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## Interventions and Management

### 1. The selective dorsal rhizotomy technique for spasticity in 2020: a review

Rick Abbott

Childs Nerv Syst. 2020 Jul 9. doi: 10.1007/s00381-020-04765-6. Online ahead of print.

This review looks at the advances in the surgical technique, selective dorsal rhizotomy, used for the management of spasticity in children.

PMID: [32642977](#)

### 2. Selective dorsal rhizotomy: functional anatomy of the conus-cauda and essentials of intraoperative neurophysiology

Claudia Pasquali, Vedran Deletis, Francesco Sala

Childs Nerv Syst. 2020 Jul 7. doi: 10.1007/s00381-020-04746-9. Online ahead of print.

**Introduction:** Spasticity is the result of an exaggeration of the monosynaptic muscle stretch reflex due to lesions affecting the central nervous system, in particular an upper motor neuron lesion. Selective dorsal rhizotomy (SDR) is a surgical technique developed to treat spastic diplegia, one of the common forms of cerebral palsy, resulting from the lack of supraspinal inhibitory controls. The aim of SDR is to identify and cut a critical amount of the sensory rootlets, in particular those contributing the most to spasticity, in order to relieve the patient from lower limb spasticity while preserving motor strength and sphincter control. Various surgical techniques to perform SDR have been proposed over time. Similarly, intraoperative neurophysiology (ION)-first introduced by Fasano and colleagues in 1976-is a safe and effective tool to guide the surgeon in the procedure of SDR, but different ION strategies are used by different authors, and the value of ION itself has been questioned. **Methods:** The purpose of this paper is to review the anatomo-physiological background of SDR, the historical development of the surgical technique, and the essential principles of ION. **Results:** While some surgeons privilege a single-level approach and others a multi-level approach, nowadays, there are still neither agreement nor guidelines on the percentage of roots to be cut. Rather, a tailored approach based on both the preoperative functional status as well as intraoperative ION findings seems reasonable. ION is considered not essential to decide the percentage of roots to cut, but it assists to distinguish between ventral and dorsal roots, and to preserve sphincter function, whenever S2 rootlets are included in SDR. **Conclusions:** To optimize the balance between reduction of spasticity and preservation of motor strength while minimizing the neurological damage remains the main goal of SDR.

PMID: [32638074](#)

### 3. Symptomatic cervical spinal stenosis in spastic cerebral palsy

Chun Wai Hung, Hiroko Matsumoto, Jacob R Ball, Stephen Plachta, Joseph P Dutkowsky, Heakyung Kim, Joshua E Hyman, K Daniel Riew, David P Roye

Dev Med Child Neurol. 2020 Jul 8. doi: 10.1111/dmcn.14607. Online ahead of print.

**Aim:** To describe the prevalence of symptomatic cervical spinal stenosis (CSS) in spastic cerebral palsy (CP) and associated characteristics. **Method:** This cross-sectional study of adults (>18y) with CP (2006-2016) at a single institution compared the patient characteristics (demographics, comorbidities, surgical history, medications, Gross Motor Function Classification System [GMFCS] level, and CP type) of patients with and without CSS. **Results:** Of 424 patients (mean age 33y 4mo, SD 13y 6mo, range 18-78y; 225 females, 199 males), 32 patients (7.5%) had symptomatic CSS. GMFCS levels in the study cohort were distributed as follows: level I, 25%; level II, 25%; level III, 22%; level IV, 19%; level V, 9%. Twenty-five out of 32 (78.1%) patients had spastic CP, two (6.3%) had dystonic CP, and one (3.1%) had mixed characteristics. Individuals with CSS were older (mean age 54y 6mo, SD 10y 5mo vs mean age 31y 7mo, SD 12y 1mo,  $p<0.05$ ) and had a higher body mass index (26.1, SD 4.8 vs 23.4, SD 6.2,  $p<0.05$ ) than those without CSS. Presentations included upper-extremity symptoms (73%), ambulation decline (70%), neck pain (53%), and incontinence (30%). Common stenosis levels were C5-C6 (59%), C4-C5 (56%), and C6-C7 (53%). **Interpretation:** Symptomatic CSS was identified in 7.5% of this adult cohort during the 2006 to 2016 period. Diagnosis in CP is difficult due to impaired communication and pre-existing gait abnormalities and spasticity. Given the high prevalence of symptomatic CSS in adults, we propose developing screening guidelines. Physicians must maintain a high level of suspicion for CSS if patients present with changes in gait or spasticity.

PMID: [32639039](#)

### 4. Clinical factors associated with mood affective disorders among adults with cerebral palsy

Daniel G Whitney, Seth A Warschausky, Daniel Whibley, Anna Kratz, Susan L Murphy, Edward A Hurvitz, Mark D Peterson

Neurol Clin Pract. 2020 Jun;10(3):206-213. doi: 10.1212/CPJ.0000000000000721.

**Objective:** To determine individual and aggregated associations of cerebral palsy (CP)-related symptoms and the effect of comorbid neurodevelopmental conditions on mood (affective) disorders among adults with CP. **Methods:** Cross-sectional data from 2016 were extracted from a random 20% sample of the Medicare fee-for-service database. International Classification of Diseases, Tenth Revision, Clinical Modification diagnosis codes were used to identify 18- to -64-year-old beneficiaries with CP, as well as mood (affective) disorders, pain, sleep disorders, fatigue, and comorbid neurodevelopmental conditions (intellectual disabilities [ID], autism spectrum disorders [ASD], and epilepsy). **Results:** Four thousand eight hundred twenty-three of the 17,212 adults with CP had mood (affective) disorders (28.0%). After adjusting for age, sex, and race, pain (odds ratio [OR] = 2.15; 99.5% confidence interval [CI] = 1.94-2.39), sleep disorders (OR = 2.43; 99.5% CI = 2.13-2.77), fatigue (OR = 1.38; 99.5% CI = 1.18-1.60), ID (OR = 1.47; 99.5% CI = 1.31-1.63), ASD (OR = 1.44; 99.5% CI = 1.16-1.80), and epilepsy (OR = 0.81; 99.5% CI = 0.73-0.91) were each associated with mood (affective) disorders. When pain, sleep disorders, and fatigue were presented as a count variable, the adjusted odds of mood (affective) disorders increased with the number of factors: 1 factor (OR = 1.99; 99.5% CI = 1.79-2.22), 2 factors (OR = 4.18; 99.5% CI = 3.58-4.89), and all 3 factors (OR = 7.38; 99.5% CI = 5.17-10.53). **Conclusions:** Among young and middle-aged adults with CP, mood (affective) disorders were associated with pain, sleep disorders, and fatigue, and increasing co-occurrence of these factors further increased the likelihood of mood (affective) disorders. Further, comorbid neurodevelopmental conditions were also associated with mood (affective) disorders among adults with CP. Study findings could be used to improve screening strategies for mood (affective) disorders among adults with CP in the clinical setting.

