

Monday 11 November 2019

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Interventions and Management

1. Hand Motor Actions of Children With Cerebral Palsy Are Associated With Abnormal Sensorimotor Cortical Oscillations.

Hoffman RM, Wilson TW, Kurz MJ.

Neurorehabil Neural Repair. 2019 Nov 2:1545968319883880. doi: 10.1177/1545968319883880. [Epub ahead of print] Background. The neuroimaging literature on cerebral palsy (CP) has predominantly focused on identifying the structural aberrations (eg, fiber track integrity), with very few studies examining neural activity within the key networks that serve the production of hand movements. Objective. We aimed to start to fill this knowledge gap by using magnetoencephalographic brain imaging to quantify the temporal dynamics of the sensorimotor oscillations during a hand motor action. Methods: Children with CP (n = 12; MACS [Manual Abilities Classification System] levels I-III) and typically developing (TD) children (n = 26) performed an arrow-based version of the Eriksen flanker task where a button press was performed with either the second or third digit of the right hand depending on the arrow's direction. Results: Overall, the children with CP were less accurate and had slower reaction times compared with the TD children. These behavioral differences were closely linked with aberrant sensorimotor cortical oscillations seen in the children with CP. Compared with the TD children, the children with CP had a weaker gamma (68-82 Hz) response during motor execution and a weaker post-movement beta rebound (PMBR; 14-26 Hz) response on movement termination. Moreover, we observed a significant correlation between the amplitude of the gamma and PMBR with reaction time, with weaker gamma and PMBR responses being linked with slower reaction times. Conclusions: Overall, these results suggest that aberrations in motor-related gamma and beta cortical oscillations are associated with the impaired hand motor actions seen in children with CP.

PMID: [31679451](#)

2. Identification of complications in paediatric cerebral palsy treated with intrathecal baclofen pump: a descriptive analysis of 15 years at one institution.

Imerci A, Rogers KJ, Pargas C, Sees JP, Miller F.

J Child Orthop. 2019 Oct 1;13(5):529-535. doi: 10.1302/1863-2548.13.190112.

PURPOSE: Intrathecal baclofen (ITB) treatment is used with increasing frequency in the cerebral palsy population. We describe the complications of ITB treatment, the incidence of complications, and our experience with their treatment. METHODS: In a period of 15 years, 341 paediatric patients with cerebral palsy treated with ITB were evaluated. Device problems associated with the catheter or pump, or infection and complications such as cerebrospinal fluid (CSF) leak and postdural spinal headache, were reviewed. Infection was classified as early (≤ 90 days) or late (> 90 days) according to the time of onset. RESULTS: The infection rate was 6.9% per procedure (50/720) and 14.6% per patient (50/341) over a mean 6.3 ± 3.9 years. There was a positive correlation between the risk of infection and preoperative comorbidities including epilepsy/seizure history, feeding tube, and mixed type cerebral palsy ($p < 0.05$, $p = 0.03$, $p = 0.01$, respectively). Eighty-five (24.9%) patients experienced 90 CSF leak episodes; 61 of these 85 patients had headache complaints as a result of CSF leak. There

was a positive correlation between the risk of early infection and CSF leak ($p < 0.05$). **CONCLUSIONS:** The most common complication related to ITB was associated with pump and catheter problems. The rate of complications with the use of ITB is relatively high; however, based on the literature reports, it is the most effective treatment for severe spasticity and dystonia in patients with severe cerebral palsy. **LEVEL OF EVIDENCE:** III.

PMID: [31695821](#)

3. The role of intra-operative neuroelectrophysiological monitoring in single-level approach selective dorsal rhizotomy. Xiao B, Constatntini S, Browd SR, Zhan Q, Jiang W, Mei R.

Childs Nerv Syst. 2019 Nov 4. doi: 10.1007/s00381-019-04408-5. [Epub ahead of print]

OBJECTIVE: Selective dorsal rhizotomy via a single-level approach (SL-SDR) to treat spasticity 100% relies on the interpretation of results from the intra-operative neuroelectrophysiological monitoring. The current study is to investigate the role EMG interpretation plays during SL-SDR procedure with regard to the selection of nerve rootlets for partially sectioning in pediatric cases with spastic cerebral palsy (CP). **METHODS:** A retrospective study was conducted in pediatric patients with spastic CP undergone our modified rhizotomy protocol-guided SL-SDR from May 2016 to Mar. 2019 in our hospital. Our study focused on intra-operative EMG interpretation and its correlation with pre-op evaluation results, and dorsal rootlet selection difference when data of our intra-operative EMG recordings interpreted using different rhizotomy protocols. **RESULTS:** Clinical and intra-operative neuroelectrophysiological monitoring data of a total of 318 consecutive cases were reviewed, which include 231 boys and 87 girls with 32 hemiplegias, 161 diplegias, and 125 quadriplegias. Age at the time of SL-SDR in those cases was between 3.0-14.0 (5.9 ± 1.9) years. The number of targeted muscle ranged from 2 to 8 over these cases (the muscle in lower limbs with its pre-op muscle tone ≥ 2 grade, Modified Ashworth scale). Among 21,728 nerve rootlets tested (68.3 ± 8.2 /case), 6272 (28.9%) were identified sphincter related by our intra-operative neuromonitoring. In the rest of 15,456 (48.6 ± 7.6 /case) nerve rootlets which neuromonitoring suggested associated with lower limbs, 11,009 were taken as the dorsal ones (34.6 ± 7.4 /case). A total of 3370 (10.6 ± 4.7 /case) rootlets matched our rhizotomy criteria with 3061 (9.6 ± 4.1 /case) sectioned 50% and 309 (1.0 ± 1.0 /case) cut 75%. The rhizotomy ratio (partially transected nerve rootlets/all dorsal rootlets associated with lower limbs in a particular case) was 15.8%, 22.3%, 33.4%, 41.8%, and 45.7% across cases with their pre-op GMFCS level from I to V, respectively. Rootlets required 75% cut had a tendency to increase as well in our cases with their pre-op GMFCS level from I to V, which comprising 1.5%, 4.8%, 8.5%, 14.1%, and 15.2% of all rootlets transected, respectively. The muscle tone of 2068 targeted muscles in these cases at the time of 3 weeks after the SL-SDR was revealed a significant decrease when compared to pre-op (1.7 ± 0.5 vs. 2.7 ± 0.6). Further investigation to compare our rootlet selection with the one guided by the traditional rhizotomy criteria using our intra-operative EMG recordings in 318 cases, revealed that the overlap ratio had a tendency to increase in cases when their pre-op GMFCS level increased (39.5%, 41.3%, 52.2%, 54.1%, and 62.8% in cases with levels I-V, respectively). While our modified rhizotomy protocol successfully identified 2-23 rootlets for sectioning in all of our 318 cases, the traditional rhizotomy protocol failed to distinguish any for cutting in about 20% of cases with their pre-op GMFCS levels I and II. **CONCLUSIONS:** The rhizotomy criteria fully rely on the EMG interpretation making intra-operative neuroelectrophysiological monitoring crucial when SDR is performed via a single-level approach. Our modified rhizotomy protocol is feasible, safe, and effective to guide SL-SDR to treat all types of spastic CP cases by decreasing muscle tone in particular spastic muscle groups in their lower limbs. Data of EMG responses during SL-SDR procedure and as well as the clinical outcomes based on their interpretation could help clinicians to further understand how neuronal circuits work in the spinal cord of these patients.

PMID: [31686140](#)

4. Improving access to selective dorsal rhizotomy for children with cerebral palsy. Davidson B, Fehlings D, Milo-Manson G, Ibrahim GM.

CMAJ. 2019 Nov 4;191(44):E1205-E1206. doi: 10.1503/cmaj.191065.

PMID: [31685663](#)

5. Electrophysiology of Sensory and Motor Nerve Root Fibers in Selective Dorsal Rhizotomies. Martinez V, Browd S, Osorio M, Hooper E, Slimp J, Bo X, Kinney GA.

