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Interventions and Management

1. A narrative review on spinal deformities in people with cerebral palsy: Measurement, norm values, incidence, risk factors and treatment

E Britz, N G Langerak, R P Lamberts

S Afr Med J. 2020 Jul 29;110(8):767-776. doi: 10.7196/SAMJ.2020.v110i8.14472.

Spinal deformities are common in people with cerebral palsy (CP), and there is a concern of an increase during the adult ageing period. There is especially a worry about the increase of scoliosis, thoracic hyperkyphosis, lumbar hyperlordosis, spondylolysis and spondylolisthesis incidence, though supporting literature is lacking. Therefore, the aim of this narrative review is to provide a scientific overview of how spinal curvatures should be measured, what the norm values are and the incidence in people with CP, as well as a description of the risk factors and the treatment regimens for these spinal abnormalities. This review can be used as a guideline relevant for a range of clinicians, including orthopaedic and neurosurgeons, radiologists, physiotherapists, and biokineticists, as well as academics.

PMID: [32880305](#)

2. Can Rapid Progression in Nonambulatory Cerebral Palsy Scoliosis be Predicted Using Humeral Head Ossification?

Joshua T Bram, John M Flynn, Alexa J Karkenny, Ronit V Shah, Divya Talwar, Keith D Baldwin

J Pediatr Orthop. 2020 Sep 1. doi: 10.1097/BPO.0000000000001673. Online ahead of print.

Background: Patients with cerebral palsy scoliosis (CPS) experience higher complication rates compared with idiopathic scoliosis and often present for surgery with larger curves. Prediction of an inflection point for rapid deformity progression has proven difficult. A proximal humerus-based skeletal maturity staging system (HS) has been recently validated and is commonly visible on the posteroanterior radiograph. The authors hypothesize that this system can be used to identify a period at which CPS may progress rapidly, perhaps facilitating discussion of timely surgical intervention. **Methods:** A retrospective review was conducted for nonambulatory pediatric patients with CPS who presented between 2009 and 2018 at our institution. All patients were considered for inclusion regardless of operative or nonoperative management. Patients who were skeletally mature at initial evaluation or had prior spine surgery were excluded. The authors analyzed radiographs in each HS available. Survival was calculated for cutoffs of 60 and 70 degrees (numbers found to increase intraoperative and postoperative complications for CPS). **Results:** Eighty-six patients with CPS were identified (54 male individuals). Major curves increased significantly between HS 1 and 2 (27.7 to 46.6 degrees, $P=0.009$) and HS 3 and 4 (53.1 to 67.9 degrees, $P=0.023$). The proportion of curves ≥ 70 degrees were significantly different between HS ($P<0.001$), with the greatest increase between HS 3 and 4 (24% to 51%; ≥ 70 degrees). The largest drop in the 60/70-degree survival curves was between HS 3 and 4. In a subanalysis, 69% of patients with curves ≥ 40 degrees but < 70 degrees in stage 3 would progress ≥ 70 degrees by stage 4. **Conclusions:** Identifying a period of rapid curve progression may guide surgical planning before CPS curves become large,

stiff, and more difficult to fix. Our findings suggest that humeral skeletal maturity staging is a valuable decision-making tool in neuromuscular scoliosis, with the HS 3 to 4 transition representing the time of the greatest risk of progression. Consider a surgical discussion or shortened follow-up interval for patients with CPS with curves ≥ 40 degrees who are HS 3. Level of evidence: Level II.

PMID: [32890123](#)

3. Postoperative Pain Protocol in Children after Selective Dorsal Rhizotomy

Jeffrey Hatef, Luke G F Smith, Giorgio C Veneziano, David P Martin, Tarun Bhalla, Jeffrey R Leonard

Pediatr Neurosurg. 2020 Sep 7;1-7. doi: 10.1159/000509333. Online ahead of print.

Introduction: Selective dorsal rhizotomy (SDR) provides lasting relief of spasticity for children suffering from cerebral palsy, although controlling postoperative pain is challenging. Postoperatively, escalation of therapies to include a patient-controlled analgesia (PCA) pump and intensive care unit (ICU) admission is common. **Objectives:** We developed a multimodal pain management protocol that included intraoperative placement of an epidural catheter with continuous opioid administration. We present the 3-year results of protocol implementation. **Methods:** With institutional review board approval, all patients who were subjected to SDR at our institution were identified for review. Hourly pain scores were recorded. Adverse effects of medication, including desaturation, nausea/vomiting, and pruritus, were also noted. Comparisons were made between patients treated with PCA and those treated with multimodal pain control using *t* and χ^2 tests as appropriate. **Results:** Thirty-nine patients undergoing the procedure with protocolized pain control (average age 6.8 years, 57% male) were compared to 7 PCA-treated controls (average age 6.6 years, 54% male). Pain control was satisfactory in both groups, with average pain scores of 1.5 in both groups on postoperative day 0, decreasing by postoperative day 3 to 1.1 in the PCA group and 0.5 in the protocol group. No patients under the protocol required ICU admission; all patients with PCA spent at least 1 day in the ICU. Desaturations were seen in 16 patients in the protocol group (41%), but none required ICU transfer. Treatment for pruritus was given to 57% of PCA patients and 15% of protocol patients. Treatment for nausea and vomiting was given to 100% of PCA patients and 51% of protocol patients. Medication requirements for the hospitalization were decreased from 1.1 to 0.28 doses per patient for pruritus, and from 3 to 1.1 doses per patient for nausea. **Conclusions:** Multimodal analgesia is an excellent alternative to PCA for postoperative pain after SDR. Actual analgesia is comparative to that of controls without the need for intensive care monitoring. Side effects of high-dose opiates were less frequent and required less medication. With the protocol, patients were safely treated outside the ICU.

PMID: [32894856](#)

4. Effect of action observation therapy on motor function in children with cerebral palsy: a systematic review of randomized controlled trials with meta-analysis

Naglaa Abdelhaleem, Samar Taher, Menna Mahmoud, Ahmad Hendawy, Maged Hamed, Hossam Mortada, Abdullah Magdy, Moustafa Raafat Ezz El-Din, Ismail Zoukiem, Shorouk Elshennawy

Clin Rehabil. 2020 Sep 9;269215520954345. doi: 10.1177/0269215520954345. Online ahead of print.

Objective: To evaluate the evidence of using Action Observation Therapy in the rehabilitation of children with Cerebral Palsy. **Study design:** Systematic review with meta-analysis of Randomised Controlled Trials. **Methods:** For the purpose of identifying relevant studies, six databases were searched from inception until July 2020. The methodological quality was assessed by Physiotherapy Evidence Database scale. The outcomes were classified within the framework of the International Classification of Functioning. A pooled meta-analysis was performed on studies that demonstrated homogeneity. **Results:** Twelve randomised controlled trials with 307 participants were included with six of them were included in the meta-analysis. Non-significant difference between the groups was demonstrated by meta-analysis. Results of capacity assessed in post treatment and follow up evaluation were (0.06, -0.22 to 0.34, 95% (CI); $P = 0.69$ and (-0.35, -0.96 to 0.27, 95% (CI); $P = 0.27$); respectively. Actual performance in post-treatment and follow up were (0.10, -0.22 to 0.48, 95% (CI); $P = 0.62$) and (0.01, -0.40 to 0.41, 95% (CI); $P = 0.97$); respectively. Perceived performance evaluated using (ABILHAND-KIDS) were (0.30, -0.28 to 0.89, 95% (CI); $P = 0.31$) and (0.15, -0.43 to 0.73, 95% (CI); $P = 0.61$) for post treatment and follow up; respectively. Overall effect on activity domain was (0.08, -0.11 to 0.28, 95% (CI); $P = 0.86$) immediately and (0.04, -0.33 to 0.26, 95% (CI); $P = 0.49$) at follow-up; respectively. **Conclusion:** No evidence of benefit had been found to draw a firm conclusion regarding the effectiveness of action observation therapy in the rehabilitation of children with cerebral palsy due to limitations in methodological quality and variations between studies.

