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Interventions and Management

1. Sacral-Alar-Iliac (SAI) Fixation in Children With Spine Deformity: Minimum 10-Year Follow-Up

Frederick Mun, Ashish Vankara, Krishna V Suresh, Adam Margalit, Khaled M Kebaish, Paul D Sponseller

J Pediatr Orthop. 2022 May 17. doi: 10.1097/BPO.0000000000002187. Online ahead of print.

Introduction: Sacral-alar-iliac (SAI) screws are utilized to achieve pelvic fixation in spine deformity patients. The primary purpose of this study is to investigate the long-term outcomes of pediatric patients with scoliosis treated with posterior spinal fusion and SAI fixation at 10-year clinical and radiographic follow-up. **Methods:** We reviewed the clinical and radiographic records of patients aged 18 years or below treated for scoliosis with posterior spinal fusion using SAI fixation. Pelvic obliquity and the major coronal curve were determined at the preoperative visit and 6-week, 1-year, 5-year, and 10-year postoperative visits. SAI screw-specific data collected included screw dimensions, rate of screw revision, pain at the SAI screw sites, presence of lucency >2 mm around the screw, screw loosening or breaking, and deep surgical site infections. **Results:** Ninety-seven of 151 patients (75%) were included. The average age at index surgery was 13.5 ± 3.1 years, and the most common diagnosis was cerebral palsy (67%). The mean duration of follow-up was 11 ± 3 years. The mean pelvic obliquity measured 20 ± 8.0 degrees preoperatively, and 8.7 ± 4.0 degrees at the 10-year follow-up. There were no significant difference in pelvic obliquity when comparing the 10-year follow-up visit with the 6-week postoperative follow-up. Average screw dimensions were 8.4×68.8 mm. By the 10-year follow-up, 4 patients (4%) had at least 1 SAI screw-related complication. Of these patients, 2 (2%) had pain at 1 SAI screw, 4 (4%) had lucency around the screw, and 3 (3%) had broken or loose screws. Two (2%) required SAI screw revision because of late deep wound infection, and underwent exchange with a longer screw. There were no intrapelvic protrusions, vascular, or neurological complications. **Conclusions:** SAI screws are a safe and effective method for pelvic fixation in children with spinal deformity. The outcomes at ≥ 10 years are satisfactory, with low rates of long-term complications and excellent postoperative correction and subsequent maintenance of coronal curvature and pelvic obliquity over time.

PMID: [35575763](#)

2. Seating system for scoliosis in nonambulatory children with cerebral palsy: a randomized controlled trial

Merve Damla Korkmaz, Murat Korkmaz, Nalan Capan, Goktug Sanli, Yasar Tatar, Ayse Resa Aydin

Randomized Controlled Trial Rev Assoc Med Bras (1992). 2022 May;68(5):616-621. doi: 10.1590/1806-9282.20211260.

Objective: This study aimed to investigate the effect of an adaptive seating system on pelvic obliquity and spinal coronal/sagittal balance in children with nonambulatory cerebral palsy and scoliosis. **Methods:** This was a single-blind, prospective, randomized interventional study. Nonambulatory children aged 6-15 years with cerebral palsy and scoliosis were included. The seating system was used for 4 h/day, and exercises were performed 3 days/week for 12 weeks. The Cobb angle, spinopelvic parameters, pelvic obliquity, Reimer's migration index, and Sitting Assessment Scale were measured before and

after treatments. Results: A total of 29 participants were randomized into two groups, namely, the seating system+exercise group (SSE-group; n=15) and the exercise group (E-group; n=14). There was no significant change in Cobb angle and Reimer's migration index for both hips in SSE-group, but there was a significant increase in E-group ($p=0.002$, 0.049 , and 0.003 , respectively). The sagittal vertical axis, pelvic incidence, and pelvic obliquity decreased in SSE-group. However, there was no difference in the other sagittal parameters and Sitting Assessment Scale-total scores among groups. Conclusion: The adaptive seating system was found to be superior in reducing the progression of Cobb angle and hip subluxation/dislocation, decreasing pelvic obliquity, and improving the sagittal balance of the spine/pelvis compared with exercise therapy.

PMID: [35584484](#)

3. Is it necessary to fuse to the pelvis when correcting scoliosis in cerebral palsy?

Shane F Strom, Matthew C Hess, Achraf H Jardaly, Michael J Conklin, Shawn R Gilbert

World J Orthop. 2022 Apr 18;13(4):365-372. doi: 10.5312/wjo.v13.i4.365.