Pediatr Neurosurg. 2019 Nov 1:1-9. doi: 10.1159/000502326. [Epub ahead of print]

AIMS: Spasticity remains a major impediment in the treatment of cerebral palsy (CP). The single-level selective dorsal rhizotomy (SDR) is a minimally invasive intervention that reduces spasticity in select patients. We provide a descriptive set of

normative data that practitioners can utilize to help guide the single-level SDR procedure, including (1) physiological threshold values used to dissociate ventral from dorsal roots; (2) response characteristics of muscles; (3) descriptions of abnormal physiological responses; and (4) percentage of rootlets transected during surgery. **METHODS:** We examined data from 38 patients with CP who underwent SDR. Dorsal and ventral roots were classified based on the amplitude of electromyographic (EMG) responses, number of muscles activated, and abnormal response characteristics. **RESULTS:** Ventral roots activated more muscles at significantly lower stimulus thresholds and demonstrated larger EMG responses than did dorsal roots. Of the transections made, $64.72 \pm 1.69\%$ of each rootlet was transected. Ventral and dorsal roots can be readily separated based on a few key physiological characteristics including response thresholds and the spread of muscle activation. It was observed that a threshold of approximately 0.4 mA could be used to dissociate ventral and dorsal roots during surgery. **CONCLUSIONS:** These data illustrate the range of physiological variance observed while performing SDR in patients with spastic CP. Notably, we encountered outlier patients whose roots demonstrated aberrant response characteristics and displayed uncharacteristically low dorsal root thresholds or abnormally high ventral root thresholds. Practitioners should be prepared to individualize their threshold criteria and customize treatment on a patient-by-patient basis.

PMID: [31678975](#)

6. Efficacy of Repeat AbobotulinumtoxinA (Dysport®) Injections in Improving Gait in Children with Spastic Cerebral Palsy.

Dursun N, Bonikowski M, Dabrowski E, Matthews D, Gormley M, Tilton A, Carranza J, Grandoulier AS, Picaut P, Delgado MR.

Dev Neurorehabil. 2019 Nov 6:1-7. doi: 10.1080/17518423.2019.1687602. [Epub ahead of print]

Purpose: This secondary analysis of a randomized, double-blind study plus open-label extension (NCT01249417/NCT01251380) evaluated the efficacy of abobotulinumtoxinA versus placebo in improving gait pattern in children with dynamic equinus due to cerebral palsy (CP) as assessed by the observational gait scale (OGS). **Methods:** Ambulatory children with CP (N = 241, aged 2-17) and dynamic equinus were randomized to treatment with abobotulinumtoxinA (10 or 15U/kg/leg) or placebo injected into the gastrocnemius. All children received abobotulinumtoxinA in the open-label phase. **Results:** In the double-blind phase, abobotulinumtoxinA significantly improved OGS total scores versus placebo at Week 4 (treatment effect vs. placebo: 10U/kg/leg: 1.5 [0.7, 2.3], $p = .0003$; 15U/kg/leg: 1.1 [0.3, 1.9], $p = .01$). In the open-label phase, treatment with abobotulinumtoxinA continued to improve the OGS score at the same magnitude as seen in the double-blind study. **Conclusion:** Repeat treatment with abobotulinumtoxinA improved gait in children with dynamic equinus.

PMID: [31691605](#)

7. Comparison of the Results of Primary Versus Repeat Hamstring Surgical Lengthening in Cerebral Palsy.

Morais Filho MC, Blumetti FC, Kawamura CM, Fujino MH, Matias M, Lopes JAF.

J Pediatr Orthop. 2019 Nov 1. doi: 10.1097/BPO.0000000000001464. [Epub ahead of print]

BACKGROUND: Hamstring surgical lengthening (HSL) has been frequently performed for the correction of knee flexion deformity in cerebral palsy (CP), although recurrence is described in long-term follow-up. Repeat hamstring surgical lengthening (RHSL) can be an option for recurrent knee flexion deformity; however, the results of this approach are still controversial. The purpose of this study was to compare the results of primary HSL and RHSL in CP. **METHODS:** Patients with spastic diplegic CP, Gross Motor Function Classification System levels I to III, underwent bilateral medial HSL with complete documentation in the gait laboratory before and after the intervention, were included in the study. A total of 229 subjects met the inclusion criteria and were divided into 2 groups: group A was formed by those who received medial HSL for the first time (185 patients), and group B was composed of individuals who underwent RHSL (44 patients). Clinical and kinematic parameters were evaluated before and after the intervention, and the results compared. **RESULTS:** The groups were matched with regard to sex distribution, Gross Motor Function Classification System levels, and follow-up time (>2 y). Popliteal angle was reduced in groups A (60.3 to 51.4 degrees, $P < 0.001$) and B (56.1 to 51.5 degrees, $P = 0.001$) after the intervention. Knee flexion at initial contact was reduced from 40.8 to 28.9 degrees in group A ($P < 0.001$) and from 40.4 to 35.1 degrees in group B ($P = 0.001$). Reduction of minimum knee flexion in the stance phase (24.9 to 17.5 degrees, $P < 0.001$) and improvement of the Gait Deviation Index (52.9 to 60.2, $P < 0.001$) occurred only in group A. Anterior pelvic tilt (APT) increased in groups A (from 17 to 19.5 degrees, $P < 0.001$) and B (from 14.9 to 19.4 degrees, $P < 0.001$) after treatment. Finally, in the comparison between groups, the reduction of knee flexion at initial contact was more significant in group A ($P < 0.001$), whereas the increase of APT was higher in group B. **CONCLUSIONS:** In the present study, the improvement of knee extension during the stance phase was observed only after the primary medial HSL. Moreover, the increase of APT was more significant when RHSL was performed. **LEVEL OF EVIDENCE:** Level III.

PMID: [31688817](#)

8. What's New in the Orthopaedic Treatment of Ambulatory Children With Cerebral Palsy Using Gait Analysis.

Sees JP, Truong WH, Novacheck TF, Miller F, Georgiadis AG.

J Pediatr Orthop. 2019 Oct 29. doi: 10.1097/BPO.0000000000001461. [Epub ahead of print]

BACKGROUND: Limb deformities in ambulatory children with cerebral palsy (CP) are common. The natural history of lower extremity deformities is variable and the impact on gait is managed with many treatment modalities. Effective interventions must consider the underlying pathophysiology, patient-specific goals, and incorporate objective outcome assessment. Evaluation and treatment include observation, tone management multilevel orthopaedic surgery to address muscle contractures and bony deformities, and the use of gait analysis for preoperative and postoperative assessment. **METHODS:** A PubMed search of the orthopaedic literature for studies published between January 2016 and February 2019 was performed. Eligible abstracts included the use of 3-dimensional instrumented gait analysis in the evaluation and treatment of the lower extremities in ambulatory children with CP. Seven hundred twenty abstracts were reviewed, with 84 papers identified as eligible, of which 45 full manuscripts were included for detailed review. **RESULTS:** The review summarized recent advances regarding the treatment of torsional alignment, knee deformities and clinical gait evaluation with visual assessment tools compared with instrumented gait analysis. **CONCLUSIONS:** Gait analysis of ambulatory children with CP remains essential to evaluation and surgical decision-making. Promising results have been reported with the goal of maintaining or reaching a higher level of function and increased endurance. **LEVEL OF EVIDENCE:** Level IV-literature review.

PMID: [31688517](#)**9. Cerebral palsy - beyond hip deformities.**

Otjen JP, Sousa TC, Bauer JM, Thapa M.

Pediatr Radiol. 2019 Nov;49(12):1587-1594. doi: 10.1007/s00247-019-04519-w. Epub 2019 Nov 4.

Cerebral palsy is a neurologic condition with myriad musculoskeletal and articular manifestations. While every patient is unique with innumerable variations in presentation, symptoms and treatments, there are broad themes and recognizable patterns of development. Many of these findings spill over to other neurodevelopmental disorders, and lessons learned from children with cerebral palsy translate well to multiple neurologic conditions. This review focuses on the more common manifestations involving the spine, knee, foot and ankle, with an emphasis on collecting and describing imaging features, along with clinical and radiologic pearls and pitfalls.

PMID: [31686165](#)**10. Gait deficits and dynamic stability in children and adolescents with cerebral palsy: A systematic review and meta-analysis.**

Chakraborty S, Nandy A, Kesar TM.