PMID: [32642322](#)

### 5. Alteration of Emotion Knowledge and Its Relationship with Emotion Regulation and Psychopathological Behavior in Children with Cerebral Palsy

Saliha Belmonte-Darraz, Casandra I Montoro, Nara C Andrade, Pedro Montoya, Inmaculada Riquelme

J Autism Dev Disord. 2020 Jul 9. doi: 10.1007/s10803-020-04605-1. Online ahead of print.

Emotion knowledge has not been explored in children with cerebral palsy (CP). To evaluate differences in emotion knowledge between children with CP and their typically developing peers (TDP), and explore its associations with affective regulation and behavioral psychopathology. 36 Children with CP and 45 TDP completed the Emotion Matching Task (emotion knowledge); their parents completed the Emotion Regulation Checklist and Child Behavior Checklist (emotional regulation and lability; psychopathological behaviors). Children with CP made more mistakes in emotion knowledge tasks, had lower emotional regulation and higher behavioral problems than their TDP. Emotion knowledge showed a positive correlation with emotional regulation and a negative correlation with behavioral problems, predicting psychopathological behaviors. Greater attention to emotion knowledge in children with CP could improve adjustment at social and behavioral functioning.

PMID: [32648147](#)

## 6. Prevalence of overweight and obesity in Irish ambulant children with cerebral palsy

Damien Kiernan, Charikleia Nikolopoulou, Karen Brady

Ir J Med Sci. 2020 Jul 6. doi: 10.1007/s11845-020-02294-4. Online ahead of print.

Background: Children with cerebral palsy may be at greater risk of being overweight or obese than their typically developed peers due to a number of biomechanical, behavioural, or medical issues that restrict participation. It has been a concern of our multi-disciplinary team that a greater number of children with cerebral palsy were presenting as overweight or obese. However, there are conflicting results in the literature as to prevalence and trends of overweight and obesity in these children. Aims: To assess the prevalence of overweight and obesity in children with cerebral palsy presenting to our movement analysis laboratory over a 20-year time period. Methods: A retrospective analysis was conducted of the laboratory database. Inclusion criteria were ambulatory children with a diagnosis of spastic cerebral palsy aged between 4 and 17 years inclusive. Height, weight, physical classification of cerebral palsy and functional level of impairment were extracted. Body mass index was calculated and data were analysed according to 4- × 5-year time periods. Results: There were 1021 children included in this study. There were no significant findings for increasing trends of overweight and obesity across time. Prevalence of obesity and combined overweight and obesity in the most recent time period (2015-2019) was 7.1% and 20% respectively. Conclusions: Prevalence of overweight and obesity is not increasing in Irish ambulatory children with cerebral palsy. However, a higher prevalence of overweight and obesity was evident when compared with their typically developed Irish peers. It is therefore important that prevalence and trends are monitored.

PMID: [32632738](#)

## 7. Sleep quantity and its relation with physical activity in children with cerebral palsy; insights using actigraphy

Denise J M Smit, Marenka Zwinkels, Tim Takken, Raquel Y Hulst, Janke F de Groot, Kristel Lankhorst, Olaf Verschuren

J Paediatr Child Health. 2020 Jul 6. doi: 10.1111/jpc.15055. Online ahead of print.

Aim: To objectively assess the sleep quantity, and explore the relationships between sleep quantity and quality, and physical activity and sedentary behaviour in children and adolescents with cerebral palsy (CP). Methods: An observational cross-sectional study was conducted. In total, 36 children with spastic CP (mean age 15y 4mo, SD 2y 6mo; classified as Gross Motor Function Classification System levels I (25), II (9), III (1) and IV (1)) were included. Active time, sedentary time and sleep quantity were measured using an activity monitor for 7 consecutive days. Results: Total sleep duration of children with CP ranged between 7.2 and 11.2 h. No significant correlations were found between active time and sleep quantity for total week, weekdays, and weekend days. Moderate negative correlations were found between sedentary time and sleep quantity during total week ( $r = -0.456$ ,  $P = 0.005$ ), weekdays ( $r = -0.453$ ,  $P = 0.006$ ) and weekend days ( $r = -0.48$ ,  $P = 0.003$ ). Conclusions: Our findings suggest that children with CP are getting the recommended sleep duration, and that sedentary behaviour is correlated with sleep quantity in children with CP and may be more applicable to children with better motor functions. Future studies using more elaborate, objective sleep quantity and quality measures are recommended.

PMID: [32627283](#)

## 8. Risk factors of malnutrition in children with severe motor and intellectual disabilities

Mari Hasegawa, Kiyotaka Tomiwa, Yukie Higashiyama, Chiharu Kawaguchi, Hajime Kin, Masaru Kubota, Midori Shima, Keiji Nogami

Brain Dev. 2020 Jul 2;S0387-7604(20)30173-X. doi: 10.1016/j.braindev.2020.06.009. Online ahead of print.