Background: Neuromuscular scoliosis is commonly associated with a large pelvic obliquity. Scoliosis in children with cerebral palsy is most commonly managed with posterior spinal instrumentation and fusion. While consensus is reached regarding the proximal starting point of fusion, controversy exists as to whether the distal level of spinal fusion should include the pelvis to correct the pelvic obliquity. Aim: To assess the role of pelvic fusion in posterior spinal instrumentation and fusion, particularly its impact on pelvic obliquity correction, and to assess if the rate of complications differed as a function of pelvic fusion. Methods: This was a retrospective, cohort study in which we reviewed the medical records of children with cerebral palsy scoliosis treated with posterior instrumentation and fusion at a single institution. Minimum follow-up was six months. Patients were stratified into two groups: Those who were fused to the pelvis and those fused to L4/L5. The major outcomes were complications and radiographic parameters. The former were stratified into major and minor complications, and the latter consisted of preoperative and final Cobb angles, L5-S1 tilt and pelvic obliquity. Results: The study included 47 patients. The correction of the L5 tilt was 60% in patients fused to the pelvis and 67% in patients fused to L4/L5 ($P = 0.22$). The pelvic obliquity was corrected by 43% and 36% in each group, respectively ($P = 0.12$). Regarding complications, patients fused to the pelvis had more total complications as compared to the other group (63.0% vs 30%, respectively, $P = 0.025$). After adjusting for differences in radiographic parameters (lumbar curve, L5 tilt, and pelvic obliquity), these patients had a 79% increased chance of developing complications (Relative risk = 1.79; 95%CI: 1.011-3.41). Conclusion: Including the pelvis in the distal level of fusion for cerebral palsy scoliosis places patients at an increased risk of postoperative complications. The added value that pelvic fusion offers in terms of correcting pelvic obliquity is not clear, as these patients had similar percent correction of their pelvic obliquity and L5 tilt compared to children whose fusion was stopped at L4/L5. Therefore, in a select patient population, spinal fusion can be stopped at the distal lumbar levels without adversely affecting the surgical outcomes.

PMID: [35582151](#)

4. GMFCS Level-Specific Differences in Kinematics and Joint Moments of the Involved Side in Unilateral Cerebral Palsy

Stefanos Tsitlakidis, Nicholas A Beckmann, Sebastian I Wolf, Sébastien Hagmann, Tobias Renkawitz, Marco Götze

J Clin Med. 2022 May 2;11(9):2556. doi: 10.3390/jcm11092556.

A variety of gait pathologies is seen in cerebral palsy. Movement patterns between different levels of functional impairment may differ. The objective of this work was the evaluation of Gross Motor Function Classification System (GMFCS) level-specific movement disorders. A total of 89 individuals with unilateral cerebral palsy and no history of prior treatment were included and classified according to their functional impairment. GMFCS level-specific differences, kinematics and joint moments, exclusively of the involved side, were analyzed for all planes for all lower limb joints, including pelvic and trunk movements. GMFCS level I and level II individuals most relevantly showed equinus/reduced dorsiflexion moments, knee flexion/reduced knee extension moments, reduced hip extension moments with pronounced flexion, internal hip rotation and reduced hip abduction. Anterior pelvic tilt, obliquity and retraction were found. Individuals with GMFCS level II were characterized by an additional pronounced reduction in all extensor moments, pronounced rotational malalignment and reduced hip abduction. The most striking characteristics of GMFCS level II were excessive anterior pelvic/trunk tilt and excessive trunk obliquity. Pronounced reduction in extensor moments and excessive trunk lean are distinguishing features of GMFCS level II. These patients would benefit particularly from surgical treatment restoring pelvic symmetry and improving hip abductor leverage. Future studies exploring GMFCS level-specific compensation of the sound limb and GMFCS level-specific malalignment are of interest.

PMID: [35566682](#)

5. Gait adaptations of individuals with cerebral palsy on irregular surfaces: A scoping review

C Dussault-Picard, S G Mohammadyari, D Arvisais, M T Robert, P C Dixon

Review Gait Posture. 2022 May 10;96:35-46. doi: 10.1016/j.gaitpost.2022.05.011. Online ahead of print.

Background: Individuals with cerebral palsy (CP) have a reduced ability to perform motor tasks such as walking. During daily walking, they are confronted with environmental constraints such as irregular surfaces (e.g., relief and uneven surfaces) which may require adaptations to maintain stability and avoid falls. Laboratory gait assessments are conventionally conducted under ideal conditions (e.g., regular and even surfaces) and may overlook subtle problems which may only present in challenging walking environments. Increased knowledge of adaptations to successfully navigate irregular surfaces may contribute to a better understanding of everyday walking barriers. **Research question:** This scoping review aims to describe gait adaptations to irregular surfaces in individuals with CP and contrast adaptations with those of healthy individuals. **Methods:** This review followed the 6-stage Joanna Briggs Institute methodology and respected the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews statement. The MEDLINE, EMBASE, CINAHL, SPORTDiscus, and Web of Science databases were searched on March 2021. **Results:** The research strategy identified 1616 studies published between 2014 and 2020, of which 10 were included after abstract and full-text screening. This review reported on 152 individuals with CP (diplegia: n = 117, hemiplegia: n = 35) and 159 healthy individuals. The included studies focused on spatial-temporal, kinematic, kinetic, and muscle activity parameters over relief, inclined, and staircase surfaces. 7/10 studies were conducted in laboratories, often using surfaces that are not representative of the real-world. The results suggest that for individuals with CP, adaptations on irregular surfaces differ from flat surface walking and across CP subtype. Moreover, individuals with CP present with typical and pathology-specific adaptations to irregular surfaces compared to healthy individuals. **Significance:** This review highlights the clinical and research interest of focusing future studies on more ecologically valid data collection approaches and provides important recommendations to overcome research gaps in the existing literature.

PMID: [35567895](#)

6. Effects of group-activity intervention with multisensory storytelling on gross motor function and activity participation in children with cerebral palsy

Eun-Jung Lee, Hae-Yeon Kwon

J Exerc Rehabil. 2022 Apr 26;18(2):96-103. doi: 10.12965/jer.2244028.014. eCollection 2022 Apr.