Clin Biomech (Bristol, Avon). 2019 Oct 18;71:11-23. doi: 10.1016/j.clinbiomech.2019.09.005. [Epub ahead of print]

BACKGROUND: Studies have demonstrated that ambulatory children and adolescents with cerebral palsy demonstrate atypical gait patterns. Out of numerous gait variables, identification of the most deteriorated gait parameters is important for targeted and effective gait rehabilitation. Therefore, this study aimed to identify the gait parameters with the most discriminating nature to distinguish cerebral palsy gait from normal gait. **METHODS:** Multiple databases were searched to include studies on ambulatory children and adolescents with cerebral palsy that included gait (spatio-temporal, kinematic, and kinetic) and dynamic stability variables. **FINDINGS:** Of 68 studies that met the inclusion criteria, 35 studies were included in the meta analysis. Effect size was used to assess the discriminative strength of each variable. A large effect (≥ 0.8) of cerebral palsy on double limb support time (Standardized Mean Difference = 0.98), step length (Standardized Mean Difference = 1.65), step width (Standardized Mean Difference = 1.21), stride length (Standardized Mean Difference = 1.75), and velocity (Standardized Mean Difference = 1.42) was observed at preferred-walking speed. At fast-walking speed, some gait variables (i.e. velocity and stride length) exhibited larger effect size compared to preferred-walking speed. For some kinematic variables (e.g. range of motion of pelvis), the effect size varied across the body planes. **INTERPRETATION:** Our systematic review detects the most discriminative features of cerebral palsy gait. Non-uniform effects on joint kinematics across the anatomical planes support the importance of 3D gait analysis. Differential effects at fast versus preferred speeds emphasize the importance of measuring gait at a range of speeds.

PMID: [31677546](#)

11. Low-intensity versus high-intensity home-based treadmill training and walking attainment in young children with spastic diplegic cerebral palsy.

Mattern-Baxter K, Looper J, Zhou C, Bjornson K.

Arch Phys Med Rehabil. 2019 Oct 31. pii: S0003-9993(19)31359-0. doi: 10.1016/j.apmr.2019.09.015. [Epub ahead of print]

OBJECTIVE: To compare the effect of low-intensity (LI) versus high-intensity (HI) TT on walking attainment and overall walking activity in children with cerebral palsy (CP). **DESIGN:** Prospective, multi-site, randomized controlled trial **SETTING:** Homes of the participants **PARTICIPANTS:** 19 children with spastic diplegic CP, Gross Motor Function Classification System Level I and II, ages 14-32 months (male n=8). **INTERVENTIONS:** The children were randomized to LI TT (2x/week for 6 weeks) (n=10) and HI TT (10x/week for 6 weeks) (n=9). The TT was carried out by the families with weekly instruction by the researchers. **MAIN OUTCOME MEASURES.** Children were assessed at study onset, post intervention, and 1 and 4 months post intervention with the Gross Motor Function Measure Dimension D/ E (GMFM-D/E), average strides/day and percentage of time spent walking with accelerometers, the Peabody Developmental Motor Scales-2 (PDMS-2), Pediatric Evaluation of Disability Index Mobility Scale, timed 10-meter and 1-minute walk test, and Functional Mobility Scale. Blinding was conducted for GMFM D/E and PDMS-2. Linear mixed effects regression models were applied to all outcomes. **RESULTS:** No significant between-group differences were found in any outcome measure at any of the time points. Children in the HI group did not show significant improvement immediately following the intervention in GMFM-E (p=.061), while children in the LI group did (p=.003), but no statistically significant differences were detected over time (p=.71). Children in the HI group showed better walking independence on the FMS at all post-intervention assessments. **CONCLUSIONS:** A twice-weekly dosage was equally effective in improving skills related to walking compared to a 10x/week program and can be more readily implemented into clinical practice.

PMID: [31678223](#)

12. [Cephalometric study of 9-15 years old patients with maxillofacial anomalies and cerebral palsy].

Poshtaru KG, Postnikov MA, Pankratova NV, Trunin DA, Stepanov GV, Rodionova AA.

Stomatologija (Mosk). 2019;98(5):78-86. doi: 10.17116/stomat20199805178. [Article in Russian; Abstract available in Russian from the publisher]

AIM: To study the morphological state of the maxillofacial system in children with cerebral palsy. **MATERIAL AND METHODS:** The frequency and prevalence of dental anomalies was studied in 30 9-15 years old children with cerebral palsy. For the registration of maxillofacial anomalies, the Bjork assessment method was used. The severity of sagittal incisive disocclusion and the reverse sagittal incisal disocclusion was measured by the magnitude of the sagittal slit. **RESULTS:** The study revealed no age-dependent correlation of lower canines and second premolars roots growth. The parameters of the cerebral part of the skull measured on the CT-bases lateral cephalograms were significantly less than normal rates except for the length of the posterior part of the skull. **CONCLUSION:** The morphological changes that determined the formation of sagittal and vertical incisive disocclusions were defined: the reduction of total anterior morphological face height (N-Me) and anterior upper morphological face height (N-SpP) and the increase in the anterior lower morphological face height (SpP-Me) which are characteristic features for patients with incisive sagittal and vertical diocclusion.

PMID: [31701934](#)

13. Nutritional Status of Indian Children with Cerebral Palsy: A Cross-sectional Study.

Goyal R, Rana R, Bhatia H, Kaushik JS.

Indian J Pediatr. 2019 Nov 7. doi: 10.1007/s12098-019-03084-2. [Epub ahead of print]

PMID: [31701428](#)

14. Short-term impact of an oral health program for adults with cerebral palsy.

Bizarra MF, Ribeiro Graça S.

Spec Care Dentist. 2019 Nov 7. doi: 10.1111/scd.12431. [Epub ahead of print]

AIM: To evaluate the impact of an oral health program for institutionalized individuals with cerebral palsy (CP) and their caregivers, after 2 and 6 months. METHODS: Sixty-two CP individuals in four homes were selected for intervention group (n = 31) and control group (n = 31). An oral hygiene practices questionnaire was applied to all caregivers at the baseline. Both groups received awareness sessions, practical demonstration of toothbrushing and adaptive techniques with role-play. In the study group, individual oral hygiene monitoring was also performed in the first 2 months. A gingival and an oral hygiene indexes were performed at the beginning, after 2 and 6 months of intervention. RESULTS: There was a significant reduction of gingival ($p < 0.001$) and oral hygiene ($p < 0.001$) indexes at 2 and 6 months in the intervention group with the most significant reductions at 2 months. Caregivers reported opening the mouth (84.6%) and swallowing toothpaste (61.5%) as the most important difficulties in performing toothbrushing. CONCLUSION: It was found that frequent and individualized monitoring of plaque control was essential to reduce dental plaque and gingivitis levels and that awareness sessions were not enough to produce clinically significant result.

PMID: [31697453](#)

15. Oral health status in pediatric patients with cerebral palsy fed by oral versus enteral route.

Cardona-Soria S, Cahuana-Cárdenas A, Rivera-Baró A, Miranda-Rius J, Martín de Carpi J, Brunet-Llobet L.

Spec Care Dentist. 2019 Nov 7. doi: 10.1111/scd.12429. [Epub ahead of print]

AIMS: Cerebral palsy (CP) is a chronic, nonprogressive disorder affecting movement, posture, and tone, caused by injuries in the central nervous system during the early stages of life. Patients with CP have swallowing disorders, which make oral feeding difficult and necessitate the use of external feeding devices. The objective of this research was to study the oral health status of pediatric patients affected with CP fed by either oral or enteral route. METHODS: A cross-sectional observational clinical study of the oral health of two groups of patients with CP, fed either orally or enterally (via percutaneous endoscopic gastrostomy, PEG). RESULTS: Patients fed by enteral route via PEG presented lower caries scores (DMFT: PEG: 1.09, non-PEG: 2.81) and higher percentages of supragingival dental calculus than the oral feeding group (PEG: 86%, non-PEG: 57.6%). CONCLUSION: Oral health status differed in pediatric patients with CP fed enterally via PEG and those fed orally. Specific preventive measures in both groups will be required to minimize the risk of complications.