PMID: [32907374](#)

5. The correlation between rhythm perception and gait characteristics at different rhythms among children with cerebral palsy and typically developing children

Maayan Schweizer, Sharon Eylon, Michal Katz-Leurer

Gait Posture. 2020 Aug 21;82:83-89. doi: 10.1016/j.gaitpost.2020.08.120. Online ahead of print.

Background: It has been shown that motor training while listening to constant rhythm, is associated with coupling between movement and rhythm. To gain a better understanding of how rhythm perception may affect gait in children with cerebral palsy (CP) it seems important first to assess rhythm perception (RP) in these children. **Research question:** To describe and compare RP and step characteristics in children with CP and typically-developing (TD) children, and to assess the impact of RP on step characteristics during different rhythms. **Methods:** The study included 24 children with CP, Gross Motor Function Classification System (GMFCS) levels I-II, age 7-12 years, who walk without assistive device, and 24 TD children matched for age and gender. RP was assessed by the perceptual beat alignment test (BAT). Gait parameters were recorded using a pressure-sensitive mat - the Gaitrite® system. Each participant walked on the mat at a comfortable walking pace and with the metronome set at 92.5 %, 100 % and 107.5 % of his preferred walking rhythm. **Results:** No significant difference in RP was noted between groups. Children with CP presented significantly larger step time and length variability. In TD children, those with better RP walked significantly slower, with lower step variability as compared to TD children with lower RP. Children in both groups, regardless of rhythm perception, successfully matched their cadence to the metronome's pace, both at the lower and higher rhythm, except TD children with lower rhythm perception, who failed to reduce their cadence sufficiently in the 92.5 % pace. Children with better RP in both groups changed more parameters in gait in response to rhythm changes. **Significance:** Assessing RP may predict which parameters of gait are expected to change when employing a metronome during child's walk.

PMID: [32906007](#)

6. Relationship between lower limb strength and walking capacities in children with spastic bilateral cerebral palsy

Annie Pouliot-Laforte, Audrey Parent, Reggie Hamdy, Pierre Marois, Martin Lemay, Laurent Ballaz

Disabil Rehabil. 2020 Sep 9;1-7. doi: 10.1080/09638288.2020.1813819. Online ahead of print.

Purpose: Evaluate the relationship between different walking capacities and muscle strength in children with bilateral cerebral palsy (BCP) and assess these relationships in stronger and weaker children. **Materials and methods:** Thirty-two children with spastic BCP were included. All participants walked under three speed conditions: comfortable, fast, and for a longer period (6 min). Walking speeds, Energy Expenditure Index (EEI), and lower limb muscle strength were measured. A global strength index (GSI) was computed as the sum of each muscle group strength. Pearson's coefficient and regression models were computed between walking capacities and the GSI. **Results:** GSI was correlated with the EEI and all walking speeds. Logarithmic regressions models explained between 24 and 34% of the variance of walking capacities. Then, the group was divided in two subgroups (weaker and stronger children). GSI was correlated with comfortable and endurance walking speed in weaker children, but not in stronger children. **Conclusion:** This study reports logarithmic relationship between muscle strength and walking capacities in children with BCP. The subgroup analysis implies that muscle strength has an impact on walking capacities solely in weaker children, suggesting that muscle strength must be preserved and reinforced in interventions targeting motor function in weaker children with BCP. **Implications for rehabilitation** In a sample of children with spastic bilateral cerebral palsy, this study shows that global muscle strength is associated with walking capacities and the relationship seems more complex than linear. Based on the results, interventions should focus on maintaining or improving muscle strength in weaker children as no association was observed between muscle strength and walking capacities in stronger children. In stronger children, intervention should focus on factors other than muscle strength as it does not influence walking capacities. Based on this study, a more accurate screening of children who could benefit from strength training could be completed by initial global muscle strength.

PMID: [32905745](#)

7. Botulinum toxin injections minimally affect modelled muscle forces during gait in children with cerebral palsy

M Wesseling, H Kainz, T Hoekstra, S Van Rossom, K Desloovere, F De Groot, I Jonkers

Gait Posture. 2020 Aug 22;82:54-60. doi: 10.1016/j.gaitpost.2020.08.122. Online ahead of print.

Background: Children with cerebral palsy (CP) present altered gait patterns and electromyography (EMG) activity compared to typically developing children. To temporarily reduce muscular activity and to correct the abnormal muscle force balance, Botulinum Toxin type A (BTX-A) injections are used. **Research question:** What is the effect of BTX-A injections on dynamic muscle forces during gait, when calculated using an EMG-constrained approach?. **Methods:** Retrospective data of ten typically developing (TD) and fourteen children with spastic diplegic CP were used for musculoskeletal modeling and dynamic simulations of gait, before and after BTX-A treatment. Individual muscle forces were calculated using an EMG-constrained optimization, in which EMG of eight muscles was used as muscle excitation signal to constrain the muscle activation patterns. Paired t-tests were used to compare average modelled muscle forces in different phases of the gait cycle pre- and post-BTX-A, summarized in the muscle profile score. Two-sample t-tests were used to determine significant differences between TD and pre- and post-BTX-A modelled muscle forces. **Results:** For most muscles, the force was decreased in CP compared to TD children in all phases of the gait cycle, both before and after BTX-A treatment. Differences in muscle forces before and after BTX-A treatment were limited, with only few significant differences between pre- and post-BTX-A. Compared to a standard static optimization approach, imposing the EMG activity increased modelled muscle forces for most muscles. **Significance:** Our findings indicate that BTX-A treatment has a limited effect on the muscle balance in CP children. Besides that, the use of EMG-constrained optimization is recommended when studying muscle balance in children with CP.

PMID: [32892101](#)

8. Amplitude and stride-to-stride variability of muscle activity during Lokomat guided walking and treadmill walking in children with cerebral palsy

Klaske van Kammen, Heleen A Reinders-Messelink, Anne L Elsinghorst, Carlijn Wesselink, Berna Meeuwisse-de Vries, Lucas H V van der Woude, Anne M Boonstra, Rob den Otter

Eur J Paediatr Neurol. 2020 Aug 21;S1090-3798(20)30165-3. doi: 10.1016/j.ejpn.2020.08.003. Online ahead of print.