**Background:** Children with severe motor and intellectual disabilities (SMID) are at a high risk of malnutrition and often require tube feeding to maintain their nutritional status. However, determining their energy requirements is difficult since inadequate dietary intake, severe neurological impairment, respiratory assistance, and cognitive impairment are all factors that affect malnutrition in SMID. **Aim:** This study investigated the factors affecting malnutrition and identified problems affecting the nutritional status of children with SMID. **Methods:** Forty-two children with SMID with oral motor dysfunction who were receiving home medical care at one of four hospitals were enrolled. Their nutritional status was assessed using a 3-day dietary record, anthropometric measurements, and laboratory tests. The clinical findings associated with malnutrition were compared, and a body mass index (BMI) z-score less than -2SD was defined as malnutrition. The relationship between BMI z-score and other potential predictors was also investigated. **Results:** Thirty-three (79%) children received tube feeding, and 20 (48%) experienced malnutrition. The median age of the malnourished children was older than that of non-malnourished children. Respiratory assistance was significantly correlated with higher BMI z-score, independent of other potential confounders such as nutrition method, muscle tonus, and energy intake. Cholesterol levels were significantly higher in children receiving a standard infant formula beyond 3 years of age than in those who switched to enteral formula before 3 years of age. **Conclusions:** Malnutrition in children with SMID was mainly associated with age or respiratory condition. Energy requirements should be regularly re-evaluated with considering these factors.

PMID: [32624241](#)

### **9. Gait improvements by assisting hip movements with the robot in children with cerebral palsy: a pilot randomized controlled trial**

Shihomi Kawasaki, Koji Ohata, Takeshi Yoshida, Atsushi Yokoyama, Shigehito Yamada

J Neuroeng Rehabil. 2020 Jul 3;17(1):87. doi: 10.1186/s12984-020-00712-3.

**Background:** Recently, rehabilitation robots are expected to improve the gait of cerebral palsy (CP) children. However, only few previous studies have reported the kinematic and kinetic changes by using wearable exoskeleton robots. The aim of this study was to investigate the change in gait parameters in CP children by training with the wearable robot-assisted gait training. **Methods:** 10 spastic CP children with Gross Motor Function Classification Scale levels I-III completed a sham-controlled crossover randomized trial. Robot-assisted gait training (RAGT) and non-assisted gait training (NAGT) were performed on the treadmill with the Honda Walking Assist (HWA) in two different days. To examine the carry-over effect from treadmill walking to overground walking, participants also performed 5.5 m overground-walks without the HWA before and after treadmill training (pre- and post-trial). During treadmill walking, peak of both hip and knee angles were measured. Also, we calculated the limb symmetry of hip range of motion. In addition, gait speed and ground reaction force were measured in overground trials. **Results:** The maximum hip angle on the limb with fewer hip movements, which was defined as the affected limb, showed a significant interaction between ASSIST (RAGT and NAGT) and TIME (pre- and post-trial) ( $p < 0.05$ ). Limb symmetry significantly improved after RAGT ( $p < 0.05$ ), but not in NAGT. Furthermore, the affected limb showed a significant increase in the positive peak of the anterior-posterior ground reaction force during 70-100% of the gait cycle ( $p < 0.05$ ). However, there was no change in gait speed. **Conclusion:** By assisting the both hip movements with the HWA, maximum hip flexion and extension angle of the affected limb improved. Also, limb symmetry and propulsion force of the affected limb improved. Our results suggest that assisting both hip movements with the HWA might be an effective method for improving gait in CP children. Trial registration: UMIN-CTR, UMIN000030667. Registered 3 January 2018, [https://upload.umin.ac.jp/cgi-open-bin/ctr\\_e/ctr\\_view.cgi?recptno=R000033737](https://upload.umin.ac.jp/cgi-open-bin/ctr_e/ctr_view.cgi?recptno=R000033737).

PMID: [32620131](#)

### **10. Improved Active Disturbance Rejection Control for Trajectory Tracking Control of Lower Limb Robotic Rehabilitation Exoskeleton**

Sumit Aole, Irraivan Elamvazuthi, Laxman Waghmare, Balasaheb Patre, Fabrice Meriaudeau

Sensors (Basel). 2020 Jun 30;20(13):E3681. doi: 10.3390/s20133681.

Neurological disorders such as cerebral paralysis, spinal cord injuries, and strokes, result in the impairment of motor control and induce functional difficulties to human beings like walking, standing, etc. Physical injuries due to accidents and muscular weaknesses caused by aging affect people and can cause them to lose their ability to perform daily routine functions. In order to help people recover or improve their dysfunctional activities and quality of life after accidents or strokes, assistive devices like exoskeletons and orthoses are developed. Control strategies for control of exoskeletons are developed with the desired intention of improving the quality of treatment. Amongst recent control strategies used for rehabilitation robots, active disturbance rejection control (ADRC) strategy is a systematic way out from a robust control paradox with possibilities and promises. In this modern era, we always try to find the solution in order to have minimum resources and maximum output, and in robotics-control, to approach the same condition observer-based control strategies is an added advantage where it uses a state estimation method which reduces the requirement of sensors that is used for measuring every state. This paper introduces improved active disturbance rejection control (I-ADRC) controllers as a combination of linear extended state observer (LESO), tracking differentiator (TD), and nonlinear state error feedback (NLSEF). The proposed controllers were evaluated through simulation by investigating the sagittal plane gait trajectory tracking performance of two degrees of freedom, Lower Limb Robotic Rehabilitation Exoskeleton (LLRRE). This multiple input multiple output (MIMO) LLRRE has two joints, one at the hip and other at the knee. In the simulation study, the proposed controllers show reduced trajectory tracking error, elimination of random, constant, and harmonic disturbances, robustness against parameter variations, and under the influence of noise, with improvement in performance indices, indicates its enhanced tracking performance. These promising simulation results would be validated experimentally in the next phase of research.

PMID: [32630115](#)

### **11. Neurodynamics of Patients during a Dolphin-Assisted Therapy by Means of a Fractal Intra-neural Analysis**

Oswaldo Morales Matamoros, Jesús Jaime Moreno Escobar, Ricardo Tejeida Padilla, Ixchel Lina Reyes

Brain Sci. 2020 Jun 25;10(6):E403. doi: 10.3390/brainsci10060403.