PMID: [31697430](#)

16. Pain in adults with cerebral palsy: measuring the contribution of spasticity.

Smith JMC1, Field TS.

Dev Med Child Neurol. 2019 Nov 7. doi: 10.1111/dmcn.14396. [Epub ahead of print]

PMID: [31696934](#)

17. Visual impairment in children with cerebral palsy: Croatian population-based study for birth years 2003-2008.

Striber N, Vulin K, Đaković I, Prvčić I, Đuranović V, Cerovski B, Pejić Roško S, Čokolić Petrović D, Martinec S, Dawidowsky B, Mejaški Bošnjak V.

Croat Med J. 2019 Oct 31;60(5):414-420.

AIM: To evaluate visual impairment (VI) in children with cerebral palsy (CP). METHODS: This population-based study included 419 children from the Surveillance of Cerebral Palsy in Europe (SCPE) C28 RCP-HR - Register of Cerebral Palsy of Croatia born 2003-2008. Vision in children with CP (according to SCPE) was classified as normal or impaired, with the subcategory of severe VI. The proportion of children with VI was assessed in groups with different CP type/subtype, gross and fine motor function, and gestational age (GA). RESULTS: A total of 266 children had some degree of VI (266/400; 66.5%), 134 had normal vision, and data on VI were unknown for 19 children. Severe VI was present in 44 children (44/400; 11%). The proportion of children with VI and severe VI increased with the Gross Motor Function Classification System and Bimanual Fine Motor Function levels. Children with bilateral spastic CP had the highest frequency of severe VI (14.9%). The percentage of severe VI in children with bilateral spastic CP was 53.8% in the group born <28 weeks of GA, 13.3% in the group born 28-31 weeks of GA, 11.1% in the group born 32-36 weeks of GA, and 24.4% in the group born >36 weeks of GA ($\lambda_2=4.95$; $df=6$; $P<0.001$). CONCLUSION: Children with CP have a high prevalence of VI and severe VI, which is increasing with the level of motor impairment. Severe VI is significantly more common in children with bilateral spastic CP, especially among extremely premature infants.

PMID: [31686455](#)

18. Diagnostic accuracy of the defining characteristics of impaired swallowing in children with encephalopathy.

Silva RA, da Silva VM, Lopes MVO, Guedes NG, Oliveira-Kumakura AR.

J Pediatr Nurs. 2019 Oct 29. pii: S0882-5963(19)30465-8. doi: 10.1016/j.pedn.2019.10.006. [Epub ahead of print]

The purpose of this study was to analyze the accuracy of the defining characteristics of the nursing diagnosis of impaired swallowing in children with encephalopathy. The measures of diagnostic accuracy for each indicator were verified through latent class analysis. The prevalence of swallowing impairment was 59.76% for a total of 82 children evaluated. The defining characteristics that had good measures of sensitivity (range: 79.59-99.99) and specificity (range: 72.72-99.99) were as follows: food falls from the mouth, tongue action ineffective in forming bolus, prolonged bolus formation, inability to clear the oral cavity, and food refusal. Eight characteristics can be used as warning signs for impaired swallowing because they have high sensitivity values. In addition, ten characteristics presented high specificity and can be used to confirm this diagnosis in children with encephalopathy. Considering the findings of the swallowing pattern assessments through the analysis of the accuracy measures, it is verified that the evidence presented here should guide the pediatrics nurses in the diagnosis decision making. Indicators of high sensitivity should be used as warning signs for swallowing impairment, and the high specificity indicators should be used as a confirmatory sign of this condition and requires immediate intervention.

PMID: [31676210](#)**19. SenseJoy, a pluggable solution for assessing user behavior during powered wheelchair driving tasks.**

Rabreau O, Chevallier S, Chassagne L, Monacelli E.

J Neuroeng Rehabil. 2019 Nov 6;16(1):134. doi: 10.1186/s12984-019-0613-x.

BACKGROUND: The complex task of Electric Powered Wheelchairs (EPW) prescription relies mainly on personal experience and subjective observations despite standardized processes and protocols. The most informative measurements come from joystick monitoring, but recording direct joystick outputs require to disassemble the joystick. We propose a new solution called "SenseJoy" that is easy to plug on a joystick and is suitable to characterize the driver behavior by estimating the joystick command. **METHODS:** SenseJoy is a pluggable system embedded on EPW built with a 3D accelerometer and a 2D gyrometer placed within the joystick and another 3D accelerometer located at the basis of the joystick. Data is sampled at 39 Hz and processed offline. First, SenseJoy sensitivity is assessed on wheelchair driving tasks performed by a group of 8 drivers (31 ± 8 years old, including one driver with left hemiplegia, one with cerebral palsy) in a lab environment. Direct joystick measurements are compared with SenseJoy estimations in different driving exercises. A second group of 5 drivers is recorded in the ecological context of a rehabilitation center (41 ± 10 years old, with two tetraplegic drivers, one tetraplegic driver with cognitive disorder, one driver post-stroke, one driver with right hemiplegia). The measurements from all groups of drivers are evaluated with an unsupervised statistical analysis, to estimate driving profile clusters. **RESULTS:** The SenseJoy is able to measure the EPW joystick inclination angles with a resolution of 1.31% and 1.23% in backward/forward and left/right directions respectively. A statistical validation ensures that the classical joystick-based indicators are equivalent when acquired with the SenseJoy or with a direct joystick output connection. Using an unsupervised methodology, based on a similarity matrix between subjects, it is possible to characterize the driver profile from real data. **CONCLUSION:** SenseJoy is a pluggable system for assessing the joystick controls during EPW driving tasks. This system can be plugged on any EPW equipped with a joystick control interface. We demonstrate that it correctly estimates the performance indicators and it is able to characterize driving profile. The system is suitable and efficient to assist therapists in their recommendation, by providing objective measures with a fast installation process.

PMID: [31694645](#)**20. Development and Validation of a Mobile Application for Measuring Femoral Anteversion in Patients with Cerebral Palsy.**

Sung KH, Youn K, Chung CY, Kitta MI, Kumara HC, Min JJ, Lee J, Park MS.

J Pediatr Orthop. 2019 Nov 1. doi: 10.1097/BPO.0000000000001468. [Epub ahead of print]

BACKGROUND: Computed tomography (CT) provides benefits for 3-dimensional (3D) visualization of femur deformities. However, the potential adverse effects of radiation exposure have become a concern. Consequently, a biplanar imaging system EOS has been proposed to enable reconstruction of the 3D model of the femur. However, this system requires a calibrated apparatus, the cost of which is high, and the area occupied by it is substantial. The purpose of this study was to develop a mobile application that included a new method of 3D reconstruction of the femur from conventional radiographic images and

to evaluate the validity and reliability of mobile the application when measuring femoral anteversion. **METHODS:** The statistical shape model, graph-cut algorithm, and iterative Perspective-n-Point algorithm were utilized to develop the application. The anteroposterior and lateral images of a femur can be input using the embedded camera or by file transfer, and the touch interface aids accurate contouring of the femur. Regarding validation, the CT scans and conventional radiographic images of 36 patients with cerebral palsy were used. To evaluate concurrent validity, the femoral anteversion measurements on the images reconstructed from the mobile application were compared with those from the 3D CT images. Three clinicians assessed interobserver reliability. **RESULTS:** The mobile application, which reconstructs the 3D image from conventional radiographs, was successfully developed. Regarding concurrent validity, the correlation coefficient between femoral anteversion measured using 3D CT and the mobile application was 0.968 ($P < 0.001$). In terms of interobserver reliability, the intraclass correlation coefficient among the 3 clinicians was 0.953. **CONCLUSIONS:** The measurement of femoral anteversion with the mobile application showed excellent concurrent validity and reliability in patients with cerebral palsy. The proposed mobile application can be used with conventional radiographs and does not require additional apparatus. It can be used as a convenient technique in hospitals that cannot afford a CT machine or an EOS system. **LEVEL OF EVIDENCE:** Level III-diagnostic.

PMID: [31688821](#)

21. Video game-based and conventional therapies in patients of neurological deficits: an experimental study. Syed UE, Kamal A.