Background: The Lokomat is a commercially available exoskeleton for gait training in persons with cerebral palsy (CP). Because active contributions and variability over movement repetitions are determinants of training effectiveness, we studied muscle activity in children with CP, and determined (i) differences between treadmill and Lokomat walking, and (ii) the effects of Lokomat training parameters, on the amplitude and the stride-to-stride variability. **Methods:** Ten children with CP (age 13.2 ± 2.9, GMFCS level II(n = 6)/III(n = 4)) walked on a treadmill (±1 km/h; 0% bodyweight support(BWS)), and in the Lokomat (50% and 100% guidance; ±1 km/h and ±2 km/h; 0% and 50% BWS). Activity was recorded from Gluteus Medius (GM), Vastus Lateralis (VL), Biceps Femoris (BF), Medial Gastrocnemius (MG) and Tibialis Anterior (TA) of the most affected side. The averaged amplitude per gait phase, and the second order coefficient of variation was used to determine the active contribution and stride-to-stride variability, respectively. **Results:** Generally, the amplitude of activity was lower in the Lokomat than on the treadmill. During Lokomat walking, providing guidance and BWS resulted in slightly lower amplitudes whereas increased speed was associated with higher amplitudes. No significant differences in stride-to-stride variability were observed between Lokomat and treadmill walking, and in the Lokomat only speed (MG) and guidance (BF) affected variability. **Conclusions:** Lokomat walking reduces muscle activity in children with CP, whereas altering guidance or BWS generally does not affect amplitude. This urges additional measures to encourage active patient contributions, e.g. by increasing speed or through instruction.

PMID: [32900595](#)

9. Effects of creative dance-based exercise on gait performance in adolescents with cerebral palsy

Hee Joung Joung, Jaebum Park, Joeeun Ahn, Moon Seok Park, Yongho Lee

J Exerc Rehabil. 2020 Aug 25;16(4):332-343. doi: 10.12965/jer.2040384.192. eCollection 2020 Aug.

The purpose of this study is to explore the feasibility and therapeutic potential of creative dance (CD) based exercise as a rehabilitation intervention for adolescents with cerebral palsy (CP). Participants were 10 adolescents with spastic CP (mean

age, 17.5±2.12 years; Gross Motor Function Classification System levels I [n=3] and II [n=7]). Outcome measures included the Gross Motor Function Measure-88 (GMFM-88; dimensions D and E), spatiotemporal gait parameters, lower limb range of motion during walking, and body image, assessed using the Body Cathexis Scale (BCS). CD was provided in 2-hr classes, twice weekly, for 12 weeks, during which participants learned movement concepts and developed their own movement. All participants completed the intervention, with an attendance rate of 98% and high satisfaction rating. GMFM-88 dimensions D (P=0.01) and E (P=0.005); walking speed (P= 0.005), cadence (P=0.009), step (P=0.005), and stride length (P=0.005); and sagittal ranges of motions of hip (P=0.009) and ankle (P=0.03) during walking were significantly improved. The time of opposite foot off (P=0.028) and first double-limb support (P=0.028) significantly decreased, whereas the percentage of single-limb support time (P=0.02) increased. Additionally, BCS scores were significantly improved. In conclusions, CD-based exercise can improve gross motor function, gait performance, and body image in adolescents with CP.

PMID: [32913838](#)

10. Aquatic high intensity interval training to improve aerobic capacity is feasible in adolescents with cerebral palsy: pilot randomised controlled trial

Julie Depiazzi, Nadine Smith, Noula Gibson, Andrew Wilson, Katherine Langdon, Kylie Hill

Clin Rehabil. 2020 Sep 9;269215520956499. doi: 10.1177/0269215520956499. Online ahead of print.

Objective: To investigate feasibility of aquatic high intensity interval training for adolescents with cerebral palsy, who can ambulate independently but may choose a mobility aid in some circumstances. **Design:** Pilot randomised controlled trial. **Method:** Following baseline assessments, participants were randomised to usual care or ten weeks of twice weekly aquatic high intensity interval training. Each class comprised 10 one-minute exercise intervals separated by one-minute rest. High intensity exercise was defined as the attainment of ≥80% of peak heart rate measured by telemetry. **Setting:** Tertiary paediatric hospital. **Main measures:** Primary outcomes related to the feasibility of the protocol to progress to a definitive trial. Consumer feedback was obtained. **Results:** Of 119 potential participants, 46 appeared eligible and 17 consented, resulting in a recruitment fraction of 37% (95% CI 23-52). Twelve completed baseline assessments and were randomised (5 males; 14 years 7 months SD 2 years 0 months). In the intervention group, of the 1190 exercise stations (across all participants and sessions), heart rate data were available for 1180 stations and high intensity exercise was achieved during 1111 stations (93%, 95% CI 92-95). All randomised participants completed the study and reported that the intervention was fun and provided friendship opportunities. There were no major adverse events or exacerbation of pain. **Conclusions:** Aquatic high intensity interval training in ambulant adolescents with cerebral palsy is feasible, while maintaining adherence and fidelity. Uncertainty remains on the efficacy of the intervention, highlighting the need for a large definitive trial.

PMID: [32907375](#)

11. The impact of botulinum toxin type A in the treatment of drooling in children with cerebral palsy secondary to Congenital Zika Syndrome: an observational study

Henrique F Sales, Caroline Cerqueira, Daniel Vaz, Débora Medeiros-Rios, Giulia Armani-Franceschi, Pedro H Lucena, Carla Sternberg, Ana C Nóbrega, Cleber Luz, Danilo Fonseca, Alessandra L Carvalho, Larissa Monteiro, Isadora C Siqueira, Igor D Bandeira, Rita Lucena

Neurol Res. 2020 Sep 11;1-7. doi: 10.1080/01616412.2020.1820698. Online ahead of print.

Objective: The main aim of this study was to determine the impact of botulinum toxin A (BTX-A) on severity and frequency of drooling in children with Cerebral Palsy (CP) secondary to Congenital Zika Syndrome (CZS). **Methods:** This is a prospective longitudinal observational study including 23 children who received bilateral injections of BTX in the parotid and submandibular glands. The Thomas-Stonell & Greenberg Drooling Severity and Frequency Scale was applied by a multidisciplinary team including Speech, Language and Hearing professionals. The Global Impression of Improvement (GII) Scale was also applied to assess parents' subjective perceptions of therapeutic response. Swallowing was assessed using Doppler ultrasonography. Univariate logistic regression was used to analyse differences between responders and non-responders. **Results:** Participant age varied from 27 to 38 months (mean 31.78, SD = 2.61) all presented with Gross Motor Function Classification System (GMFCS) V. Drooling Severity and Frequency Scale scores ranged from 7 to 9 points (median = 9) prior to BTX administration and from 4 to 6 (median = 6) after. Pre- and post-treatment reduction in drooling severity occurred (Z = -3.746; p < 0.001). No cases of drooling worsening were reported. Only two subjects presented adverse effects attributed to BTX administration. Correlation was only confirmed with GII. **Discussion:** This article presents the safe and

positive impact of BTX-A administration guided by anatomical references described in the literature, even on children with microcephaly. Further studies are needed to facilitate the use of Doppler ultrasonography as a tool to characterize changes in sensory processing and motor response following intraoral input in children with CP.

PMID: [32915712](#)

12. [Multicentre longitudinal study of the nutritional status and swallowing difficulties in children with severe neurological diseases][Article in Spanish]

E Crehuá-Gaudiza, M García-Peris, C Jovaní-Casano, M A Moreno-Ruiz, C Martínez-Costa

Rev Neurol. 2020 Sep 16;71(6):213-220. doi: 10.33588/rn.7106.2020032.