The recent proliferation of sensor technology applications in therapies for children's disabilities to promote positive behavior among such children has produced optimistic results in developing a variety of skills and abilities in them. Dolphin-Assisted Therapy (DAT) has also become a topic of public and research interest for these disorders' intervention and treatment. This work exposes the development of a system that controls brain-computer interaction when a patient with different abilities undergoes a DAT. To develop the proposed system, TGAM1, i.e., ThinkGear-AM1 series of NeuroSky company, was used, connecting it to an isolated Bluetooth 4.0 communication protocol from a brackish and humid environment, and a Notch Filter was applied to reduce the input noise. In this way, at Definiti Ixtapa-Mexico facilities, we explored the behavior of three children with Infantile Spastic Cerebral Palsy (Experiment 1), as well as the behavior of Obsessive Compulsive Disorder and neurotypical children (Experiment 2). This was done applying the Power Spectrum Density (PSD) and the Self-Affine Analysis (SSA) from Electroencephalogram (EEG) biosignals. The EEG Raw data were time series showing the cerebral brain activity (voltage versus time) before and during DAT for the Experiment 1, and before, during DAT and after for the Experiment 2. Likewise, the EEG RAW data were recorded by the first frontopolar electrode (FP1) by means of an EEG biosensor TGAM1 Module. From the PSD we found that in all child patients a huge increment of brain activity during DAT regarding the before and after therapy periods around 376.28%. Moreover, from the SSA we found that the structure function of the all five child patients displayed an antipersistent behavior, characterized by  $\sigma \propto \delta t^H$ , for before, during DAT and after. Nonetheless, we propose that one way to assess whether a DAT is being efficient to the child patients is to increase the during DAT time when the samples are collected, supposing the data fitting by a power law will raise the time, displaying a persistent behavior or positive correlations, until a crossover appears and the curve tends to be horizontal, pointing out that our system has reached a stationary state.

PMID: [32630512](#)

### **12. Using different definitions affected the reported prevalence of neurodevelopmental impairment in children born very preterm**

Sirkku Setänen, Ylva Fredriksson Kaul, Martin Johansson, Cecilia Montgomery, Nima Naseh, Gerd Holmström, Katarina Strand-Brodd, Lena Hellström-Westas



Acta Paediatr. 2020 Jul 8. doi: 10.1111/apa.15464. Online ahead of print.

**Aim:** We investigated the impact of varying definitions on the prevalence of neurodevelopmental impairment (NDI) in children born very preterm at 6.5 years of age. **Methods:** Cognitive development and neurosensory impairments were assessed in 91 children (40/51 girls/boys) born <32 gestational weeks, in 2004-2007 in Uppsala county, Sweden. The results were compared with data from a reference group of 67 children born full term. The prevalence of NDI in the present cohort was reported according to definitions used by seven contemporary studies of children born very or extremely preterm. **Results:** The prevalence of severe NDI varied from 2% to 23% depending on the definition used. The prevalence of cognitive impairment varied from 2% (-3 SD according to test norms) to 16% (-2 SD according to control group), the prevalence of cerebral palsy from 0% (severe) to 9% (any), and the prevalence of severe visual impairment from 0% (blindness) to 1% (visual acuity <0.3). There were no children with severe hearing impairment. **Conclusion:** A high variability in definitions affect the reporting of the prevalence of NDI in long-term follow-up studies of very or extremely preterm born children. There is a need for a better consensus to enable comparisons across studies.

PMID: [32640081](#)

### **13. Nomogram for pneumonia prediction among children and young people with cerebral palsy: A population-based cohort study**

Tsu Jen Kuo, Chiao-Lin Hsu, Pei-Hsun Liao, Shih-Ju Huang, Yao-Min Hung, Chun-Hao Yin

PLoS One. 2020 Jul 6;15(7):e0235069. doi: 10.1371/journal.pone.0235069. eCollection 2020.

**Background:** Pneumonia is the leading cause of death among children and young people (CYP) with severe cerebral palsy (CP). Only a few studies used nomogram for assessing risk factors and the probability of pneumonia. Therefore, we aimed to identify risk factors and devise a nomogram for identifying the probability of severe pneumonia in CYP with severe CP. **Methods:** This retrospective nationwide population-based cohort study examined CYP with newly diagnosed severe CP before 18 years old between January 1st, 1997 and December 31st, 2013 and followed them up through December 31st, 2013. The primary endpoint was defined as the occurrence of severe pneumonia with  $\geq 5$  days of hospitalization. Logistic regression analysis was used for determining demographic factors and comorbidities associated with severe pneumonia. These factors were assigned integer points to create a scoring system to identify children at high risk for severe pneumonia. **Results:** Among 6,356 CYP with newly diagnosed severe CP, 2,135 (33.59%) had severe pneumonia. Multivariable logistic regression analysis revealed that seven independent predictive factors, namely age <3 years, male sex, and comorbidities of pressure ulcer, gastroesophageal reflux, asthma, seizures, and perinatal complications. A nomogram was devised by employing these seven significant predictive factors. The prediction model presented favorable discrimination performance. **Conclusions:** The nomogram revealed that age, male sex, history of pressure ulcer, gastroesophageal reflux, asthma, seizures, and perinatal complications were potential risk factors for severe pneumonia among CYP with severe CP.

PMID: [32628682](#)

### **14. Over 25 Years of Pediatric Botulinum Toxin Treatments: What Have We Learned from Injection Techniques, Doses, Dilutions, and Recovery of Repeated Injections?**

Heli Sätälä

Review Toxins (Basel). 2020 Jul 6;12(7):E440. doi: 10.3390/toxins12070440.

Botulinum toxin type A (BTXA) has been used for over 25 years in the management of pediatric lower and upper limb hypertonia, with the first reports in 1993. The most common indication is the injection of the triceps surae muscle for the correction of spastic equinus gait in children with cerebral palsy. The upper limb injection goals include improvements in function, better positioning of the arm, and facilitating the ease of care. Neurotoxin type A is the most widely used serotype in the pediatric population. After being injected into muscle, the release of acetylcholine at cholinergic nerve endings is blocked, and a temporary denervation and atrophy ensues. Targeting the correct muscle close to the neuromuscular junctions is considered essential and localization techniques have developed over time. However, each technique has its own limitations. The role of BTXA is flexible, but limited by the temporary mode of action as a focal spasticity treatment and the restrictions on the total dose deliverable per visit. As a mode of treatment, repeated BTXA injections are needed. This literature reviewed BTXA injection techniques, doses and dilutions, the recovery of muscles and the impact of repeated injections, with a focus on

the pediatric population. Suggestions for future studies are also discussed.