Disabil Rehabil Assist Technol. 2019 Nov 5:1-8. doi: 10.1080/17483107.2019.1679266. [Epub ahead of print]

Purpose: In the past few years, medicine has upgraded its therapeutic techniques and practices, with the use of various modern methods that are due to advancement in technology and sciences. It is recognized that the physical health of the patients is significantly associated to their mental state, their motivation and engagement in overcoming the illness. This paper presents experimental comparison between virtual reality (VR) technology and conventional mode of therapy for physical rehabilitation among patients of neurological deficits. The objective was to explore the effectiveness of VR during physical interactions with different game-like virtual environment and potentially leading to increased mental health (i.e., lower depression, anxiety and stress), self-esteem, social support and intrinsic motivation (task-based competence, choice and interest). **Method:** The study sample consisted of thirty-four subjects with Cerebral palsy (CP), Traumatic brain injury (TBI), Spinal cord injury, Stroke and Parkinson's disease; divided into two experimental groups virtual reality exercise group ($n = 17$), and conventional therapy group ($n = 17$); who have upper- or lower-limb impairment. **Results:** The outcome measures revealed significant differences across pretest and post-test conditions of both the experimental groups. Findings emerged from the study showed noticeable effectiveness of virtual-reality based rehabilitation in TBI, stroke and CP patients. Relationships between study variables and demographic variables (age and gender) were also presented. **Conclusion:** This study opens the way for future researchers, psychologists, physiotherapist and other practitioners to do more extensive work in the domain of virtual reality with different sample, constructs and approaches. **Implications for rehabilitation** It has become increasing important to introduce new state-of-art technologies in domain of rehabilitation. People are reluctant to use all the traditional modes of treatment. As these conventional ways of treatment are least motivating and interesting to indulge the patients without force and burden. It is evident in the present study that addition of virtual reality-based exercise increases the self-motivated balance during functional task in contrast to conventional and task-dependent training participants. This study opens the way for future researchers to do more extensive work in this domain.

PMID: [31684776](#)

22. Sensorimotor ECoG Signal Features for BCI Control: A Comparison Between People With Locked-In Syndrome and Able-Bodied Controls.

Freudenburg ZV, Branco MP, Leinders S, van der Vijgh BH, Pels EGM, Denison T, van den Berg LH, Miller KJ, Aarnoutse EJ, Ramsey NF, Vansteensel MJ.

Front Neurosci. 2019 Oct 16;13:1058. doi: 10.3389/fnins.2019.01058. eCollection 2019.

The sensorimotor cortex is a frequently targeted brain area for the development of Brain-Computer Interfaces (BCIs) for communication in people with severe paralysis and communication problems (locked-in syndrome; LIS). It is widely acknowledged that this area displays an increase in high-frequency band (HFB) power and a decrease in the power of the low frequency band (LFB) during movement of, for example, the hand. Upon termination of hand movement, activity in the LFB band typically shows a short increase (rebound). The ability to modulate the neural signal in the sensorimotor cortex by imagining or attempting to move is crucial for the implementation of sensorimotor BCI in people who are unable to execute movements. This may not always be self-evident, since the most common causes of LIS, amyotrophic lateral sclerosis (ALS) and brain stem stroke, are associated with significant damage to the brain, potentially affecting the generation of baseline

neural activity in the sensorimotor cortex and the modulation thereof by imagined or attempted hand movement. In the Utrecht NeuroProsthesis (UNP) study, a participant with LIS caused by ALS and a participant with LIS due to brain stem stroke were implanted with a fully implantable BCI, including subdural electrocorticography (ECoG) electrodes over the sensorimotor area, with the purpose of achieving ECoG-BCI-based communication. We noted differences between these participants in the spectral power changes generated by attempted movement of the hand. To better understand the nature and origin of these differences, we compared the baseline spectral features and task-induced modulation of the neural signal of the LIS participants, with those of a group of able-bodied people with epilepsy who received a subchronic implant with ECoG electrodes for diagnostic purposes. Our data show that baseline LFB oscillatory components and changes generated in the LFB power of the sensorimotor cortex by (attempted) hand movement differ between participants, despite consistent HFB responses in this area. We conclude that the etiology of LIS may have significant effects on the LFB spectral components in the sensorimotor cortex, which is relevant for the development of communication-BCIs for this population.

PMID: [31680806](#)

23. How are children with cerebral palsy managed in public hospitals of KwaZulu-Natal, South Africa?

Maharaj SS, White TL, Kaka B.

Physiother Theory Pract. 2019 Nov 5;1-9. doi: 10.1080/09593985.2019.1686791. [Epub ahead of print]

Background: Medical advances have resulted in the survival of infants who are born prematurely. This makes them at risk of developing neurological manifestations and increases the incidence of children diagnosed with cerebral palsy (CP). Physiotherapy plays an important role in the management of children with CP. However, in KwaZulu-Natal (KZN) there are challenges for rehabilitation of children presenting with CP due to limited equipment, assistive devices and shortage of health care professionals. The aim of this study was to determine the current physiotherapy management for children presenting with CP in public hospitals of KZN. **Methods:** One hundred and fifty-two physiotherapists were recruited using convenience sampling from different levels of public hospitals in KZN. The design was a cross-sectional study using a survey with a self-designed questionnaire to review current physiotherapy management of CP. The data was analyzed and presented by means of descriptive statistics. **Results:** Seventy-two participants completed the study indicating a 47.4% response rate with an age range of 31 to 40 years. Thirty-five (48.6%) of participants treated one to ten children with CP each month. Twenty-five (34.7%) used outcome measures to evaluate their CP management. This study showed the most common treatment techniques used by physiotherapists were: postural stabilizing activities - 68 (94.4%); respiratory care - 67 (92.9%); and positioning - 67 (92.9%). **Conclusion:** Despite challenges by physiotherapists in KZN, the overall management of children with CP was holistic and favorable. The most common treatment approach was postural stabilizing activities with children with CP receiving treatment once a month for 30 minutes.

PMID: [31686566](#)

24. The Pooled Diagnostic Accuracy of Neuroimaging, General Movements, and Neurological Examination for Diagnosing Cerebral Palsy Early in High-Risk Infants: A Case Control Study.

Morgan C, Romeo DM, Chorna O, Novak I, Galea C, Del Secco S, Guzzetta A.

J Clin Med. 2019 Nov 5;8(11). pii: E1879. doi: 10.3390/jcm8111879.

INTRODUCTION: Clinical guidelines recommend using neuroimaging, Prechtl's General Movements Assessment (GMA), and Hammersmith Infant Neurological Examination (HINE) to diagnose cerebral palsy (CP) in infancy. Previous studies provided excellent sensitivity and specificity for each test in isolation, but no study has examined the pooled predictive power for early diagnosis. **METHODS:** We performed a retrospective case-control study of 441 high-risk infants born between 2003 and 2014, from three Italian hospitals. Infants with either a normal outcome, mild disability, or CP at two years, were matched for birth year, gender, and gestational age. Three-month HINE, GMA, and neuroimaging were retrieved from medical records. Logistic regression was conducted with log-likelihood and used to determine the model fit and Area Under the Curve (AUC) for accuracy. **RESULTS:** Sensitivity and specificity for detecting CP were 88% and 62% for three-month HINE, 95% and 97% for absent fidgety GMs, and 79% and 99% for neuroimaging. The combined predictive power of all three assessments gave sensitivity and specificity values of 97.86% and 99.22% (PPV 98.56%, NPV 98.84%). **CONCLUSION:** CP can be accurately detected in high-risk infants when these test findings triangulate. Clinical implementation of these tools is likely to reduce the average age when CP is diagnosed, and intervention is started.

PMID: [31694305](#)

25. Niemann-Pick Disease Type C Misdiagnosed as Cerebral Palsy: A Case Report.

Ko EJ, Sung IY, Yoo HW.

Ann Rehabil Med. 2019 Oct;43(5):621-624. doi: 10.5535/arm.2019.43.5.621. Epub 2019 Oct 31.

