TEA- magnetic resonance imaging (MRI) was calculated. Ordinal regression was performed to analyze the relationship among severe disease, early cUS classifications, psychomotor and mental development, and death. Operating characteristic curve were used to analyze the relationship between serial cUS grades and MDI/PDI scores. Results: The mortality and survival rates of 129 very preterm infants were 32.8% and 67.3%, respectively. Among the 86 surviving infants, 20.9% developed mild cerebral palsy (CP) and 5.8% to 6.9% developed severe CP. The consistency between TEA-cUS and TEA-MRI was 88%. Grades 2 and 3 at first ultrasound were associated with adverse mental (OR = 3.2, OR = 3.78) and motor (OR = 2.25, OR = 2.59) development. cUS classification demonstrated high sensitivity (79%-96%). Among all cUS classifications, the specificity of the first cUS was the lowest and that of TEA-cUS was the highest (57% for PDI and 48% for MDI). Conclusions: Moderate and severe brain injury at first ultrasound is the most important factor affecting the survival rate and brain development of very premature infants. The cUS classification had high sensitivity and high specificity for the prediction of CP, especially in TEA-cUS.

PMID: 33847641

25. Long-term risk of epilepsy, cerebral palsy and attention-deficit/hyperactivity disorder in children affected by a threatened abortion in utero
Elena Dudukina, Erzsébet Horváth-Puhó, Henrik Toft Sørensen, Vera Ehrenstein

Int J Epidemiol. 2021 Apr 13;dyab069. doi: 10.1093/ije/dyab069. Online ahead of print.

Background: The birth of a child affected by a threatened abortion (TAB) in utero is associated with autism spectrum disorder; association with other neurological disorders is unknown. Methods: This nationwide registry-based cohort study included singletons live-born in Denmark (1979-2010), followed through 2016. The outcomes were epilepsy, cerebral palsy (CP) and attention-deficit/hyperactivity disorder (ADHD). We used Cox regression to compute hazard ratios (HRs), adjusted for birth year, birth order, parental age, morbidity, medication use and maternal socio-economic factors. To remove time-invariant family-shared confounding, we applied sibling analyses. Results: The study population included 1 864 221 singletons live-born in 1979-2010. Among the TAB-affected children (N = 59 134) vs TAB-unaffected children, at the end of follow-up, the cumulative incidence was 2.2% vs 1.6% for epilepsy, 0.4% vs 0.2% for CP and 5.5% vs 4.2% for ADHD (for children born in 1995-2010). The adjusted HRs were 1.25 [95% confidence interval (CI) 1.16-1.34] for epilepsy, 1.42 (95% CI 1.20-1.68) for CP and 1.21 (95% CI 1.14-1.29) for ADHD. In the sibling design, the adjusted HRs were unity for epilepsy (full siblings: 0.96, 95% CI 0.82-1.12; maternal: 1.04, 95% CI 0.90-1.20; paternal: 1.08, 95% CI 0.93-1.25) and ADHD (full: 1.08, 95% CI 0.92-1.27; maternal: 1.04, 95% CI 0.90-1.20; paternal: 1.08, 95% CI 0.93-1.25). For CP, HRs shifted away from unity among sibling pairs (full: 2.92, 95% CI 1.33-6.39; maternal: 2.03, 95% CI 1.15-3.57; paternal: 3.28, 95% CI 1.36-7.91). Conclusions: The birth of a child affected by TAB in utero was associated with a greater risk of CP, but not epilepsy or ADHD.

PMID: 33846731

26. The long-term view for cerebral palsy research and care
Edward A Hurvitz

Dev Med Child Neurol. 2021 Apr 11. doi: 10.1111/dmcn.14886. Online ahead of print.

PMID: 33843047

27. [Interpretation of the international expert recommendations of clinical features to prompt referral for diagnostic assessment of cerebral palsy][Article in Chinese]
Bin Hu, Rui Mou, Wan-Qiu Tang, Cheng-Ju Wang, Yu-Ping Zhang

Zhongguo Dang Dai Er Ke Za Zhi. 2021 Apr;23(4):328-331. doi: 10.7499/j.issn.1008-8830.2012174.

Under the guidance and support of national policies in recent years, the community medical system has been developed rapidly, among which primary child healthcare is carried out routinely in community hospitals, greatly alleviating the pressure of specialized pediatric hospitals and departments of pediatrics in secondary and tertiary general hospitals. However, due to the lack of professional training for primary child healthcare personnel in community medical institutions, early symptoms of children with cerebral palsy cannot be identified and so children with cerebral palsy are often unable to receive early diagnosis and intervention, which may affect their prognosis. An article about international expert consensus and recommendations on early identification and referral of cerebral palsy in community medical institutions was published in Development Medicine and Child Neurology in 2020. It proposed six clinical features that should prompt referral and two warning signs that warrant enhanced monitoring, as well as five recommendations for referral to medical experts and other healthcare professionals for the diagnosis of cerebral palsy. The recommendations may help primary child healthcare personnel in community medical institutions to early identify the children at high risk of cerebral palsy, thus reducing the delay of referral and intervention. This article gives an interpretation of the recommendations based on the actual situation in China, in order to improve the ability of primary child healthcare personnel in community medical institutions to early identify high-risk signals of cerebral palsy and conduct reasonable referral. This will help to achieve the early identification, early diagnosis, and early intervention to improve the prognosis of children with cerebral palsy.