PMID: [32640636](#)

### **15. [Effect of Baixiao moxibustion at meridian sinew nodal points on upper limb motor function in children with spastic hemiplegic cerebral palsy] [Article in Chinese]**

Wei Luo, Chun-Lei Liu, Yan Long, Fei-Fei Chen, Su-Fen Zhao, Yong Yang, Sha Fu, Pao-Qiu Wang

Zhen Ci Yan Jiu. 2020 Jun 25;45(6):480-3. doi: 10.13702/j.1000-0607.190585.

**Objective:** To investigate the effect of Baixiao moxibustion at meridian sinew nodal points combined with routine rehabilitation on upper limb motor function in children with spastic hemiplegic cerebral palsy. **Methods:** A total of 50 children with spastic hemiplegic cerebral palsy were divided into control group and treatment group using a random number table, with 25 children in each group. The children in the control group were given routine rehabilitation training of the ipsilateral upper and lower limbs, and those in the treatment group were given Baixiao moxibustion at the meridian sinew nodal points of the ipsilateral upper limb in addition to the treatment in the control group, once a day and five times a week. Each course of treatment was 4 consecutive weeks, and both groups were treated for 3 courses. Before treatment and at weeks 4 and 12 of treatment, modified Ashworth score was used to evaluate muscle tension of the ipsilateral upper limb, and 88-item version of the Gross Motor Function Measure (GMFM-88) and Carroll upper extremities functional test (UEFT) were used to assess the motor function of the ipsilateral upper limb. **Results:** At weeks 4 and 12 of treatment, both groups had a significant reduction in modified Ashworth score ( $P < 0.05$ ) and significant increases in GMFM-88 and UEFT scores ( $P < 0.05$ ). Both groups had significant changes in modified Ashworth score, GMFM-88 score, and UEFT score from week 4 to week 12 of treatment ( $P < 0.05$ ). Compared with the control group at week 12 of treatment, the treatment group had a significant reduction in modified Ashworth score ( $P < 0.05$ ) and significant increases in GMFM-88 and UEFT scores ( $P < 0.05$ ). **Conclusion:** Baixiao moxibustion at meridian sinew nodal points can significantly improve the muscle tension and motor function of the ipsilateral upper limb in children with spastic hemiplegic cerebral palsy, and the improvement becomes more apparent as the treatment lasts longer.

PMID: [32643885](#)

### **16. Invasive Home Mechanical Ventilation: 10-Year Experience of a Pediatric Home Care Service**

Eliza Fernanda Borges, Laerte Honorat Borges-Júnior, Antônio José Lana Carvalho, Hyster Martins Ferreira, Wallisen Tadashi Hattori, Vivian Mara Gonçalves de Oliveira Azevedo

Respir Care. 2020 Jul 7;respcare.07406. doi: 10.4187/respcare.07406. Online ahead of print.

**Background:** Children dependent on invasive home mechanical ventilation (HMV) represent a growing population worldwide. The objective of this study was to assess the experience of 10 years of medical assistance given to pediatric patients on continuous invasive HMV at a Brazilian Home Care Service (HCS), specifically patient characteristics and predictors of outcome (ie, hospital readmission, death, and location of death). **Methods:** Medical records for children on invasive HMV at the HCS between 2007 and 2016 were evaluated to collect the following data: age at admission to HCS, sex, principal diagnosis, length of hospital admission and home care period, number and cause of hospital readmissions, number of procedures, death and location of death. The odds ratio was used to understand the likelihood of death for each diagnosis, hospital readmission, and admission age, using a binary logistic regression model. **Results:** Twenty-seven children were evaluated. The most prevalent diagnosis was cerebral palsy (37.0%). The mean duration of home care was higher than the mean hospital length of stay ( $955.0 \pm 4.6$  d versus  $341.0 \pm 0.5$  d, respectively). First hospital readmission mean was at  $392.6 \pm 548.9$  d, and the main cause was respiratory tract infection (45.9%), especially tracheitis. Of the total number of deaths (13), 76.9% occurred in hospital units. There was no statistically significant result observed for greater odds of death for any of the diagnoses and admission age on HCS. However, children who had a hospital readmission  $< 6$  months after hospital discharge presented 10% greater chance of death ( $P = .02$ ). **Conclusions:** The most prevalent diagnosis of children on continuous invasive HMV was cerebral palsy. The main cause of hospital readmission was respiratory tract infection, especially tracheitis. Having the first hospital readmission at  $< 6$  months after discharge was shown to be a risk factor associated with mortality.

PMID: [32636275](#)

### 17. Health-Related Quality of Life of Young People With and Without Chronic Conditions

Martin Pinquart

J Pediatr Psychol. 2020 Jul 9;jsaa052. doi: 10.1093/jpepsy/jsaa052. Online ahead of print.

**Objective:** The aim of this meta-analysis was to compare levels of health-related quality of life (HRQOL) among children with and without chronic physical and/or sensory conditions, based on PedsQL 4.0 General Core Scales. **Methods:** Studies were identified with electronic databases (CINAHL, PSYCINFO, MEDLINE, Google Scholar, PSYINDEX) and from the PedsQL website. We included controlled studies that compared PedsQL scores of children (mean age < 18 years) with and without chronic physical and/or sensory conditions and uncontrolled studies on children with chronic physical and/or sensory conditions from countries where data from peers without chronic conditions have been published. Random-effects meta-analyses were computed. **Results:** In total, 1,231 studies fulfilled the inclusion criteria. There were large declines of the total and physical score as well as medium-sized declines of psychosocial health and its subscales, based on criteria of interpreting effect sizes by Cohen [Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112, 155-159]. Children with cerebral palsy and spina bifida showed the largest declines across all scales, but significant declines emerged in all compared 29 chronic conditions. We identified moderating effects of duration of the chronic condition, rater, child gender, country, sociodemographic equivalence of the compared groups, type of control condition, and publication status. **Conclusions:** Young people with chronic health conditions should be screened for HRQOL, and the profile across different domains should be preferred over the use of a sum score. Child self-reports are particularly relevant for assessing emotional and social functioning. Effective measures aimed at improving HRQOL are needed, especially if the chronic condition leads to severe declines of physical functioning.