Niemann-Pick disease type C (NP-C) is a rare autosomal recessive neurovisceral lysosomal lipid storage disorder. The clinical manifestations of the disorder are variable. This report describes the case of a 27-month-old girl with NP-C whose condition had been misdiagnosed as spastic cerebral palsy (CP). She had spasticity, particularly at both ankles, and gait disturbance. Magnetic resonance imaging of the brain revealed findings suspicious of sequelae from a previous insult, such as periventricular leukomalacia, leading to the diagnosis of CP. However, she had a history of hepatosplenomegaly when she was a fetus and her motor development had deteriorated, with symptoms of vertical supranuclear gaze palsy, cataplexy, and ataxia developing gradually. Therefore, NP-C was considered and confirmed with a genetic study, which showed mutation of the NPC1 gene. Thus, if a child with CP-like symptoms presents with a deteriorating course and NP-C-specific symptoms, NP-C should be cautiously considered.

PMID: [31693851](#)**26. Variability of Steady State Oral Baclofen Dosing in Pediatric Patients with Cerebral Palsy.**

McLaughlin MJ, Ratnasingam D, McGhee E.

Am J Phys Med Rehabil. 2019 Oct 25. doi: 10.1097/PHM.0000000000001334. [Epub ahead of print]

The primary objective of this study was to identify oral baclofen dosing variability at steady state based on weight and Gross Motor Functional Classification System (GMFCS) level using a retrospective cross-sectional study design. The medical records of 500 pediatric aged patients (age 1-21) were reviewed to obtain 144 pediatric patients who met inclusion criteria. One way ANOVA tests revealed increasing mean doses in baclofen (in mg/kg) with higher GMFCS levels ($p=0.001$). Post-hoc Tukey analysis showed patients with higher ambulatory ability (GMFCS I-II) received a lower total daily dosage than did patients with less ambulatory ability (GMFCS III-V). A moderate correlation was observed with increasing oral baclofen dose as weight increased ($r=0.43$, $p<0.0001$). Due to the variability in dosing between GMFCS levels, prescribing oral baclofen for pediatric patients with CP may not follow the traditional model of weight-based dosing seen in other pediatric conditions.

PMID: [31688017](#)**27. Cerebral palsy and bruxism: Effects of botulinum toxin injections-A randomized controlled trial.**

Cahlin BJ, Lindberg C, Dahlström L.

Clin Exp Dent Res. 2019 Jun 29;5(5):460-468. doi: 10.1002/cre2.207. eCollection 2019 Oct.

OBJECTIVE: Cerebral palsy (CP) includes disturbances in muscular control caused by perinatal brain injury. Masticatory muscle involvement hampers functions such as chewing and talking. Bruxism and temporomandibular disorders are overrepresented. Neuromuscular blocks with botulinum toxin type A (BTX-A) may alleviate problems due to muscular hyperactivity. The aim was to evaluate masticatory muscle BTX-A injections in subjects with CP and bruxism. **METHODS:** A prospective, parallel, randomized, placebo-controlled, and double-blind trial in 12 patients with CP was performed. End points were alterations in objective and subjective oral capacities after two BTX-A or corresponding placebo injections. Matched, healthy references were also evaluated. **RESULTS:** The reference group demonstrated stronger and more efficient oral functions compared with the CP group. Subjective and objective oral capacities appeared to vary considerably between CP patients and also over time in this patient group and were poorly correlated. No significant effect of BTX-A compared with placebo on outcome variables was observed at group level, but continued treatment with BTX-A was requested by the majority of the patients. **CONCLUSION:** The evidence is unable to support the use of BTX-A for the treatment of affected masticatory muscles in CP, but the findings are inconclusive in certain respects. Larger, more homogeneous groups of CP patients need to be evaluated in future trials.

PMID: [31687178](#)**28. Model for prompt and effective classification of motion recovery after stroke considering muscle strength and coordination factors.**

Costa-García Á, Ozaki KI, Yamasaki H, Itkonen M, S FA, Okajima S, Tanimoto M, Kondo I, Shimoda S.

J Neuroeng Rehabil. 2019 Nov 4;16(1):130. doi: 10.1186/s12984-019-0611-z.

BACKGROUND: Muscle synergies are now widely discussed as a method for evaluating the existence of redundant neural networks that can be activated to enhance stroke rehabilitation. However, this approach was initially conceived to study muscle coordination during learned motions in healthy individuals. After brain damage, there are several neural adaptations that contribute to the recovery of motor strength, with muscle coordination being one of them. In this study, a model is proposed that assesses motion based on surface electromyography (sEMG) according to two main factors closely related to the neural adaptations underlying motor recovery: (1) the correct coordination of the muscles involved in a particular motion and (2) the ability to tune the effective strength of each muscle through muscle fiber contractions. These two factors are hypothesized to be affected differently by brain damage. Therefore, their independent evaluation will play an important role in understanding the origin of stroke-related motor impairments. **RESULTS:** The model proposed was validated by analyzing sEMG data from 18 stroke patients with different paralysis levels and 30 healthy subjects. While the factors necessary to describe motion were stable across healthy subjects, there was an increasing disassociation for stroke patients with severe motor impairment. **CONCLUSIONS:** The clear dissociation between the coordination of muscles and the tuning of their strength demonstrates the importance of evaluating these factors in order to choose appropriate rehabilitation therapies. The model described in this research provides an efficient approach to promptly evaluate these factors through the use of two intuitive indexes. **KEYWORDS:** Electromyography; Motion performance; Motor strength gain; Muscle effective strength; Muscle mirror symmetry; Muscle synergies; Stroke recovery

PMID: [31684980](#)

29. Prediction of Drug-Resistant Epilepsy in Children with Cerebral Palsy.

Tokatly Latzer I, Blumovich A, Sagi L, Uliel-Sibony S, Fattal-Valevski A.

J Child Neurol. 2019 Nov 4;883073819883157. doi: 10.1177/0883073819883157. [Epub ahead of print]

Epilepsy is estimated to exist in approximately 40% of individuals with cerebral palsy; however, the specific features that make it drug resistant are not well defined. The main aim of this study was to determine the clinical risk factors that could predict drug-resistant epilepsy, in children with cerebral palsy. The study was performed via a retrospective chart review, analyzing clinical parameters of 118 children with cerebral palsy with either drug-resistant epilepsy or controlled epilepsy, between the years 2013 and 2018. We established a predictive model for drug-resistant epilepsy in children with cerebral palsy that is simple to apply in clinical settings and composed of the additive effect of a low Apgar score at 5 minutes, neonatal seizures, focal-onset epilepsy, and focal slowing on electroencephalogram (EEG; area under the receiver operating characteristic of 0.840). Early prediction of drug-resistant epilepsy may benefit to achieve better seizure control in children with cerebral palsy.

PMID: [31684798](#)

30. Inflammatory biomarkers in children with cerebral palsy: A systematic review.

Magalhães RC, Moreira JM, Lauer AO, da Silva AAS, Teixeira AL, E Silva ACS.

Res Dev Disabil. 2019 Dec;95:103508. doi: 10.1016/j.ridd.2019.103508. Epub 2019 Nov 1.

BACKGROUND: An exacerbated systemic inflammatory response has been associated with the occurrence of central nervous system injuries that may determine, in long term, motor, sensorial and cognitive disabilities. Persistence of this exacerbated inflammatory response seems to be involved in the pathophysiology of cerebral palsy (CP). **METHODS:** A systematic search was conducted in Bireme, Embase, PubMed and Scopus including studies that were published until August 2019. The key words used were "cerebral palsy", "brain injury", "inflammation", "oxidative stress", "cytokines", "chemokines", "neuropsychomotor development", "neurodevelopment outcomes" and "child". The quality of the eligible studies was determined according to the criteria suggested by the Newcastle-Ottawa Scale (NOS). **RESULTS:** Fourteen eligible studies aimed to investigate the association between peripheral inflammatory molecules and neurodevelopment in infants. The studies differed regarding CP-related risk factors and its classification. Inflammatory proteins were measured in blood, plasma, serum, cerebrospinal fluid or urine. In ten studies, higher circulating levels of cytokines, including IL-1 β , IL-6, TNF and CXCL8/IL-8, were associated with abnormal neurological findings. **CONCLUSION:** The investigation of the potential association between inflammatory molecules and neurological development in children with CP requires further original studies in order to clarify the influence of prenatal and perinatal inflammation on neurological outcomes.