Introduction: Nutritional problems are common in children with neurological diseases, especially if they have significant motor impairment. Oropharyngeal dysphagia is very prevalent in these patients, and can contribute to worsening nutritional status and produce pulmonary aspirations. **Aim:** Longitudinal assessment of the nutritional status of a sample of pediatric patients with moderate-severe neurological disease and establish the prevalence of oropharyngeal dysphagia in that sample. **Patients and methods:** An observational multicenter prospective study was conducted. We included children under 16 years of age with moderate-to-severe neurological impairment from four hospitals, with clinical and anthropometric monitoring for one year. Questions were asked to conduct oropharyngeal dysphagia screening. **Results:** Sixty-eight children were included, the main diagnosis obtained was cerebral palsy. In the anthropometric assessment, 42 patients (62%) showed weight z scores below -2, and 29 (43%) height z scores below -2, while body mass index, mid upper arm circumference and triceps and subscapular skinfolds remained less affected. We found an oropharyngeal dysphagia prevalence of 73.5% in our sample, increasing with greater motor impairment. **Conclusions:** These patients showed lower weight and height than children without neurological impairment. However, with a correct follow-up they remain stable with an adequate body composition. It is important to proactively investigate the presence of oropharyngeal dysphagia, especially in those with greater motor impairment, as it occurs very frequently and an adequate diagnosis can improve clinical evolution and prevent complications.

PMID: [32895904](#)

13. Nutritional status of children with cerebral palsy attending rehabilitation centers

María de Las Mercedes Ruiz Brunner, María E Cieri, María P Rodríguez Marco, A Sebastian Schroeder, Eduardo Cuestas

Dev Med Child Neurol. 2020 Sep 6. doi: 10.1111/dmcn.14667. Online ahead of print.

Aim: To describe the nutritional status of children with cerebral palsy (CP) from rehabilitation and therapeutic centers in Argentina, and to analyze their risk of undernutrition based on their Gross Motor Function Classification System (GMFCS) level. **Method:** This was a cross-sectional study with data collected from 321 children (196 males, 125 females) with CP age 2 to 19 years (mean age 9y 3mo, SD 4y 5mo) from 17 rehabilitation and therapeutic centers in five Argentine provinces. Nutritional status was defined by height, weight, and body mass index for age z-scores using World Health Organization growth charts. Odds ratios were used to evaluate the association between GMFCS level and nutritional status. **Results:** Of the children with CP studied, 52.4% were in GMFCS levels IV and V. Regarding the nutritional status, 41.7% were normal, 19.0% had moderate undernutrition, 33.9% severe undernutrition, 2.5% overweight, and 2.8% obese. When compared to those in GMFCS levels I to III, the odds of children in GMFCS levels IV and V having moderate undernutrition are four times greater and the odds of having severe undernutrition are 14 times greater. **Interpretation:** There is a high prevalence of undernutrition associated with CP (GMFCS levels IV and V) among children in rehabilitation and therapeutic centers in Argentina. Risk of severe undernutrition increases with increased motor compromises.

PMID: [32893359](#)

14. Blood transfusion following major orthopaedic surgery in cerebral palsy: a retrospective analysis

Matthias Z H Lu, Susan M Reid, Kristopher Lundine, Gemma Crighton

ANZ J Surg. 2020 Sep 6. doi: 10.1111/ans.16288. Online ahead of print.

Background: Progressive musculoskeletal pathology is ubiquitous among children with cerebral palsy (CP). Corrective surgery places them at risk of major blood loss and red blood cell (RBC) transfusion. Significant variability exists in uptake of perioperative patient blood management (PBM) strategies. This study aimed to examine factors contributing to RBC transfusion and assist in future development of care pathways. **Methods:** A retrospective review at a tertiary paediatric hospital was undertaken to identify patients with CP undergoing either primary spinal fusion or single event, multilevel surgery (SEMLS) between 2010 and 2015. Solely soft tissue procedures were excluded. Data collected included demographics, Gross Motor Function Classification System level, surgical details, perioperative PBM and transfusion rates. Univariable analysis was performed to assess contributing factors to RBC transfusion. **Results:** A total of 36 spinal fusion and 98 SEMLS patients were included. Preoperatively, 12% were anaemic, but only 19% had a ferritin checked. Overall, 49 patients (37%) received RBC transfusions. Intraoperative usage of tranexamic acid and cell salvage was 89% and 81%, respectively, for the spine cohort, and 22% and 3% for the SEMLS cohort. Successively higher Gross Motor Function Classification System levels, sodium valproate usage, longer surgical times, spinal fusion, pelvis instrumentation and more osteotomies were associated with RBC transfusion. **Conclusion:** More than one-third of CP patients who underwent major orthopaedic surgery received RBC transfusion. As expected, the more severely affected patients undergoing longer procedures were at highest risk. Significant improvements can be made in PBM to help optimize patients for surgery and minimize the need for transfusion.

PMID: [32893430](#)

15. A Case Report of Baclofen Toxicity in a Pediatric Patient With Normal Kidney Function Successfully Treated With Hemodialysis

Siddharth A Shah, Stephanie J Kwon, Katherine E Potter

Case Reports Can J Kidney Health Dis. 2020 Aug 19;7:2054358120950874. doi: 10.1177/2054358120950874. eCollection 2020.

Rationale: Baclofen is a commonly prescribed medication used to decrease spasticity in children with cerebral palsy. Despite its widespread use, this medication has not demonstrated to be consistently effective in clinical studies. Baclofen is also associated with systemic adverse effects due to potent neuronal depression. The management of baclofen toxicity is mainly supportive; however, some studies have shown that hemodialysis may alleviate the symptoms of an overdose and shorten the recovery time. **Presenting concerns:** In this case report, a 6-year-old boy with mild cerebral palsy, neuromyelitis optica, and normal kidney function was found unresponsive at home, with altered mental status, after ingesting 1300 mg of baclofen unobserved. The patient was intubated and mechanically ventilated because of significant neurologic depression with subsequent respiratory failure. **Diagnosis:** The patient was diagnosed with baclofen-induced encephalopathy. An elevated serum baclofen level of 4.00 µg/mL (therapeutic range of 0.08-0.40 µg/mL) was observed 10 hours after he was found unresponsive. The patient's respiratory status deteriorated; he had high ventilatory requirements and remained comatose. **Intervention:** With the worsening of his clinical condition in the intensive care unit, hemodialysis, administered via a high-efficiency high-flux dialyzer, was initiated approximately 18 hours after he was found unresponsive. The patient underwent 2 hemodialysis runs spaced 9 hours apart, with blood flow rates approaching 250 mL/min. **Outcomes:** Within 3 hours of the first hemodialysis treatment, the patient started to regain consciousness. He was extubated to room air 6 hours after the second hemodialysis treatment. **Novel findings:** Supportive management is the primary treatment of baclofen toxicity in a pediatric patient with normal kidney function. Hemodialysis may be considered in severe cases of baclofen toxicity and worsening clinical status, but further studies are needed to confirm this finding.

PMID: [32913654](#)

16. Constraint Induced Movement Therapy Camp for Children with Hemiplegic Cerebral Palsy Augmented by Use of an Exoskeleton to Play Games in Virtual Reality

Heather Roberts, Angela Shierk, Nancy J Clegg, Deborah Baldwin, Linsley Smith, Paul Yeatts, Mauricio R Delgado

Phys Occup Ther Pediatr. 2020 Sep 7;1-16. doi: 10.1080/01942638.2020.1812790. Online ahead of print.