This study determined the effectiveness of 16 multisensory storytelling sessions on physical function and activity participation in children with cerebral palsy. Twenty-four children aged 7 to 8 who belonged to stage I to III of the Gross Motor Function Classification System were randomly divided into experimental and control groups, with 12 children in each group. The experimental group performed group activities through multisensory storytelling for 60 min, twice a week for 8 weeks, while the control group performed structured physical activities. The motor function, activity participation, and peer relationship skills were measured. The collected data were analyzed using the SPSS 25.0 for windows program, and the significance level (α) for statistical verification was set to 0.05. The Wilcoxon signed-rank test was performed for intragroup changes in motor function and activity participation in the experimental and control groups. The Mann-Whitney U-test was used to compare the difference between the 2 groups. Both groups improved gross motor function ($P < 0.05$) and activity participation ($P < 0.05$). A significant difference between both groups was also measured. Multisensory storytelling resulted in significant improvements in large motor function and activity participation. Therefore, it can be an effective intervention for improving gross motor function and activity participation in children with cerebral palsy.

PMID: [35582682](#)

7. Effectiveness of nutritional interventions to prevent nonprogressive congenital and perinatal brain injuries: a systematic review and meta-analysis of randomized trials

Cintia C Curioni, Michel C Mocellin, Marina Dos S Tavares, Ana C F da Silva, Patricia C de Velasco, Simone A Ribas, Fernando Lamarca, Charles André

Nutr Rev. 2022 May 14;nuac028. doi: 10.1093/nutrit/nuac028. Online ahead of print.

Context: Nutritional interventions for newborns with brain injury are scarce, and there are gaps in the knowledge of their mechanisms of action in preventing the occurrence of cerebral palsy (CP) or the incidence of other developmental disabilities. Objective: The objective of this review was to assess the effect of nutritional interventions in preventing nonprogressive congenital or perinatal brain injuries, or in improving outcomes related to neurological development. Data sources: Randomized trials on any nutritional intervention for pregnant women at risk of preterm delivery, or for children with low birth weight, preterm, or with confirmed or suspected microcephaly, CP, or fetal alcohol syndrome disorders (FASDs) were retrieved from MEDLINE, Embase, Scopus, Web of Science, LILACS, and CENTRAL databases from inception to September 17, 2020. Data extraction: Data extraction, risk of bias (Cochrane Risk of Bias tool 2), and quality of evidence (GRADE approach) were assessed by 2 authors. Data analysis: Pooled risk ratios (RRs) with 95% confidence intervals were calculated using a random-effects meta-analysis. Seventeen studies were included on intravenous interventions (magnesium sulfate [n = 5], amino acids [n = 4], vitamin A [n = 1], and N-acetylcysteine [n = 1]); enteral interventions (vitamin D [n = 1], probiotic [n = 1], nutrient-enriched formula [n = 1], and speed of increasing milk feeds [n = 1]); and oral interventions (choline [n = 1] and docosahexaenoic acid, choline, and uridine monophosphate [n = 1]). All studies assessed CP, except 1 on FASDs. Eight studies were judged as having high risk of bias. Five studies (7413 babies) with high-quality evidence demonstrated decreased risk of childhood CP (RR = 0.68, 95% CI: 0.52-0.88) with magnesium sulfate. Interventions with amino acids had no effect on CP prevention or other outcomes. Except for 1 study, no other intervention decreased the risk of CP or FASDs. Conclusion: Although different types of nutritional interventions were found, only those with antenatal magnesium sulfate were effective in decreasing CP risk in preterm infants. Well-designed, adequately powered randomized clinical trials are required.

PMID: [35568996](#)

8. Baclofen Toxicity

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In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan. 2022 Mar 24.

Baclofen is FDA-approved and primarily used as an antispasmodic agent and muscle relaxant. It is utilized as an adjunct in treating painful muscle spasticity, clonus, and rigidity caused by spinal-cord related diseases such as multiple sclerosis, cerebral palsy, or spinal cord injury. It is most often administered as an oral medication, but in severe or chronic cases, and can also be delivered centrally using an implantable intrathecal pump. Chronic use of baclofen can result in withdrawal when abruptly discontinued. Baclofen overdose or withdrawal can be life-threatening. This review summarizes the clinical toxicity of baclofen, baclofen withdrawal, and acute management principles.

PMID: [35593857](#)

9. Outcomes of a novel single case study incorporating Rapid Syllable Transition treatment, AAC and blended intervention in children with cerebral palsy: a pilot study

Marjut Johanna Korkalainen, Patricia McCabe, Andy Smidt, Catherine Morgan

Disabil Rehabil Assist Technol. 2022 May 16;1-10. doi: 10.1080/17483107.2022.2071488. Online ahead of print.