PMID: [32642762](#)

### 18. Caregiver's perspectives on facilitators and barriers of active participation in cerebral palsy rehabilitation in North West Nigeria: a qualitative study

Auwal Abdullahi, Auwal Isah

BMC Health Serv Res. 2020 Jul 6;20(1):615. doi: 10.1186/s12913-020-05487-w.

**Background:** Cerebral Palsy (CP) refers to the permanent disorders involving postural and movement control as a result of injury to the developing brain. As a result of impairment in postural and movement control, children with CP usually have problems in carrying out activities of daily living (ADL). This makes them dependent on help from their caregivers. Thus, for effective rehabilitation of children with CP, active participation of their caregivers is important. This study seeks to explore the facilitators and barriers of active participation of caregivers in the rehabilitation of children with CP in Kano, Nigeria. **Methods:** The study design used was qualitative in-depth interview. The participants were caregivers of children with CP at Hasiya Bayero Paediatric Specialists Hospital, Kano. The caregivers were interviewed face-to-face, and their responses were audio-recorded with a tape recorder, supplemented with note taking. The data generated was analyzed using constant comparative analysis. **Results:** Forty young caregivers (mean age,  $27.17 \pm 4.46$  years) participated in the study. They expressed encouragement from the therapist managing the child, family support, empathy, improvement in the conditions of other children with CP, cooperation of the child during home programs family support and improvement in the child's condition as factors that facilitate their active participation in the rehabilitation of the children. However, they mentioned occupation, financial resources and the number of children the caregiver has are the barriers to their active participation in the rehabilitation of the children. **Conclusions:** Both the facilitators and barriers of active participation of caregivers in the rehabilitation of children with CP need to be recognized in order to help caregivers reinforce or overcome them respectively. In addition, economically sustainable and accessible rehabilitation services are needed for all children with CP. Similarly, sharing caregiving rehabilitation tasks amongst family members could facilitate caregiver active participation.

PMID: [32631316](#)

### 19. Evidence and Open Questions for the Use of Video-Feedback Interventions With Parents of Children With Neurodevelopmental Disabilities

Livio Provenzi, Lorenzo Giusti, Marzia Caglia, Elisa Rosa, Eleonora Mascheroni, Rosario Montiroso

Review Front Psychol. 2020 Jun 18;11:1374. doi: 10.3389/fpsyg.2020.01374. eCollection 2020.



The Video-Feedback Intervention (VFI) is a technique aimed at promoting positive parenting that has been found to be supportive of child development and parent-child interaction in different at-risk and clinical populations. The application of VFI with parents of children with neurodevelopmental disabilities (ND; e.g., cerebral palsy, sensory and/or psychomotor delay, and genetic syndromes) is growing. Nonetheless, no systematic review is currently available documenting whether this type of intervention improves children's developmental outcomes (e.g., behavioral stability and cognitive abilities), parental caregiving skills (e.g., responsive parenting), and parental emotional well-being (e.g., depressive symptomatology). In the present mini-review, 212 VFI records were retrieved from three databases (i.e., PubMed, Scopus, and Web of Science), and 10 papers were finally included. Abstracted information included age, diagnosis, methodological aspects (timing, setting, and themes), and child/parent outcomes. Significant improvements from pre- to post-VFI were observed in all studies. Specifically, the VFIs were significantly associated with better children developmental outcomes and parental caregiving skills. Inconsistent findings emerged for the VFI effects on parental emotional well-being. Overall, the current mini-review supports the potential effectiveness of parent-focused VFI interventions for parents of children with ND, despite the presence of open questions that need to be addressed in future clinical trials.

PMID: [32625153](#)

## **20. The general movements assessment in term and late-preterm infants diagnosed with neonatal encephalopathy, as a predictive tool of cerebral palsy by 2 years of age: a scoping review protocol**

Judy Seesahai, Maureen Luther, Carmen Cindy Rhoden, Paige Terrien Church, Elizabeth Asztalos, Rudaina Banihani

Review Syst Rev. 2020 Jul 4;9(1):154. doi: 10.1186/s13643-020-01358-x.

**Background:** Prediction of long-term neurodevelopmental outcomes remains an elusive goal for neonatology. Clinical and socioeconomic markers have not proven to be adequately reliable. The limitation in prognostication includes those term and late-preterm infants born with neonatal encephalopathy. The General Movements Assessment tool by Precht has demonstrated reliability for identifying infants at risk for neuromotor impairment. This tool is non-invasive and cost-effective. The purpose of this study is to identify the published literature on how this tool applies to the prediction of cerebral palsy in term and late-preterm infants diagnosed with neonatal encephalopathy and so detect the research gaps. **Methods:** We will conduct a systematic scoping review for data on sensitivity, specificity, positive, and negative predictive value and describe the strengths and limitations of the results. This review will consider studies that included infants more than or equal to 34 + 0 weeks gestational age, diagnosed with neonatal encephalopathy, with a General Movements Assessment done between birth to six months of life and an assessment for cerebral palsy by at least 2 years of age. Experimental and quasi-experimental study designs including randomized controlled trials, non-randomized controlled trials, before and after studies, interrupted time-series studies and systematic reviews will be considered. Case reports, case series, case control, and cross-sectional studies will be included. Text, opinion papers, and animal studies will not be considered for inclusion in this scoping review as this is a highly specific and medical topic. Studies in the English language only will be considered. Studies published from at least 1970 will be included as this is around the time when the General Movements Assessment was first introduced in neonatology as a potential predictor of neuromotor outcomes. We will search five databases (MEDLINE, Embase, PsychINFO, Scopus, and CINAHL). Two reviewers will conduct all screening and data extraction independently. The articles will be categorized according to key findings and a critical appraisal performed. **Discussion:** The results of this review will guide future research to improve early identification and timely intervention in infants with neonatal encephalopathy at risk of neuromotor impairment. **Systematic review registration:** Title registration with Joanna Briggs Institute [https://joannabriggs.org/ebp/systematic\\_review\\_register](https://joannabriggs.org/ebp/systematic_review_register).