Aim: To determine the acceptability and effects of a pediatric constraint induced movement therapy (P-CIMT) camp for children with hemiplegic cerebral palsy (hCP) augmented by use of an exoskeleton to play games in virtual reality (VR).

Method: 31 children with hCP attended a P-CIMT camp 6 hours per day for 10 days over 2 successive weeks (60 hours) that included 30 minutes of unilateral training with the Hocoma Armeo®Spring Pediatric that combines the assistance of an exoskeleton and VR games. The primary outcome measure was the Assisting Hand Assessment (AHA); secondary outcome measures were the Melbourne Assessment of Uni-lateral Hand Function (MUUL), and the Canadian Occupational Performance Measure (COPM). Assessments were completed at pre-intervention, post-intervention, and 6 months following intervention. Results: Participants demonstrated clinically and statistically significant improvement in bimanual performance (AHA) ($p < .001$) and COPM Performance ($p < .001$) and Satisfaction with performance ($p < .001$). Improvement in unilateral performance (MUUL) was statistically ($p < .001$) but not clinically significant. Conclusions: A P-CIMT camp augmented by the Hocoma Armeo®Spring Pediatric was feasible and accepted by participants. Bimanual hand function and occupational performance improved immediately following intervention, and the treatment effects persisted 6 months following intervention.

PMID: [32892679](#)

17. Weekend and off-hour effects on the incidence of cerebral palsy: contribution of consolidated perinatal care

Satoshi Toyokawa, Junichi Hasegawa, Tsuyomu Ikenoue, Yuri Asano, Emi Jojima, Shoji Satoh, Tomoaki Ikeda, Kiyotake Ichizuka, Satoru Takeda, Nanako Tamiya, Akihito Nakai, Keiya Fujimori, Tsugio Maeda, Hideaki Masuzaki, Hideaki Suzuki, Shigeru Ueda

Environ Health Prev Med. 2020 Sep 10;25(1):52. doi: 10.1186/s12199-020-00889-y.

Objective: This study estimated the effects of weekend and off-hour childbirth and the size of perinatal medical care center on the incidence of cerebral palsy. Methods: The cases were all children with severe cerebral palsy born in Japan from 2009 to 2012 whose data were stored at the Japan Obstetric Compensation System for Cerebral Palsy database, a nationally representative database. The inclusion criteria were the following: neonates born between January 2009 and December 2012 who had a birth weight of at least 2000 g and gestational age of at least 33 weeks and who had severe disability resulting from cerebral palsy independent of congenital causes or factors during the neonatal period or thereafter. Study participants were restricted to singletons and controls without report of death, scheduled cesarean section, or ambulance transportation. The controls were newborns, randomly selected by year and type of delivery (normal spontaneous delivery without cesarean section and emergency cesarean section) using a 1:10 case to control ratio sampled from the nationwide Japan Society of Obstetrics and Gynecology database. Results: A total of 90 cerebral palsy cases and 900 controls having normal spontaneous delivery without cesarean section were selected, as were 92 cerebral palsy cases and 920 controls with emergent cesarean section. A significantly higher risk for cerebral palsy was found among cases that underwent emergent cesarean section on weekends (odds ratio [OR] 1.72, 95% confidence interval [CI] 1.06-2.81) and during the night shift (OR 2.29, 95% CI 1.30-4.02). No significant risk was found among normal spontaneous deliveries on weekends (OR 1.63, 95% CI 0.97-2.73) or during the quasi-night shift (OR 1.26, 95% CI 0.70-2.27). Regional perinatal care centers showed significantly higher risk for cerebral palsy in both emergent cesarean section (OR 2.35, 95% CI 1.47-3.77) and normal spontaneous delivery (OR 2.92, 95% CI 1.76-4.84). Conclusion: Labor on weekends, during the night shift, and at regional perinatal medical care centers was associated with significantly elevated risk for cerebral palsy in emergency cesarean section.

PMID: [32912144](#)

18. Hospitalizations in School-Aged Children with Cerebral Palsy and Population-Based Controls

Olivier Fortin, Pamela Ng, Marc Dorais, Louise Koclas, Nicole Pigeon, Michael Shevell, Maryam Oskoui

Can J Neurol Sci. 2020 Sep 11;1-24. doi: 10.1017/cjn.2020.199. Online ahead of print.

PMID: [32912375](#)

19. Disease burden of congenital cytomegalovirus infection in Japan

Hirosato Aoki, Taito Kitano, Daisuke Kitagawa

J Infect Chemother. 2020 Sep 7;S1341-321X(20)30311-1. doi: 10.1016/j.jiac.2020.08.018. Online ahead of print.

Introduction: Cytomegalovirus is the most frequently acquired congenital infectious agent that causes malformation in newborns in developed countries. Although there are many discussions worldwide about neonatal screening and treatment, there is scarce information relating to the lifetime economic burden of this disease, which is essential for calculating the cost-effectiveness of any screening and treatment programs. **Materials and methods:** Economic and lifetime health burdens of congenital cytomegalovirus infection in the Japanese annual birth cohort in 2019 were calculated, using demographic, epidemiologic, health value, and economic indicators. The economic burden was divided into medical and social costs. Sensitivity analysis was performed, using high and low values for some indicators. **Results:** Our model estimated that the overall cost due to congenital cytomegalovirus infection in 2019 was 27.6 billion JPY. Acute care costs comprised a small portion of the medical costs. Social costs were much higher than medical costs. **Conclusion:** Our study revealed the economic burden of congenital cytomegalovirus infection in Japan, which highlighted the significance of this disease. Our study will be helpful for guiding national strategies in Japan, including neonatal screening and early treatment.

PMID: [32912713](#)

20. Neurological disorders in autism: A systematic review and meta-analysis

Pei-Yin Pan, Sven Bölte, Preet Kaur, Sadia Jamil, Ulf Jonsson

Autism. 2020 Sep 9;1362361320951370. doi: 10.1177/1362361320951370. Online ahead of print.

Neurological disorders, such as epilepsy and cerebral palsy, have been reported to occur among individuals with autism beyond chance and may have an impact on daily living across the lifespan. Although there has been research investigating neurological disorders in autism, the findings are not always conclusive. Previous summaries of existing studies have not evaluated the full range of neurological disorders. This study aimed to comprehensively explore the neurological problems appearing in autism to provide updated information that is needed for better healthcare and support in this population. We looked at already published studies focusing on risk or frequency of neurological disorders in autism. Our results suggest that individuals with autism are more likely than the general population to have a range of neurological disorders, including epilepsy, macrocephaly, hydrocephalus, cerebral palsy, migraine/headache, and inborn abnormalities of the nervous system. In order to provide individualized healthcare and support of high quality to individuals diagnosed with autism, health care professionals and other support providers need to be attentive to neurological complications. To further improve our understanding about the link between autism and neurological disorders, future research should follow the neurological health of children who are diagnosed with or are at increased likelihood of autism.

PMID: [32907344](#)

21. Prevalence of Malocclusions and Associated Factors in Brazilian Children and Adolescents with Cerebral Palsy: A Multi-Institutional Study

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Int J Dent. 2020 Aug 29;2020:8856754. doi: 10.1155/2020/8856754. eCollection 2020.