PMID: [31683246](#)

31. The Opening of Connexin 43 Hemichannels Alters Hippocampal Astrocyte Function and Neuronal Survival in Prenatally LPS-Exposed Adult Offspring.

Chávez CE, Oyarzún JE, Avendaño BC, Mellado LA, Inostroza CA, Alvear TF, Orellana JA.

Front Cell Neurosci. 2019 Oct 11;13:460. doi: 10.3389/fncel.2019.00460. eCollection 2019.

Clinical evidence has revealed that children born from mothers exposed to viral and bacterial pathogens during pregnancy are more likely to suffer various neurological disorders including schizophrenia, autism bipolar disorder, major depression, epilepsy, and cerebral palsy. Despite that most research has centered on the impact of prenatal inflammation in neurons and microglia, the potential modifications of astrocytes and neuron-astrocyte communication have received less scrutiny. Here, we evaluated whether prenatally LPS-exposed offspring display alterations in the opening of astrocyte hemichannels and pannexons in the hippocampus, together with changes in neuroinflammation, intracellular Ca²⁺ and nitric oxide (NO) signaling, gliotransmitter release, cell arborization, and neuronal survival. Ethidium uptake recordings revealed that prenatal LPS exposure enhances the opening of astrocyte Cx43 hemichannels and Panx1 channels in the hippocampus of adult offspring mice. This enhanced channel activity occurred by a mechanism involving a microglia-dependent production of IL-1 β /TNF- α and the stimulation of p38 MAP kinase/iNOS/[Ca²⁺]_i-mediated signaling and purinergic/glutamatergic pathways. Noteworthy, the activity of Cx43 hemichannels affected the release of glutamate, [Ca²⁺]_i handling, and morphology of astrocytes, whereas also disturbed neuronal function, including the dendritic arbor and spine density, as well as survival. We speculate that excitotoxic levels of glutamate triggered by the activation of Cx43 hemichannels may contribute to hippocampal neurotoxicity and damage in prenatally LPS-exposed offspring. Therefore, the understanding of how astrocyte-neuron crosstalk is an auspicious avenue toward the development of broad treatments for several neurological disorders observed in children born to women who had a severe infection during gestation.

PMID: [31680871](#)

32. Multi-center results on the clinical use of KANET.

Kurjak A, Spalldi Barišić L, Stanojević M, Antsaklis P, Panchal S, Honemeyer U, Moreira Neto R, Tinjić S, Vladareanu R, Esin S, Bomba-Opon D, Mededović E, Hata T.

J Perinat Med. 2019 Nov 26;47(9):897-909. doi: 10.1515/jpm-2019-0281.

An extensive review of the literature on the diagnostic and clinical accuracy of Kurjak's antenatal neurodevelopmental test (KANET) and the summarized results of the multi-center study involving 10 centers revealed that four-dimensional ultrasonography (4D US) has become a powerful tool and KANET a valuable test that empowers the clinicians worldwide to evaluate the fetal behavior in a systematic way and contribute to the detection of fetuses that might be at high risk for neurological impairments and in particular cerebral palsy (CP). After 10 years of clinical use, many published papers and multi-center studies, hundreds of trained physicians and numerous tests performed all over the world, KANET has proven its value and has been showing encouraging results so far. The aim of this paper is to show the results from the studies done so far and to reveal the clinical value of the KANET. We expect that data from the larger ongoing collaborative study, the short- and long-term postnatal follow-up will continue to improve our knowledge. Ultimately, we all strive to prevent the CP disorders, autism spectrum disorder (ASD) and other neurological impairments and we are convinced that KANET might be helpful in the realization of this important aim.

PMID: [31677378](#)

33. Semi-automatic methods for tracking the medial gastrocnemius muscle-tendon junction using ultrasound: A validation study.

Cenni F, Bar-On L, Monari D, Schless SH, Kalkman B, Aertbeliën E, Desloovere K, Bruyninckx H.

Exp Physiol. 2019 Nov 2. doi: 10.1113/EP088133. [Epub ahead of print]

NEW FINDING: What is the central question of this study? Is the proposed semi-automatic algorithm suitable for tracking the medial gastrocnemius muscle-tendon junction in ultrasound images collected during passive and active conditions? What is the main finding and its importance? The validation of a method allowing efficient tracking of the muscle-tendon junction in both passive and active conditions, in healthy as well as in pathological conditions. This method was tested in common acquisition conditions and the developed software made freely available. **ABSTRACT:** Clinically-relevant information can be extracted from ultrasound (US) images by tracking the displacement of the junction between muscle and tendon. This paper validated automatic methods for tracking the location of muscle-tendon junction (MTJ) between the medial gastrocnemius and the Achilles tendon during passive slow and fast stretches, and active ankle rotations while walking on a treadmill. First, an

automatic algorithm based on an optical flow approach was applied on collected US images. Second, results of the automatic algorithm were evaluated and corrected using a quality measure that indicated which critical images need to be manually corrected. US images from 12 typically developed (TD) children, 12 children with spastic cerebral palsy (SCP) and 8 healthy adults were analysed. Automatic and semi-automatic tracking methods were compared to manual tracking using root mean square errors (RMSE). For the automatic tracking, RMSE was less than 3.1 mm for the slow stretch and 5.2 mm for the fast stretch, being the worst case in SCP. The tracking results in the fast stretch condition were improved (especially in SCP) by using the semi-automatic approach, with an RMSE reduction of about 30%. During walking, the semi-automatic method also reduced errors, with a final RMSE of 3.6 mm. In all cases, data processing was considerably shorter using the semi-automatic method (2 min) compared to manual tracking (20 min). A quick manual correction considerably improves tracking of the MTJ during gait and allows to achieve results suitable for further analyses. The proposed algorithm is freely available. This article is protected by copyright. All rights reserved.

PMID: [31677311](#)

34. Ophthalmologic disorders and risk factors in children with autism spectrum disorder.

Chang MY, Gandhi N, O'Hara M.

J AAPOS. 2019 Oct 29. pii: S1091-8531(19)30530-0. doi: 10.1016/j.jaapos.2019.09.008. [Epub ahead of print]

PURPOSE: To report the results of our review of all children with autism spectrum disorder (ASD) who underwent complete pediatric ophthalmologic examination at our institution over a 10-year period. **METHODS:** The medical records of all children (0-17 years of age) with a diagnosis of ASD seen at University of California, Davis, over a 10-year period were reviewed retrospectively. Demographic data, birth history, genetic testing results, neuropsychiatric comorbidities, and ophthalmologic findings were extracted from the record. Multiple logistic regression was used to identify risk factors for ophthalmologic disorders. **RESULTS:** A total of 2,555 children with ASD were seen at the university over the study period, of whom 380 (15%) were evaluated in the ophthalmology clinic. Eye examination revealed an ophthalmic diagnosis in 71% of children, of which the most common were significant refractive error (42%), strabismus (32%), and amblyopia (19%). Optic neuropathy occurred in 14 children (4%). Cerebral palsy was a significant risk factor for refractive error (OR = 3.22; P = 0.016), strabismus (OR = 3.59; P = 0.012), amblyopia (OR = 3.49; P = 0.0097), and optic neuropathy (OR = 14.0; P = 0.0009). **CONCLUSIONS:** Ophthalmic disorders were found in 71% of children with ASD evaluated at our university-based ophthalmology clinic. The rates of significant refractive error, strabismus, amblyopia, and optic neuropathy exceeded those of the general pediatric population. ASD and cerebral palsy may have additive risk for these disorders.

PMID: [31676470](#)

35. The relationship between caregiver burden and resilience and quality of life in a Turkish pediatric rehabilitation facility.

Keniş-Coşkun Ö, Atabay CE, Şekeroğlu A, Akdeniz E, Kasil B, Bozkurt G, Karadağ-Saygı E.