Purpose: Motor speech and augmentative and alternative communication (AAC) interventions are commonly used with children with cerebral palsy (CP) but there is limited literature comparing the effectiveness of these interventions. The purpose of this study was to investigate the effectiveness of intensive AAC, Rapid Syllable Transition Treatment (ReST), and blended intervention, a combination of motor-speech and AAC, on speech accuracy and sentence length and complexity. Methods: A single case experimental design across participants with repeated measurements across phases (ABACADA design) was used. Four participants aged 8-14 years with CP who used a speech-generating device (SGD) received three 6-week intervention blocks that included ReST, AAC, and blended intervention. Measures were taken during intervention and baseline phases and at maintenance two and four weeks after the last intervention phase. Participants were randomized to starting with either ReST or AAC with the blended intervention delivered last. Results: All participants improved their speech accuracy and sentence length and complexity in speech and with their SGD in all three interventions. The data demonstrated overall immediacy of the effect with all interventions and retention of gains across the whole sequence of phases. The order of AAC or ReST interventions or the severity of CP did not impact the intervention gains. Conclusion: This study suggests that intensive AAC, a multi-modal approach, and ReST improve speech accuracy and sentence length and complexity in children with moderate CP, but all require further investigation. Implications for rehabilitation In this paper intensive AAC intervention with a speech generating device (SGD), ReST treatment and multimodal blended intervention were effective in improving speech accuracy and sentence length and complexity in both verbal speech and on communication with the SGD. ReST treatment has not been used with children with CP before. This study established a proof of concept for its effectiveness in children with CP. Further research is warranted.

PMID: [35576498](#)

10. Determinants of spoken language comprehension in children with cerebral palsy

Emma Vaillant, Johanna J M Geytenbeek, Kim J Oostrom, Heleen Beckerman, R Jeroen Vermeulen, Annemieke I Buizer

Disabil Rehabil. 2022 May 15;1-13. doi: 10.1080/09638288.2022.2072960. Online ahead of print.

Purpose: To identify determinants of spoken language comprehension (SLC) in children with cerebral palsy (CP). **Materials and methods:** Cross-sectional data of 207 children with CP were included: 82 toddlers (18 months-3;11 years), 59 preschool children (4;0-5;11 years), and 66 schoolchildren (6;0-8;11 years), across all Gross Motor Function Classification System (GMFCS) levels. SLC was assessed using the Computer-Based instrument for Low motor Language Testing (C-BiLLT). Potential determinants were retrieved from medical files and through parental questionnaires. Per developmental stage, multivariable regression analyses were used to assess determinants of SLC. **Results:** Fifty-nine percent of the children showed below average SLC. Significant determinants for SLC differed per developmental stage. In toddlers: age, motor type, functional communication and speech function ($R^2 = 0.637$); in preschool children: functional communication, speech function and language activities ($R^2 = 0.820$), and in schoolchildren: functional communication, intellectual functioning and arm-hand functioning ($R^2 = 0.807$). For all developmental stages, functional mobility was not a significant determinant. **Conclusions:** A large proportion of children with CP across all GMFCS levels have SLC impairments. Findings indicate that SLC is strongly determined by functional communication classified with CFCS. We recommend standardized assessment and monitoring of SLC in all children with CP. **IMPLICATIONS FOR REHABILITATION** Children across all GMFCS levels can experience difficulties in spoken language comprehension. At all developmental stages, functional communication (classified with CFCS) is an important determinant of spoken language comprehension. Standardized assessment and monitoring of spoken language comprehension, language production, speech, and communication of all children with CP, is strongly recommended. When children show below average performances, especially in spoken language comprehension, intervening with speech and language therapy and guidance for parents, is advised.

PMID: [35574615](#)

11. At-Home Orthodontic Treatment for Severe Teeth Arch Malalignment and Severe Obstructive Sleep Apnea Syndrome in a Child with Cerebral Palsy

Atsuko Tamura, Kohei Yamaguchi, Ryosuke Yanagida, Rie Miyata, Haruka Tohara

Case Reports Int J Environ Res Public Health. 2022 Apr 27;19(9):5333. doi: 10.3390/ijerph19095333.

Children with cerebral palsy typically have severe teeth arch malalignment, causing swallowing and respiration dysfunction. Malalignment in cerebral palsy, especially in children, worsens dysphagia and respiratory disorders; sometimes, it is also noted with obstructive sleep apnea. However, no study has reported on the improvement in obstructive sleep apnea after at-home orthodontic treatment in children with cerebral palsy. We herein present a pediatric case of cerebral palsy wherein obstructive sleep apnea improved with at-home orthodontic treatment for malalignment. We administered at-home orthodontic treatment to a 15-year-old boy with quadriplegia, due to spastic-type cerebral palsy, having no oral intake, obstructive sleep apnea, and teeth arch malalignment. After treatment, a decline in the severity of sleep apnea was observed. Perioral muscle hypertension and oral intake difficulties cause maxillary protrusion, narrowed teeth arch, and tilting of teeth in children with cerebral palsy. We expanded the oral cavity volume by orthodontic treatment to relieve muscle hypertension and correct the tongue position, thereby remarkably improving obstructive sleep apnea. Our findings suggest that at-home orthodontic treatment for malalignment effectively improves perioral muscle hypertension, glossoptosis, and obstructive sleep apnea.

PMID: [35564726](#)

12. Robotic Systems for the Physiotherapy Treatment of Children with Cerebral Palsy: A Systematic Review

Rocío Llamas-Ramos, Juan Luis Sánchez-González, Inés Llamas-Ramos

Review Int J Environ Res Public Health. 2022 Apr 22;19(9):5116. doi: 10.3390/ijerph19095116.

Cerebral palsy is a neurological condition that is associated with multiple motor alterations and dysfunctions in children.