Background: To assess the prevalence and factors associated with malocclusions in children and adolescents with cerebral palsy (CP). **Methods:** The study included 134 subjects with CP aged 2-18 years enrolled in six rehabilitation institutions and their caregivers, which provided demographic, systemic, and behavioral data. A calibrated researcher held oral examinations with record of the following malocclusion indexes, DAI and DMFT. Poisson regression analysis was used ($\alpha < 0.05$). **Results:** About 85.8% (n = 115) of patients had malocclusion. In deciduous and mixed dentition (n = 99), increased overjet (75.8%), open bite (51.5%), posterior cross bite (19.2%), and anterior cross bite (3.0%) were identified. Increased overjet was associated with the age group of 2-5 years and mild communication impairment. Anterior open bite was more common in children who underwent tongue interposition, lip interposition, and pacifier sucking. Communication skills, mouth breathing, and tongue interposition were associated with posterior cross bite. Severe malocclusions (DAI > 30) were observed in 88.6% of patients with permanent dentition (n = 35) and were associated with liquid diet consistency and finger sucking. **Conclusion:** The prevalence of malocclusion in individuals with CP was high and associated with demographic, behavioral, and systemic factors.

PMID: [32908512](#)

22. Navigating being a young adult with cerebral palsy: a qualitative study

Gitte Normann, Kirsten Arntz Boisen, Peter Uldall, Anne Brødsgaard

Int J Adolesc Med Health. 2020 Sep 5;/ijamh.ahead-of-print/ijamh-2020-0039/ijamh-2020-0039.xml. doi: 10.1515/ijamh-2020-0039. Online ahead of print.

Objectives Young adults with cerebral palsy (CP) face potential challenges. The transition to young adulthood is characterized by significant changes in roles and responsibilities. Furthermore, young adults with chronic conditions face a transfer from pediatric care to adult healthcare. This study explores how living with CP affects young adults in general, and specifically which psychosocial, medical and healthcare needs are particularly important during this phase of life. **Methods** A qualitative study with data from individual, semi-structured, in-depth interviews with six young adults with CP (ages 21-31 years) were transcribed verbatim and analyzed. The participants were selected to provide a maximum variation in age, gender, Gross Motor Function Classification System score and educational background. A descriptive thematic analysis was used to explore patterns and identify themes. **Results** Three themes were identified: "Being a Young Adult", "Development in Physical Disability and New Challenges in Adulthood" and "Navigating the Healthcare System". The three themes emerged from 15 sub-themes. Our findings emphasized that young adults with CP faced psychosocial challenges in social relationships, participation in education and work settings and striving towards independence. The transition to young adulthood led to a series of new challenges that the young adults were not prepared for. Medical challenges included managing CP-related physical and cognitive symptoms and navigating adult health care services, where new physicians with insufficient knowledge regarding CP were encountered. **Conclusion** The young adults with CP were not prepared for the challenges and changes they faced during their transition into adulthood. They felt that they had been abandoned by the healthcare system and lacked a medical home. Better transitional care is urgently needed to prepare them for the challenges in young adulthood.

PMID: [32887183](#)

23. Comparison of the CHU-9D and the EQ-5D-Y instruments in children and young people with cerebral palsy: a cross-sectional study

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BMJ Open. 2020 Sep 10;10(9):e037089. doi: 10.1136/bmjopen-2020-037089.

Objective: To compare the performance of the EuroQol 5D youth (EQ-5D-Y) and child health utility 9D (CHU-9D) for assessing health-related quality of life (HRQoL) in children and young people (CYP) with cerebral palsy (CP). **Design:** Cross-sectional study. **Setting:** England. **Participants:** Sixty-four CYP with CP aged 10-19 years in Gross Motor Function Classification System (GMFCS) levels I-III. **Main outcome measures:** Missing data were examined to assess feasibility. Associations between utility values and individual dimensions on each instrument were examined to assess convergent validity. Associations between utility values and GMFCS level were examined to assess known-group differences. **Results:** Missing data were <5% for both instruments. Twenty participants (32.3%) and 11 participants (18.0%) reported full health for the EQ-5D-Y and CHU-9D, respectively. There was poor agreement between utilities from the two instruments (intraclass correlation coefficient=0.62; 95% limits of agreement -0.58 to 0.29). Correlations between EQ-5D-Y and CHU-9D dimensions were weak to moderate ($r=0.25$ to 0.59). GMFCS level was associated with EQ-5D-Y utility values but not CHU-9D utility values. **Conclusion:** The EQ-5D-Y and CHU-9D are feasible measures of HRQoL in CYP with CP. However, the two instruments demonstrate poor agreement and should not be used to measure and value HRQoL in CYP with CP interchangeably. We propose that the CHU-9D may be preferable to use in this population as it assesses concepts that influence HRQoL among CYP with CP and provides less extreme utility values than the EQ-5D-Y.

PMID: [32912983](#)

24. The Relationship between the Family Empowerment Scale and Gross Motor Function Measure-66 in Young Children with Cerebral Palsy

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Child Care Health Dev. 2020 Sep 3. doi: 10.1111/cch.12807. Online ahead of print.

Background: Cerebral palsy (CP) is the most common cause of motor disability in children. A concept to consider in order to meet the needs of children with CP and their families is family empowerment. Family empowerment can be defined as the process by which families acquire the skills, knowledge, and resources to allow them to gain control and improve the quality of their lives. The relationship between gross motor function and family empowerment may be important because children with CP vary so widely in their ability to perform motor skills which may affect their family's levels of empowerment. The purpose of this research was to investigate the relationship between the Family Empowerment Scale (FES) and Gross Motor Function Measure-66 (GMFM-66) in children with CP who were under three years of age. **Methods:** Forty-one children with a mean age of 23.8 months participated in this study. The FES was completed by the participants' parents or regular caregivers and includes a total score, and subscales of empowerment in the family, in service situations, and in community/political environments. The GMFM-66 was administered by a physical therapist and consists of a total score of gross motor function (GMFM-66) and subscores for Dimension B (sitting), Dimension C (crawling and kneeling), Dimension D (standing), and Dimension E (walking, running, and jumping). **Results:** Statistically significant positive correlations were found between the FES total and GMFM (total score and Dimensions B-E) with coefficients varying from 0.43-0.62. Significant relationships were also found between most subscales of the FES and the GMFM-66. **Conclusions:** This study provides evidence of a relationship between family empowerment and gross motor function in young children with CP and suggests that caregivers of children with higher gross motor function report higher levels of self-efficacy.

PMID: [32881016](#)

25. Disability, Hospital Care, and Cost: Utilization of Emergency and Inpatient Care by a Cohort of Children with Intellectual and Developmental Disabilities

Scott Lindgren, Emily Lauer, Elizabeth Momany, Tara Cope, Julie Royer, Lindsay Cogan, Suzanne McDermott, Brian S Armour

J Pediatr. 2020 Sep 2;S0022-3476(20)31120-3. doi: 10.1016/j.jpeds.2020.08.084. Online ahead of print.