PMID: [32622366](#)

## **21. Cost-Utility Analysis of Prophylactic Dextrose Gel vs. Standard Care for Neonatal Hypoglycemia In At-Risk Infants**

Matthew J Glasgow, Richard Edlin, Jane E Harding

J Pediatr. 2020 Jul 4;S0022-3476(20)30827-1. doi: 10.1016/j.jpeds.2020.06.073. Online ahead of print.

**Objective:** To evaluate the long-term costs and impact on quality of life of using prophylactic dextrose gel in subjects at increased risk of developing neonatal hypoglycemia. **Study design:** A cost-utility analysis was performed from the perspective of the health system, using a decision tree to model the long-term clinical outcomes of neonatal hypoglycemia, including

cerebral palsy, epilepsy, vision disturbances, and learning disabilities, in subjects at increased risk of neonatal hypoglycemia who received prophylactic dextrose gel vs standard care. Model parameters including likelihoods of hypoglycemia and admission to a neonatal intensive care unit, were based on the pre-hPOD Study. Estimations of the likelihood of long-term condition(s), and their costs, were based on review of published literature. Results: Subjects who received prophylactic dextrose gel incurred costs to the health system of around United States \$14,000 over an 18 year time horizon, accruing 11.25 quality adjusted life years (QALYs), whereas those who did not receive prophylactic treatment incurred cost of around \$16,000 and experienced a utility of 11.10 QALYs. Conclusion: A prophylactic strategy of using dextrose gel in infants at increased risk of neonatal hypoglycemia is likely to be cost effective compared with standard care, to reduce the direct costs to the health system over an 18 year time horizon, and improve quality of life.

PMID: [32634402](#)

## 22. The impact of high intensity care around birth on long-term neurodevelopmental outcomes

Corneliu Bolbocean, Michael Shevell

Health Econ Rev. 2020 Jul 8;10(1):22. doi: 10.1186/s13561-020-00279-8.

Background: An equitable and affordable healthcare system requires a constant search for the optimal way to deliver increasingly expensive neonatal care. Therefore, evaluating the impact of hospital intensity around birth on long-term health outcomes is necessary if we are to assess the value of high intensity neonatal care against its costs. Methods: This study exploits uneven geographical distribution of high intensity birth hospitals across Canada to generate comparisons across similar Cerebral Palsy (CP) related births treated at hospitals with different intensities. We employ a rich dataset from the Canadian Multi-Regional CP Registry (CCPR) and instrumental variables related to the mother's location of residence around birth. Results: We find that differences in hospitals' intensities are not associated with differences in clinically relevant, long-term CP health outcomes. Conclusions: Our results suggest that existing matching mechanism of births to hospitals within large metropolitan areas could be improved by early detection of high risk births and subsequent referral of these births to high intensity birthing centers. Substantial hospitalization costs might be averted to Canadian healthcare system (\$16 million with a 95% CI of \$6,131,184 - \$24,103,478) if CP related births were assigned to low intensity hospitals and subsequently transferred if necessary to high intensity hospitals.

PMID: [32642972](#)

## 23. Severity of retinopathy of prematurity was associated with a higher risk of cerebral dysfunction in young adults born extremely preterm

Lena Jacobson, Brigitte Vollmer, Anna Kistner, Birgitta Böhm

Acta Paediatr. 2020 Jul 6. doi: 10.1111/apa.15461. Online ahead of print.

Aim: This Swedish study evaluated whether the severity of retinopathy of prematurity (ROP) in extremely preterm infants was related to their overall outcome in young adulthood. Methods: We followed 39 individuals born 1988-93 at less than 28 gestational weeks, included in the Stockholm Neonatal Project. 19 were treated for severe ROP and 20 had no or mild ROP. They were assessed for general cognitive abilities and mental health at 18 years of age and compared with 23 term-born controls. Visual acuity was examined at 21-25 years. They were asked about their education and everyday life. Results: The 19 individuals with severe, treated ROP had lower visual acuity and higher risk for intellectual deficits, cerebral palsy, and neuropsychiatric diagnoses than those with no or mild ROP and the term controls. Three were visually impaired, none were blind. They were less physically active than the other groups and had more problems finding their way around. However, nine were at university. Conclusion: Young adults treated for severe ROP had more problems resulting from cerebral dysfunction than those with no or mild ROP and term-born controls. Retinal and brain pathologies in the extremely preterm infant constitute different expressions of neuro-vascular disease.

PMID: [32628800](#)

## 24. Long-term neurodevelopmental outcomes of significant neonatal jaundice in Taiwan from 2000-2003: a nationwide,

**population-based cohort study**

Pei-Chen Tsao, Hsin-Ling Yeh, Yu-Shih Shiau, Yen-Chen Chang, Szu-Hui Chiang, Wen-Jue Soong, Mei-Jy Jeng, Kwang-Jen Hsiao, Po-Huang Chiang

Sci Rep. 2020 Jul 9;10(1):11374. doi: 10.1038/s41598-020-68186-w.

Newborns with significant neonatal jaundice (SNJ) would admit for evaluation and/or intervention due to an earlier or more rapid increase in bilirubin level. Bilirubin-induced neurological dysfunction in this population might be underestimated. We aimed to investigate the risk of long-term neurodevelopmental sequelae of SNJ in Taiwan. An SNJ 2000-2003 follow-up cohort consisting of 66,983 neonates was extracted from the nationwide, population-based health insurance database in Taiwan to survey the accumulative incidence of long-term (7-year) neurodevelopmental sequelae in comparison to a reference general-population neonate cohort of 12,579 individuals born in 2000. The SNJ follow-up cohort was furtherly categorized into subgroups according to interventions (phototherapy, intensive phototherapy, and exchange transfusion). The SNJ follow-up cohort exhibited significantly higher cumulative rates of long-term neurodevelopmental sequelae than did the reference cohort ( $P < 0.05$ ). The risks of infantile cerebral palsy, hearing loss, and developmental delay in the SNJ follow-up cohort were between twice and three times of those in the reference cohort after adjusting for gender, comorbid perinatal disorders and urbanization levels. All intervention subgroups demonstrated higher risks for long-term neurodevelopmental sequelae than the reference cohort ( $P < 0.05$ ) after adjustment. Patients with SNJ are at risk of developing neurodevelopmental disorders during their growth period. A scheduled follow-up protocol of physical and neurodevelopmental assessment during early childhood for these SNJ patients would potentially be helpful for the early detection of and intervention for neurodevelopmental disorders.