Robotic systems are new devices that are becoming increasingly popular as a part of the treatment for cerebral palsy. A systematic review of the Pubmed, Web of Science, MEDLINE, Cochrane, Dialnet, CINAHL, Scopus, Lilacs and PEDro databases from November 2021 to February 2022 was conducted to prove the effectiveness of these devices for the treatment of motor dysfunctions in children who were diagnosed with cerebral palsy. Randomized clinical trials in Spanish and English were included. In total, 653 potential manuscripts were selected but only 7 of them met the inclusion criteria. Motor dysfunctions in the lower limbs and those that are specifically related to gait are the main parameters that are affected by cerebral palsy and the robotic systems Lokomat, Innowalk, Robogait and Waltbox-K are the most commonly used. There is no consensus about the effectiveness of these devices. However, it seems clear that they have presented a good complement to conventional physical therapies, although not a therapy as themselves. Unfortunately, the low quality of some of the randomized clinical trials that were reviewed made it difficult to establish conclusive results. More studies are needed to prove and test the extent to which these devices aid in the treatment of children with cerebral palsy.

PMID: [35564511](#)

13. The efficacy of virtual reality interventions compared with conventional physiotherapy in improving the upper limb motor function of children with cerebral palsy: a systematic review of randomised controlled trials

Mohammed Alrashidi, Curtis A Wadey, Richard J Tomlinson, Gavin Buckingham, Craig A Williams

Disabil Rehabil. 2022 May 16;1-11. doi: 10.1080/09638288.2022.2071484. Online ahead of print.

Purpose: Cerebral palsy (CP) is the commonest motor disability affecting children. This study reviewed the evidence for virtual reality (VR) intervention compared with conventional physiotherapy in upper limb function of children with CP. **Methods:** Searches were undertaken in MEDLINE, EMBASE, PEDro, CENTRAL, Web of Science, CINAHL, ERIC, ICTRP, EU-CTR, ClinicalTrials.gov and EThOS databases. Only randomised-controlled trials (RCTs) were included. Two reviewers independently screened the search results, assessed full-text articles, extracted data and appraised the methodological quality by using the Cochrane collaboration's risk of bias (RoB2) tool. Albatross plots were used to synthesise the data. **Results:** Seven RCTs, examining motor function in a total of 202 children with CP, included. Four trials used the Quality of Upper Extremity Skills Test (QUEST) as an outcome measure, and three trials used grip strength. These outcome measures were utilised to develop two Albatross plots. Data from the plots showed contradictory findings of the included studies. **Conclusions:** The effect of VR in the upper limb rehabilitation of children with CP remains unclear. All included studies used commercial non-immersive VR games. Future high-quality clinical research is needed to explore the extent to which non-immersive and immersive VR is feasible and effective with children and adolescents. **IMPLICATIONS FOR REHABILITATION** The current evidence supporting the use of VR as a rehabilitative tool is weak and uncertain. The current use of VR relies only on commercial non-immersive VR (off-shelf) games, which are not adjustable to meet the demands and goals of therapy programmes. Future research is needed to study the therapeutic feasibility of immersive VR with children and adolescents.

PMID: [35575755](#)

14. Effect of virtual reality and haptic feedback on upper extremity function and functional independence in children with hemiplegic cerebral palsy: a research protocol

Chanan Goyal, Vishnu Vardhan, Waqar Naqvi, Sakshi Arora

Pan Afr Med J. 2022 Feb 22;41:155. doi: 10.11604/pamj.2022.41.155.32475. eCollection 2022.

Hemiplegic cerebral palsy (CP) is a subcategory of CP which is characterized by sensory motor deficits primarily on one side of the body that adversely affects functionality. Virtual reality (VR) systems have been advanced in the recent past for the use in rehabilitation of patients with neurological conditions. Virtual reality has an inherent motivational component that provides the much-needed compliance for active participation by children. The rationale of the proposed study is to investigate the effect of VR and haptic feedback for improvement of upper extremity function of children with hemiplegic cerebral palsy. This comparative experimental study will be recruiting 36 children with hemiplegic CP and will be treating them by VR and haptic feedback along with conventional physiotherapy in group A and by conventional physiotherapy only in group B. The children will undergo the treatment for six weeks (five days/week) with each session extending for 60 minutes/day. The primary outcome measures including 'nine-hole peg test' (9HPT) and 'box and block test' (BBT) will assess the manual dexterity and secondary outcome measures including 'ABILHAND-kids' and 'WeeFIM (self-care)' will assess the functional independence that are hypothesized to be gained by haptic enhanced VR intervention when combined with the conventional therapy.

PMID: [35573442](#)

15. Does ultrasound imaging of the spastic muscle have an additive effect on clinical examination tools in patients with cerebral palsy?: A pilot study

Kardelen Gencer Atalay, Evrim Karadag Saygi, Firat Akbas, Ozge Kenis Coskun, Ahmet Hamdi Akgulle, Ilker Yagci

North Clin Istanbul. 2022 Mar 11;9(2):102-108. doi: 10.14744/10.14744/nci.2020.78045. eCollection 2022.