Objective: To use medical claims data to determine patterns of healthcare utilization in children with intellectual and developmental disabilities, including frequency of service utilization, conditions that require hospital care, and costs. **Study design:** Medicaid administrative claims from four states (Iowa, Massachusetts, New York, and South Carolina) from years 2008-2013 were analyzed, including 108,789 children (75,417 male; 33,372 female) under 18 years with intellectual and developmental disabilities. Diagnoses included cerebral palsy, autism, fetal alcohol syndrome, Down syndrome/trisomy/autosomal deletions, other genetic conditions, and intellectual disability. Utilization of ED and inpatient hospital services were analyzed for 2012. **Results:** Children with intellectual and developmental disabilities used both inpatient and ED care at 1.8 times that of the general population. Epilepsy/convulsions was the most frequent reason for hospitalization at 20 times the relative risk of the general population. Other frequent diagnoses requiring hospitalization were mood disorders, pneumonia, paralysis, and asthma. Annual per capita expenses for hospitalization and ED care were 100% higher for children with intellectual and developmental disabilities, compared with the general population (\$153,348,562 and \$76,654,361, respectively). **Conclusions:** Children with intellectual and developmental disabilities utilize significantly more ED and inpatient care than other children, which results in higher annual costs. Recognizing chronic conditions that increase risk for hospital care can provide guidance for developing outpatient care strategies that anticipate common clinical problems in intellectual and developmental disabilities and ensure responsive management before hospital care is needed.

PMID: [32890584](#)

26. Developmental Remodelling of the Motor Cortex in Hemiparetic Children With Perinatal Stroke

Kayla Baker, Helen L Carlson, Ephrem Zewdie, Adam Kirton

Pediatr Neurol. 2020 Aug 6;112:34-43. doi: 10.1016/j.pediatrneurol.2020.08.004. Online ahead of print.

Background: Perinatal stroke often leads to lifelong motor impairment. Two common subtypes differ in timing, location, and mechanism of injury: periventricular venous infarcts (PVI) are fetal white matter lesions while most arterial ischemic strokes

(AIS) are cortical injuries acquired near term birth. Both alter motor system development and primary motor cortex (M1) plasticity, often with retained ipsilateral corticospinal fibers from the non-lesioned motor cortex (M1'). Methods: Task-based functional magnetic resonance imaging was used to define patterns of motor cortex activity during paretic and unaffected hand movement. Peak coordinates of M1, M1', and the supplementary motor area in the lesioned and intact hemispheres were compared to age-matched controls. Correlations between displacements and clinical motor function were explored. Results: Forty-nine participants included 14 PVI (12.59 ± 3.7 years), 13 AIS (14.91 ± 3.9 years), and 22 controls (13.91 ± 3.4 years). AIS displayed the greatest M1 displacement from controls in the lesioned hemisphere while PVI locations approximated controls. Peak M1' activations were displaced from the canonical hand knob in both PVI and AIS. Extent of M1 and M1' displacement were correlated ($r = 0.50$, $P = 0.025$) but were not associated with motor function. Supplementary motor area activity elicited by paretic tapping was displaced in AIS compared to controls ($P = 0.003$). Conclusion: Motor network components may be displaced in both hemispheres after perinatal stroke, particularly in AIS and those with ipsilateral control of the affected limb. Modest correlations with clinical function may support that more complex models of developmental plasticity are needed to inform targets for individualized neuromodulatory therapies in children with perinatal stroke.

PMID: [32911261](#)

27. Is There a Role for Cerebral Ultrasonography in Near-Term/Term Neonates Following Assisted Vaginal Delivery? A Prospective, Single-Center Study

Martin Poryo, Anika Zimmer, Amr Hamza, Stefan Wagenpfeil, Michael Zemlin, Martina Geipel, Günther Löffler, Sascha Meyer, Erol Tutdibi

Ultraschall Med. 2020 Sep 10. doi: 10.1055/a-1232-1179. Online ahead of print.

Aim: To evaluate the role of cerebral ultrasonography studies (CUSS) in detecting intracerebral and cranial pathologies (hemorrhages, ischemia, skull fractures) in near-term and term neonates following assisted vaginal delivery. Patients and methods: Prospective single-center study (11/2017-11/2018) at the University Children's Hospital of Saarland, Homburg, Germany including newborns with a gestational age ≥ 36 weeks born by assisted vaginal delivery. In all newborns, a standardized CUSS was performed within the first three days of life prior to discharge. Results: 200 neonates (43.0 % female, 57.0 % male; gestational age 39.6 ± 1.3 weeks) were included in this study (birth weight 3345.6 ± 450.6 g, body length 51.7 ± 2.5 cm, head circumference 35.0 ± 1.5 cm). 67 (33.5 %) neonates had minor external injuries of the scalp. 5 children showed clinical neurologic abnormalities: 4 (2.0 %) seizures and 1 facial palsy (0.5 %). In 34 (17.0 %) patients, minor incidental intracranial abnormalities unrelated to mode of delivery were detected on CUSS. No intracerebral, cranial pathologies or skull fractures were seen on routine CUSS. Conclusion: Routine CUSS in newborns after assisted vaginal delivery did not yield clinically relevant results in our cohort. Clinical observation and selective CUSS in symptomatic newborns might be more efficient than routine CUSS.

PMID: [32911558](#)

28. International consensus recommendations on the diagnostic work-up for malformations of cortical development

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Review Nat Rev Neurol. 2020 Sep 7. doi: 10.1038/s41582-020-0395-6. Online ahead of print.

Malformations of cortical development (MCDs) are neurodevelopmental disorders that result from abnormal development of the cerebral cortex in utero. MCDs place a substantial burden on affected individuals, their families and societies worldwide, as these individuals can experience lifelong drug-resistant epilepsy, cerebral palsy, feeding difficulties, intellectual disability and other neurological and behavioural anomalies. The diagnostic pathway for MCDs is complex owing to wide variations in presentation and aetiology, thereby hampering timely and adequate management. In this article, the international MCD network Neuro-MIG provides consensus recommendations to aid both expert and non-expert clinicians in the diagnostic work-up of MCDs with the aim of improving patient management worldwide. We reviewed the literature on clinical presentation, aetiology and diagnostic approaches for the main MCD subtypes and collected data on current practices and recommendations from clinicians and diagnostic laboratories within Neuro-MIG. We reached consensus by 42 professionals from 20 countries, using expert discussions and a Delphi consensus process. We present a diagnostic workflow that can be applied to any

individual with MCD and a comprehensive list of MCD-related genes with their associated phenotypes. The workflow is designed to maximize the diagnostic yield and increase the number of patients receiving personalized care and counselling on prognosis and recurrence risk.

PMID: [32895508](#)

29. Animal models for neonatal brain injury induced by hypoxic ischemic conditions in rodents

Nancy Hamdy, Sarah Eide, Hong-Shuo Sun, Zhong-Ping Feng

Review Exp Neurol. 2020 Sep 1;113457. doi: 10.1016/j.expneurol.2020.113457. Online ahead of print.

Neonatal hypoxia-ischemia and resulting encephalopathies are of significant concern. Intrapartum asphyxia is a leading cause of neonatal death globally. Among surviving infants, there remains a high incidence of hypoxic-ischemic encephalopathy due to neonatal hypoxic-ischemic brain injury, manifesting as mild conditions including attention deficit hyperactivity disorder, and debilitating disorders such as cerebral palsy. Various animal models of neonatal hypoxic brain injury have been implemented to explore cellular and molecular mechanisms, assess the potential of novel therapeutic strategies, and characterize the functional and behavioural correlates of injury. Each of the animal models has individual advantages and limitations. The present review looks at several widely-used and alternative rodent models of neonatal hypoxia and hypoxia-ischemia; it highlights their strengths and limitations, and their potential for continued and improved use.