J Pediatr Nurs. 2019 Oct 29. pii: S0882-5963(19)30344-6. doi: 10.1016/j.pedn.2019.10.014. [Epub ahead of print]

PURPOSE: To investigate the effect of caregiver burden, resilience, and quality of life of the parents of patients who are followed-up in a tertiary pediatric rehabilitation clinic. **DESIGN AND METHODS:** This is a correlational cross-sectional study. Parents of patients who attend to utilize pediatric rehabilitation outpatient clinics of a tertiary center on a regular basis were invited to participate. All participants filled in the Zarit Caregiver Burden (ZCB) scale, Family Resilience scale (FRS) and Nottingham Health Profile (NHP). **RESULTS:** A total of 107 patient and caregiver dyads were included. Fifty-five (51%) patients had cerebral palsy, 10 (9%) had spina bifida and 42 (39%) had other neurodevelopmental disorders. Eighty-one (75%) of the caregivers were mothers. There was a significant difference in the caregiver burden between ambulatory children (Mean ZCB score 30.11 ± 13.56) and non-ambulatory patients (Mean ZCB score 37.22 ± 13.91) ($p = .01$). There were moderate negative correlations between caregiver burden and FRS commitment to life and FRS self-sufficiency subscales. Caregiver burden significantly positively correlated with all NHP domains. **CONCLUSIONS:** Caregiver burden is significantly higher in parents of non-ambulatory children when compared to ambulatory children in the pediatric rehabilitation setting. Caregiver burden and resilience correlated on moderate levels, but the factors influencing them are still unclear. **PRACTICE IMPLICATIONS:** Healthcare and social support should be given to all caregivers in pediatric rehabilitation setting, but more so to the caregivers of non-ambulatory patients.

PMID: [31676209](#)

Prevention and Cure

36. Targeted resequencing identifies genes with recurrent variation in cerebral palsy.

van Eyk CL, Corbett MA, Frank MSB, Webber DL, Newman M, Berry JG, Harper K, Haines BP, McMichael G, Woenig JA, MacLennan AH, Gecz J.

NPJ Genom Med. 2019 Nov 4;4:27. doi: 10.1038/s41525-019-0101-z. eCollection 2019.

A growing body of evidence points to a considerable and heterogeneous genetic aetiology of cerebral palsy (CP). To identify recurrently variant CP genes, we designed a custom gene panel of 112 candidate genes. We tested 366 clinically unselected singleton cases with CP, including 271 cases not previously examined using next-generation sequencing technologies. Overall, 5.2% of the naïve cases (14/271) harboured a genetic variant of clinical significance in a known disease gene, with a further 4.8% of individuals (13/271) having a variant in a candidate gene classified as intolerant to variation. In the aggregate cohort of individuals from this study and our previous genomic investigations, six recurrently hit genes contributed at least 4% of disease burden to CP: COL4A1, TUBA1A, AGAP1, L1CAM, MAOB and KIF1A. Significance of Rare VARIANTS (SORVA) burden analysis identified four genes with a genome-wide significant burden of variants, AGAP1, ERLIN1, ZDHHC9 and PROC, of which we functionally assessed AGAP1 using a zebrafish model. Our investigations reinforce that CP is a heterogeneous neurodevelopmental disorder with known as well as novel genetic determinants.

PMID: [31700678](#)

37. Stem cell treatment and cerebral palsy: Systemic review and meta-analysis.

Enggenberger S, Boucard C, Schoeberlein A, Guzman R, Limacher A, Surbek D, Mueller M.

World J Stem Cells. 2019 Oct 26;11(10):891-903. doi: 10.4252/wjsc.v11.i10.891.

BACKGROUND: Perinatal complications may result in life-long morbidities, among which cerebral palsy (CP) is the most severe motor disability. Once developed, CP is a non-progressive disease with a prevalence of 1-2 per 1000 live births in developed countries. It demands an extensive and multidisciplinary care. Therefore, it is a challenge for our health system and a burden for patients and their families. Recently, stem cell therapy emerged as a promising treatment option and raised hope in patients and their families. **AIM:** The aim is to evaluate the efficacy and safety of stem cell treatment in children with CP using a systematic review and meta-analysis. **METHODS:** We performed a systematic literature search on PubMed and EMBASE to find randomized controlled clinical trials (RCT) investigating the effect of stem cell transplantation in children with CP. After the review, we performed a random-effects meta-analysis focusing on the change in gross motor function, which was quantified using the gross motor function measure. We calculated the pooled standardized mean differences of the 6- and/or 12-month outcome by the method of Cohen. We quantified the heterogeneity using the I-squared measure. **RESULTS:** We identified a total of 8 RCT for a qualitative review. From the initially selected trials, 5 met the criteria and were included in the meta-analysis. Patients' population ranged from 0.5 up to 35 years (n = 282). We detected a significant improvement in the gross motor function with a pooled standard mean difference of 0.95 (95% confidence interval: 0.13-1.76) favoring the stem cell group and a high heterogeneity (I² = 90.1%). Serious adverse events were rare and equally distributed among both intervention and control groups. **CONCLUSION:** Stem cell therapy for CP compared with symptomatic standard care only, shows a significant positive effect on the gross motor function, although the magnitude of the improvement is limited. Short-term safety is present and further high-quality RCTs are needed.

PMID: [31692977](#)

38. Genetic variation in dopamine neurotransmission and motor development of infants born extremely-low-birthweight.

Worley G, Erickson SW, Gustafson KE, Nikolova YS, Ashley-Koch AE, Belsky DW, Goldstein RF, Page GP2, Cotten CM; Eunice Kennedy Shriver National Institute of Child Health and Human Development Neonatal Research Network.

Dev Med Child Neurol. 2019 Nov 6. doi: 10.1111/dmcn.14383. [Epub ahead of print]

AIM: To determine if genetic variation associated with decreased dopamine neurotransmission predicts a decrease in motor development in a convenience cohort study of infants born extremely-low-birthweight (ELBW). **METHOD:** Four hundred and ninety-eight infants born ELBW had genome-wide genotyping and a neurodevelopmental evaluation at 18 to 22 months of age, corrected for preterm birth. A polygenic risk score (PRS) was created to combine into one predictor variable the hypothesized influences on motor development of alleles at seven independent single nucleotide polymorphisms previously associated with

relative decreases in both dopamine neurotransmission and motor learning, by summing the number of alleles present in each infant (range=0-14). The motor development outcome was the Psychomotor Development Index (PDI) of the Bayley Scales of Infant Development, Second Edition. The linear regression models were adjusted for seven clinical and four genetic ancestry covariates. The mean PRS of infants with cerebral palsy (CP) was compared to those without CP. RESULTS: PRS was inversely related to PDI ($p=0.011$). Each 1-point increase in PRS resulted in an average decrease in PDI of 1.37 points. Patients with CP did not have a greater mean PRS than those without ($p=0.67$), both with and without adjustment for covariates. INTERPRETATION: Genetic variation that favors a decrease in dopamine neurotransmission predisposes to a decrease in motor development in infants born ELBW, but not to the diagnosis of CP.

PMID: [31691959](#)

39. Intraventricular Hemorrhage and White Matter Injury in Preclinical and Clinical Studies.

Romantsik O, Bruschetti M, Ley D.

Neoreviews. 2019 Nov;20(11):e636-e652. doi: 10.1542/neo.20-11-e636.

Germinal matrix-intraventricular hemorrhage (IVH) occurs in nearly half of infants born at less than 26 weeks' gestation. Up to 50% of survivors with IVH develop cerebral palsy, cognitive deficits, behavioral disorders, posthemorrhagic ventricular dilatation, or a combination of these sequelae. After the initial bleeding and the primary brain injury, inflammation and secondary brain injury might lead to periventricular leukomalacia or diffuse white matter injury. Potential factors that are involved include microglia and astrocyte activation, degradation of blood components with release of "toxic" products, infiltration of the brain by systemic immune cells, death of neuronal and glial cells, and arrest of preoligodendrocyte maturation. In addition, impairment of the blood-brain barrier may play a major role in the pathophysiology. A wide range of animal models has been used to explore causes and mechanisms leading to IVH-induced brain injury. Preclinical studies have identified potential targets for enhancing brain repair. However, little has been elucidated about the effectiveness of potential interventions in clinical studies. A systematic review of available preclinical and clinical studies might help identify research gaps and which types of interventions may be prioritized. Future trials should report clinically robust and long-term outcomes after IVH.

PMID: [31676738](#)