Objective: The Modified Ashworth Scale, the Modified Tardieu Scale, and measuring the passive range of motion is commonly preferred examination tools for spasticity in cerebral palsy (CP). Ultrasonography has become increasingly used to provide relevant insight into spastic muscle morphology and structure recently. It was aimed to reveal associations between the clinical and ultrasonographic parameters of gastrocnemius medialis (GM) and lateralis muscles in this population. **Methods:** Thirty-four children with spastic CP aged between 4 and 12 years who did not have botulinum neurotoxin A intervention within 6 months or had no previous history of any orthopedic or neurological surgery were included. The spasticity of GM and lateralis was evaluated firstly by the Modified Ashworth Scale, Modified Tardieu Scale, and ankle passive range of motion. Then, the cross-sectional area (CSA), muscle thickness (MT), qualitative and quantitative echo intensity (EI) values of both muscles were measured from their ultrasonographic images. **Results:** The CSA of GM, and qualitative EI of both muscles were found to be mild-to-moderately correlated to all clinical examination tools ($p < 0.01$), whereas the CSA of gastrocnemius lateralis was mildly related to Modified Ashworth Scale ($p = 0.009$). The MT and quantitative EI of both muscles were not associated with any of the clinical tools ($p > 0.05$). **Conclusion:** Ultrasonographic measurements of GM and lateralis partially reflect ankle spasticity in children with CP. Ultrasonography can be used as an alternative tool in this patient population where the clinical evaluation can not perform ideally.

PMID: [35582513](#)

16. A Power-Efficient Brain-Machine Interface System with a Sub-mW Feature Extraction and Decoding ASIC Demonstrated in Nonhuman Primates

Hyochan An, Samuel R Nason-Tomaszewski, Jongyup Lim, Kyumin Kwon, Matthew S Willsey, Parag G Patil, Hun-Seok Kim, Dennis Sylvester, Cynthia A Chestek, David Blaauw

IEEE Trans Biomed Circuits Syst. 2022 May 20;PP. doi: 10.1109/TBCAS.2022.3175926. Online ahead of print.

Intracortical brain-machine interfaces have shown promise for restoring function to people with paralysis, but their translation to portable and implantable devices is hindered by their high power consumption. Recent devices have drastically reduced power consumption compared to standard experimental brain-machine interfaces, but still require wired or wireless connections to computing hardware for feature extraction and inference. Here, we introduce a Neural Recording And Decoding (NeuRAD) application specific integrated circuit (ASIC) in 180 nm CMOS that can extract neural spiking features and predict two-dimensional behaviors in real-time. To reduce amplifier and feature extraction power consumption, the NeuRAD has a hardware accelerator for extracting spiking band power (SBP) from intracortical spiking signals and includes an M0 processor with a fixed-point Matrix Acceleration Unit (MAU) for efficient and flexible decoding. We validated device functionality by recording SBP from a nonhuman primate implanted with a Utah microelectrode array and predicting the one- and two-dimensional finger movements the monkey was attempting to execute in closed-loop using a steady-state Kalman filter (SSKF). Using the NeuRAD's real-time predictions, the monkey achieved 100 % success rate and 0.82 s mean target acquisition time to control one-dimensional finger movements using just 581 μW . To predict two-dimensional finger movements, the NeuRAD consumed 588 μW to enable the monkey to achieve a 96 % success rate and 2.4 s mean acquisition time. By employing SBP, ASIC brain-machine interfaces can close the gap to enable fully implantable therapies for people with paralysis.

PMID: [35594208](#)

17. Impact of Preterm Birth on Neurodevelopmental Disorders in South Korea: A Nationwide Population-Based Study

Jong Ho Cha, Ja-Hye Ahn, Yun Jin Kim, Bong Gun Lee, Johanna Inhyang Kim, Hyun-Kyung Park, Bung-Nyun Kim, Hyun Ju Lee

J Clin Med. 2022 Apr 28;11(9):2476. doi: 10.3390/jcm11092476.

Neurodevelopmental disorder (NDD) in preterm infants has become of great interest. We aimed to investigate the impact of preterm birth on the proportion of NDD using nationwide data provided by the Korean National Health Insurance Service. We

included 4894 extremely preterm or extremely low-birth-weight (EP/ELBW; <28 weeks of gestation or birth weight < 1000 g) infants, 70,583 other preterm or low-birth-weight (OP/LBW; 28-36 weeks of gestation or birth weight < 2500 g) infants, and 264,057 full-term infants born between 2008 and 2015. We observed their neurodevelopment until 6 years of age or until the year 2019, whichever occurred first. Diagnoses of NDDs were based on the World Health Organization's International Classification of Diseases 10th revision. An association between preterm birth and NDD was assessed using a multivariable logistic regression model. There was a stepwise increase in the risk of overall NDD with increasing degree of prematurity, from OP/LBW (adjusted odds ratio 4.46; 95% confidence interval 4.34-4.58), to EP/ELBW (16.15; 15.21-17.15). The EP/ELBW group was strongly associated with developmental delay (21.47; 20.05-22.99), cerebral palsy (88.11; 79.89-97.19), and autism spectrum disorder (11.64; 10.37-13.06). Preterm birth considerably increased the risk of NDD by the degree of prematurity.

PMID: [35566601](#)

18. Prevalence and characteristics of children with cerebral palsy according to socioeconomic status of areas of residence in a French department

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PLoS One. 2022 May 19;17(5):e0268108. doi: 10.1371/journal.pone.0268108. eCollection 2022.