PMID: [32889009](#)

30. Developmental neuroplasticity of the white-matter connectome in children with perinatal stroke

Brandon T Craig, Alicia Hilderley, Eli Kinney-Lang, Xiangyu Long, Helen L Carlson, Adam Kirton

Neurology. 2020 Sep 4;10.1212/WNL.000000000010669. doi: 10.1212/WNL.000000000010669. Online ahead of print.

Objective: We aimed to employ diffusion imaging connectome methods to explore network development in the contralesional hemisphere of children with perinatal stroke and its relationship to clinical function. We hypothesized alterations in global efficiency of the intact hemisphere would correlate with clinical disability. **Methods:** Children with unilateral perinatal arterial (n = 26) or venous (n = 27) stroke and typically developing controls (n = 32) underwent 3T diffusion and T1 anatomical MRI and completed established motor assessments. A validated atlas co-registered to whole-brain tractography for each individual was used to estimate connectivity between 47 regions. Graph theory metrics (assortativity, hierarchical coefficient of regression, global and local efficiency, and small worldness) were calculated for the left hemisphere of controls and the intact contralesioned hemisphere of both stroke groups. Validated clinical motor assessments were then correlated with connectivity outcomes. **Results:** Global efficiency was higher in arterial strokes compared to venous strokes ($p < 0.001$) and controls ($p < 0.001$) and was inversely associated with all motor assessments (all $p < 0.012$). Additional graph theory metrics including assortativity, hierarchical coefficient of regression, and local efficiency also demonstrated consistent differences in the intact hemisphere associated with clinical function. **Conclusions:** The structural connectome of the contralesional hemisphere is altered after perinatal stroke and correlates with clinical function. Connectomics represents a powerful tool to understand whole brain developmental plasticity in children with disease-specific cerebral palsy.

PMID: [32887781](#)

31. Long term therapeutic effects of Katona therapy in moderate to severe perinatal brain damage

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Neurosci Lett. 2020 Aug 31;135345. doi: 10.1016/j.neulet.2020.135345. Online ahead of print.

Aim: To determine the long term efficacy of Katona therapy and early rehabilitation of infants with moderate to severe

perinatal brain damage (PBD). Methods: Thirty two participants were recruited (7-16 years) and divided into 3 groups: one Healthy group (n = 11), one group with PBD treated with Katona methodology from 2 months of corrected age, and with long term follow up (n = 12), and one group with PBD but without treatment in the first year of life due to late diagnosis of PBD (n = 9). Neuropediatric evaluations, motor evoked potentials (MEPs) and magnetic resonance images (MRI) were made. The PBD groups were matched by severity and topography of lesion. Results: The patients treated with Katona had better motor performance when compared to patients without early treatment (Gross Motor Function Classification System levels; 75% of Katona group were classified in levels I and II and 78% of patients without early treatment were classified in levels III and IV). Furthermore, independent k means cluster analyses of MRI, MEPs, and neuropediatric evaluations data were performed. Katona and non treated early groups were classified in the same MRI cluster which is the expected for patient's population with PBD. However, in MEPs and neuropediatric evaluations clustering, the 67% of Katona group were assigning into Healthy group showing the impact of Katona therapy over the patients treated with it. These results highlight the Katona therapy benefits in early rehabilitation of infants with moderate to severe PBD. Conclusions: Katona therapy and early rehabilitation have an important therapeutic effect in infants with moderate to severe PBD by decreasing the severity of motor disability in later stages of life.

PMID: [32882316](#)

Prevention and Cure

32. Optimal timing of antenatal corticosteroid administration and preterm neonatal and early childhood outcomes

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Am J Obstet Gynecol MFM. 2020 Feb;2(1):100077. doi: 10.1016/j.ajogmf.2019.100077. Epub 2019 Dec 17.

Background: Antenatal corticosteroids reduce morbidity and mortality among preterm neonates. However, the optimal timing of steroid administration with regards to severe neonatal and early childhood morbidity is uncertain. **Objective:** To evaluate the association between the timing of antenatal corticosteroid administration and preterm outcomes. We hypothesized that neonates exposed to antenatal corticosteroids 2 to <7 days before delivery would have the lowest risks of neonatal and childhood morbidity. **Study design:** Secondary analysis of two prospective multicenter studies enriched for spontaneous preterm birth, Genomics and Proteomics Network for Preterm Birth Research (11/2007-1/2011) and Beneficial Effect of Antenatal Magnesium (12/1997-5/2004). We included women with singleton gestations who received antenatal corticosteroids and delivered at 23 0/7-33 6/7 weeks' gestation. Women who received ≥ 1 course of corticosteroids were excluded. Neonatal outcomes were compared by the timing of the first dose of antenatal corticosteroids in relation to delivery: <2 days, 2 to <7 days, 7 to <14 days, and ≥ 14 days. The primary outcome was respiratory distress syndrome. Secondary outcomes included composite neonatal morbidity (death, intraventricular hemorrhage grade III or IV, periventricular leukomalacia, bronchopulmonary dysplasia, or necrotizing enterocolitis), and early childhood morbidity (death or moderate to severe cerebral palsy at age 2). Multivariable logistic regression estimated the association between timing of antenatal corticosteroid administration and study outcomes. **Results:** A total of 2,259 subjects met inclusion criteria: 622 (27.5%) received antenatal corticosteroids <2 days before delivery, 821 (36.3%) 2 to <7 days, 401 (17.8%) 7 to <14 days, and 415 (18.4%) ≥ 14 days. The majority (78.1%) delivered following idiopathic spontaneous preterm labor or preterm premature rupture of membranes at a mean gestational age of 29.5 \pm 2.8 weeks. Neonates exposed to antenatal corticosteroids 2 to <7 days before delivery were the least likely to develop respiratory distress syndrome (51.3%), compared to those receiving antenatal corticosteroids <2 days, 7 to <14 days, and ≥ 14 days before delivery (62.7%, 55.9%, and 57.6%, respectively, $p < 0.001$). Compared to receipt 2 to <7 days before delivery, there was an increased odds of respiratory distress syndrome with receipt of antenatal corticosteroids <2 days (aOR 2.07, 95%CI 1.61-2.66), 7 to <14 days (aOR 1.40, 95% CI 1.07-1.83), and ≥ 14 days (aOR 2.34, 95%CI 1.78-3.07). Neonates exposed to antenatal corticosteroids ≥ 14 days before delivery were at increased odds for severe neonatal morbidity (aOR 1.57, 95%CI 1.12-2.19) and early childhood morbidity (aOR 1.74, 95%CI 1.02-2.95), compared to those exposed 2 to <7 days before delivery. There was no significant association between antenatal corticosteroid receipt <2 days or 7 to <14 days and severe neonatal morbidity or severe childhood morbidity. **Conclusions:** Preterm neonates exposed to antenatal corticosteroids 2 to <7 days before delivery had the lowest odds of respiratory distress syndrome, compared to shorter and longer time intervals between steroid administration and delivery. Antenatal corticosteroid administration ≥ 14 days before delivery is associated with an increased odds of severe neonatal and childhood morbidity, compared to 2 to <7 days before delivery. These results emphasize the importance of optimally timed antenatal corticosteroids to improve both short- and long-term outcomes.

PMID: [32905377](#)