PMID: [32647318](#)

**25. Efficacy of antiepileptic drugs in neonatal seizures: a systematic review protocol**

Yang He, Jun Tang, Meng Zhang, Tao Xiong, Shalini Ojha, Imti Choonara, Dezhi Mu

BMJ Paediatr Open. 2020 Jun 29;4(1):e000683. doi: 10.1136/bmjpo-2020-000683. eCollection 2020.

**Introduction:** Seizures are one of the most common neurological disorders of neonates, which is also an emergency in the neonatal intensive care unit. For neonates, the recommended first-line antiepileptic drugs (AEDs) include phenobarbitone, which may be effective in only 50% of seizures. Some new AEDs, such as levetiracetam, have been shown to be effective in adults and older children. However, their efficacy for neonatal seizures remains uncertain. The aim of this investigation is to conduct a systematic review to evaluate the efficacy of all AEDs in neonates. Additionally, the long-term outcomes following neonatal seizures, in relation to the development of cerebral palsy and epilepsy, will be studied. **Method:** We will perform a systematic review including randomised controlled studies (RCTs), cohort studies, case-controlled studies and case series studies which evaluated the efficacy of AEDs and short-term and long-term outcomes in neonatal seizures. PubMed, Embase, Web of Science, Cochrane Library and Clinical trial.gov will be searched. There will be no language restriction. Risk bias in RCTs will be evaluated by the Cochrane risk-of-bias tool, while cohort and case-control studies will be evaluated by the Newcastle-Ottawa Scale. A network meta-analysis will be performed by the Bayesian model using WinBUGS V.1.4.3 and R software if there is a high degree of homogeneity among studies. Otherwise, we will perform a narrative review without pooling. Subgroup analyses will be performed in different AEDs and dosage groups. **Outcome:** The primary outcomes will be seizure cessation confirmed by electroencephalogram and long-term neurodevelopmental outcome. Secondary outcomes will be neonatal mortality during hospitalisation and suspected drug toxicity. **Ethics and dissemination:** Formal ethical approval is not required as no primary data are collected. This systematic review will be disseminated through a peer-reviewed publication.

PMID: [32626827](#)

**26. Baclofen Toxicity in Children With Acute Kidney Injury: Case Reports and Review of the Literature**

Ram A Mishaal, Nancy E Lanphear, Erez Armarnik, Esias R van Rensburg, Douglas G Matsell

Case Reports Child Neurol Open. 2020 Jun 24;7:2329048X20937113. doi: 10.1177/2329048X20937113. eCollection Jan-Dec 2020.

Baclofen is a medication used for tone management in cerebral palsy. Although it acts mainly at the spinal cord level, it can cause central nervous system adverse reactions at higher doses. Baclofen is mainly eliminated by renal excretion and there have been reports on adverse events when used in adults with renal impairment; however, there are no consensus guidelines as to the dose adjustments required due to renal impairment. The authors describe 2 children with acute kidney injury (AKI) and systemic side effects with initiation of oral baclofen, which was started for treatment of dystonia/spasticity in the recovery phase of their kidney injury. Following the initiation of the drug, they both had decreased level of consciousness and respiratory difficulties, which warranted discontinuation of the drug. These cases highlight the need for reduced initial dose, slow titration, and close monitoring when initiating baclofen treatment in children with AKI.

PMID: [32637443](#)

### **27. Bi-allelic Mutations in ALDH5A1 is associated with succinic semialdehyde dehydrogenase deficiency and severe intellectual disability**

Mahshid Fattahi, Ata Bushehri, Afagh Alavi, Vahid Asghariazar, Ahoura Nozari, Saghar Ghasemi Firouzabadi, Parisa Motamedian Dehkordi, Marzieh Javid, Saeed Farajzadeh Valiliou, Javad Karimian, Farkhondeh Behjati

Gene. 2020 Jul 1;144918. doi: 10.1016/j.gene.2020.144918. Online ahead of print.

Homozygous mutations of ALDH5A1 have been reportedly associated with Succinic semialdehyde dehydrogenase deficiency (SSADHD) that affects gamma-aminobutyric acid (GABA) catabolism and evinces a wide range of clinical phenotype from mild intellectual disability to severe neurodegenerative disorders. We report clinical and molecular data of a Lor family with 2 affected members presenting with severe intellectual disability, developmental delay, and generalized tonic-clonic seizures. A comprehensive genetic study that included whole-exome sequencing identified a homozygous missense substitution (NM\_001080:c.G1321A:p.G441R) in ALDH5A1 (Aldehyde Dehydrogenase 5 Family Member A1) gene, consistent with clinical phenotype in the patients and co-segregating with the disease in the family. The non-synonymous mutation, p.G441R, affects a highly conserved amino acid residue, which is expected to cause a severe destabilization of the enzyme. Protein modeling demonstrated an impairment of the succinic semialdehyde (SSA) binding tunnel accessibility, and the anticipation of the protein folding stability and dynamics was a decrease in the free energy by 4.02 kcal/mol. Consistent with these in silico findings, excessive  $\gamma$ -hydroxybutyrate (GHB) could be detected in patients' urine as the byproduct of the GABA pathway. SSADHD, Succinic semialdehyde dehydrogenase deficiency; GABA, gamma-aminobutyric acid; ALDH5A1, Aldehyde Dehydrogenase 5 Family Member A1; GHB,  $\gamma$ -hydroxybutyrate; SSA, succinic semi aldehyde; WISC, Wechsler Intelligence Scale for Children; CNS, central nervous system; EEG, electroencephalography; EEEF, empirical effective energy functions; ASD, autism spectrum disorder; ADHD, attention deficit hyperactivity disorder; IQ, intelligence quotient; EMG, electromyography; NCV, nerve conduction velocity; CP, cerebral palsy.

PMID: [32621952](#)