Aim: To study the association between the socioeconomic environment of area of residence and prevalence and characteristics of children with cerebral palsy (CP). **Method:** Data on 8-year-old children with CP born in 2000-2011 (n = 252) were extracted from a regional population-based register in France. The European Deprivation Index (EDI), available at census block level, characterised socioeconomic deprivation in the child's area of residence at age of registration. The prevalence of CP was estimated in each group of census units defined by EDI distribution tertiles in the general population. The association between deprivation level and CP severity was assessed according to term/preterm status. **Results:** CP prevalence differed between deprivation risk groups showing a J-shaped form with the prevalence in the most deprived tertile (T3) being the highest but not significantly different of the prevalence in the least deprived one (T1). However, the prevalence in the medium deprivation tertile (T2) was significantly lower than that in the most deprived one with a prevalence risk ratio (PRR) of: $PRR_{T2/T3} = 0.63$ 95% CI [0.44-0.89]. Prevalences of CP with associated intellectual disability (ID) and CP with inability to walk were significantly higher in the most deprived tertile compared to the least deprived one (respectively $PRR_{T3/T1} = 1.86$ 95% CI [1.19-2.92] and $PRR_{T3/T1} = 1.90$ 95% CI [1.07-3.37]). Compared to children living in the least deprived areas, children with CP born preterm living in the most deprived areas had more severe forms of motor impairment, such as an inability to walk or a combination of an inability to walk and moderate to severe impairment of bimanual function. They also had more associated intellectual disability. No associations were observed among term-born children. **Interpretation:** A significant association between area deprivation group and CP severity was observed among preterm children but not among term-born children.

PMID: [35588131](#)

19. Defining longer term outcomes in an ovine model of moderate perinatal hypoxia-ischemia

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Dev Neurosci. 2022 May 19. doi: 10.1159/000525150. Online ahead of print.

Hypoxic-ischemic encephalopathy (HIE) is the leading cause of neonatal morbidity and mortality worldwide. Approximately 1 million infants born with HIE each year survive with cerebral palsy (CP) and/or serious cognitive disabilities. While infants born with mild and severe HIE frequently result in predictable outcomes, infants born with moderate HIE exhibit variable outcomes that are highly unpredictable. Here, we describe an umbilical cord occlusion (UCO) model of moderate HIE with a 6-day follow-up. Near term lambs (n=27) are resuscitated after the induction of 5 minutes of asystole. Following recovery, lambs are assessed to define neurodevelopmental outcomes. At the end of this period, lambs are euthanized, and brains harvested for histological analysis. Compared with prior models that typically follow lambs for 3 days, the observation of neurobehavioral outcomes for 6 days enables identification of animals that recover significant neurological function. Approximately 35 % of lambs exhibited severe motor deficits throughout the entirety of the 6-day course and, in the most severely affected lambs, developed spastic diparesis similar to that observed in infants who survive severe neonatal HIE (severe, UCOs). Importantly, and similar to outcomes in human neonates, while initially developing significant acidosis and encephalopathy, the remainder of the lambs in this model recovered normal motor activity and exhibited normal neurodevelopmental outcomes by 6 days of life (improved, UCOi). The UCOs group exhibited gliosis and inflammation in both white and gray matter, oligodendrocyte

loss, and neuronal loss and cellular death in the hippocampus and cingulate cortex. While the UCO_i group exhibited more cellular death and gliosis in the parasagittal cortex and demonstrated more preserved white matter markers, along with reduced markers of inflammation and lower cellular death and neuronal loss in Ca3 of the hippocampus compared with UCOs lambs. Our large animal model of moderate HIE with prolonged follow-up will help further define pathophysiologic drivers of brain injury while enabling identification of predictive biomarkers that correlate with disease outcomes and ultimately help support development of therapeutic approaches to this challenging clinical scenario.

PMID: [35588703](#)

20. A unique cerebellar pattern of microglia activation in a mouse model of encephalopathy of prematurity

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Glia. 2022 May 17. doi: 10.1002/glia.24190. Online ahead of print.

Preterm infants often show pathologies of the cerebellum, which are associated with impaired motor performance, lower IQ and poor language skills at school ages. Using a mouse model of inflammation-induced encephalopathy of prematurity driven by systemic administration of pro-inflammatory IL-1 β , we sought to uncover causes of cerebellar damage. In this model, IL-1 β is administered between postnatal day (P) 1 to day 5, a timing equivalent to the last trimester for brain development in humans. Structural MRI analysis revealed that systemic IL-1 β treatment induced specific reductions in gray and white matter volumes of the mouse cerebellar lobules I and II (5% false discovery rate [FDR]) from P15 onwards. Preceding these MRI-detectable cerebellar volume changes, we observed damage to oligodendroglia, with reduced proliferation of OLIG2+ cells at P10 and reduced levels of the myelin proteins myelin basic protein (MBP) and myelin-associated glycoprotein (MAG) at P10 and P15. Increased density of IBA1+ cerebellar microglia were observed both at P5 and P45, with evidence for increased microglial proliferation at P5 and P10. Comparison of the transcriptome of microglia isolated from P5 cerebellums and cerebrums revealed significant enrichment of pro-inflammatory markers in microglia from both regions, but cerebellar microglia displayed a unique type I interferon signaling dysregulation. Collectively, these data suggest that perinatal inflammation driven by systemic IL-1 β leads to specific cerebellar volume deficits, which likely reflect oligodendrocyte pathology downstream of microglial activation. Further studies are now required to confirm the potential of protective strategies aimed at preventing sustained type I interferon signaling driven by cerebellar microglia as an important therapeutic target.