PMID: 33840402

28. Concussion in para sport: the first position statement of the Concussion in Para Sport (CIPS) Group
Richard Weiler, Cheri Blauwet, David Clarke, Kristine Dalton, Wayne Derman, Kristina Fagher, Vincent Gouttebarge, James Kissick, Kenneth Lee, Jan Lexell, Peter Van de Vliet, Evert Verhagen, Nick Webborn, Osman Hassan Ahmed

Br J Sports Med. 2021 Apr 9;bjsports-2020-103696. doi: 10.1136/bjsports-2020-103696. Online ahead of print.

Concussion is a frequent injury in many sports and is also common in para athletes. However, there is a paucity of concussion research related to para sport, and prior International Concussion in Sport (CIS) consensus papers have not substantively addressed this population. To remedy this and to improve concussion care provided to para athletes, the concussion in para sport (CIPS) multidisciplinary expert group was created. This group analysed and discussed in-depth para athlete-specific issues within the established key clinical domains of the current (2017) consensus statement on CIS. Due to the onset of the COVID-19 pandemic, the group held all meetings by video conferencing. The existing Sport Concussion Assessment Tool 5 (SCAT5) for the immediate on-field and office-based off-field assessment of concussion was evaluated as part of this process, to identify any para athlete-specific concerns. Regular preparticipation and periodic health examinations are essential to determine a baseline reference point for concussion symptoms but pose additional challenges for the interpreting clinician. Further considerations for concussion management for the para athlete are required within the remove, rest, reconsider and refer consensus statement framework. Considering return to sport (RTS), the 2017 CIS consensus statement has limitations when considering the RTS of the para athlete. Case-by-case decision making related to RTS following concussion is imperative for para athletes. Additional challenges exist for the evaluation and management of concussion in para athletes. There is a need for greater understanding of existing knowledge gaps and attitudes towards concussion among athlete medical staff, coaches and para athletes. Future research should investigate the use and performance of common assessment tools in the para athlete population to better guide their clinical application and inform potential modifications. Concussion prevention strategies and sport-specific rule changes, such as in Para Alpine Skiing and Cerebral Palsy Football, also should be carefully considered to reduce the occurrence of concussion in para athletes.

PMID: 33837003

Prevention and Cure

29. Preventing Brain Damage from Hypoxic-Ischemic Encephalopathy in Neonates: Update on Mesenchymal Stromal Cells and Umbilical Cord Blood Cells
Makoto Nabetani, Takeo Mukai, Haruo Shintaku

Am J Perinatol. 2021 Apr 14. doi: 10.1055/s-0041-1726451. Online ahead of print.

Objective: Neonatal hypoxic-ischemic encephalopathy (HIE) causes permanent motor deficit "cerebral palsy (CP)," and may result in significant disability and death. Therapeutic hypothermia (TH) had been established as the first effective therapy for neonates with HIE; however, TH must be initiated within the first 6 hours after birth, and the number needed to treat is from 9 to 11 to prevent brain damage from HIE. Therefore, additional therapies for HIE are highly needed. In this review, we provide an introduction on the mechanisms of HIE cascade and how TH and cell therapies such as umbilical cord blood cells and mesenchymal stromal cells (MSCs), especially umbilical cord-derived MSCs (UC-MSCs), may protect the brain in newborns, and discuss recent progress in regenerative therapies using UC-MSCs for neurological disorders. Results: The brain damage process "HIE cascade" was divided into six stages: (1) energy depletion, (2) impairment of microglia, (3) inflammation, (4) excitotoxity, (5) oxidative stress, and (6) apoptosis in capillary, glia, synapse and/or neuron. The authors showed recent 13 clinical trials using UC-MSCs for neurological disorders. Conclusion: The authors suggest that the next step will include reaching a consensus on cell therapies for HIE and establishment of effective protocols for cell therapy for HIE. Key points: · This study includes new insights about cell therapy for neonatal HIE and CP in schema.. · This study shows precise mechanism of neonatal HIE cascade.. · The mechanism of cell therapy by comparing umbilical cord blood stem cell with MSC is shown.. · The review of recent clinical trials of UC-MSC is shown.

PMID: 33853147