PMID: [35579329](#)

21. Androgens Upregulate Pathogen-Induced Placental Innate Immune Response

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Int J Mol Sci. 2022 Apr 29;23(9):4978. doi: 10.3390/ijms23094978.

Group B Streptococcus (GBS) is a leading cause of placental infection, termed chorioamnionitis. Chorioamnionitis is associated with an increased risk of neurobehavioral impairments, such as autism spectrum disorders, which are more prominent in males than in female offspring. In a pre-clinical model of chorioamnionitis, a greater inflammatory response was observed in placenta associated with male rather than female fetuses, correlating with the severity of subsequent neurobehavioral impairments. The reason for this sex difference is not understood. Our hypothesis is that androgens upregulate the placental innate immune response in male fetuses. Lewis dams were injected daily from gestational day (G) 18 to 21 with corn oil (vehicle) or an androgen receptor antagonist (flutamide). On G 19, dams were injected with saline (control) or GBS. Maternal, fetal sera and placentas were collected for protein assays and in situ analyses. Our results showed that while flutamide alone had no effect, a decrease in placental concentration of pro-inflammatory cytokines and infiltration of polymorphonuclear cells was observed in flutamide/infected compared to vehicle/infected groups. These results show that androgens upregulate the placental innate immune response and thus may contribute to the skewed sex ratio towards males observed in several developmental impairments resulting from perinatal infection/inflammation.

PMID: [35563368](#)

22. Somatic Development Disorders in Children and Adolescents Affected by Syndromes and Diseases Associated with Neurodysfunction and Hydrocephalus Treated/Untreated Surgically

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Int J Environ Res Public Health. 2022 May 7;19(9):5712. doi: 10.3390/ijerph19095712.

Background: This study was conducted to evaluate the co-occurrence of hydrocephalus treated/untreated surgically and congenital nervous system disorders or neurological syndromes with symptoms visible since childhood, and with somatic development disorders, based on significant data obtained during admission to a neurological rehabilitation unit for children and adolescents. **Methods:** The study applied a retrospective analysis of data collected during hospitalization of 327 children and adolescents, aged 4-18 years, all presenting congenital disorders of the nervous system and/or neurological syndromes associated with at least one neurodysfunction that existed from early childhood. To allow the identification of individuals with somatic development disorders in the group of children and adolescents with hydrocephalus treated/untreated surgically, the adopted criteria considered the z-score values for body height, body weight, head circumference, body mass index, and head circumference index. **Results:** Treated/untreated hydrocephalus was observed in the study group at the rates of 8% and 0.9%, respectively. Among 239 patients with cerebral palsy, 9 (3.8%) had surgically treated hydrocephalus, 17 (70.8%) of 24 patients with neural tube defects also had hydrocephalus treated with surgery, and 3 (12.5%) of 24 patients with neural tube defects had untreated hydrocephalus. This medical condition was a more frequent comorbidity in subjects with neural tube defects compared with those with cerebral palsy ($p < 0.001$). Subjects with untreated hydrocephalus most frequently presented macrocephaly ($p < 0.001$), including absolute macrocephaly ($p = 0.001$), and with tall stature ($p = 0.007$). Excessive body mass co-occurred more frequently with surgically untreated hydrocephalus, but the relationship was not statistically significant ($p = 0.098$). **Conclusions:** Surgically treated hydrocephalus occurred in patients with cerebral palsy and neural tube defects, and untreated hydrocephalus was present only in patients with neural tube defects. Untreated hydrocephalus negatively changed the course of individual development in the studied group of children, in contrast to surgically treated hydrocephalus.

PMID: [35565107](#)

23. Cost savings for single event multilevel surgery in comparison to sequential surgery in ambulatory children with cerebral palsy

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Gait Posture. 2022 May 7;96:53-59. doi: 10.1016/j.gaitpost.2022.05.005. Online ahead of print.

Background: The purpose of this study was to determine the differences in billable provider charges between single event multilevel surgery (SEMLS) based on comprehensive gait analysis and a staged surgical approach (SSA) without comprehensive gait analysis for the orthopedic treatment of ambulatory children with cerebral palsy (CP). **Methods:** The charges associated with nine common orthopedic surgical combinations (both unilateral and bilateral, soft tissue or soft tissue plus bony) for children with CP were determined and compared between SEMLS and SSA. The charges included surgical, anesthesia, operating room, recovery room, hospital stay, physical therapy, and, for SEMLS only, comprehensive computerized gait analysis. **Results:** Total charges to complete each combination was higher for SSA than for SEMLS. The differential ranged from \$10,247 to \$75,069 with the percentage difference ranging from 20% to 47%. The mean difference was \$43,606 ($p = 0.0002$). The dollar difference ($r = 0.98$, $p < 0.0001$) and percentage difference ($r = 0.79$, $p = 0.01$) were both related to the total charge of the SEMLS surgery. **Significance:** Financial costs are lower for SEMLS vs. SSA for the treatment of multilevel gait issues in children with CP. The cost of gait analysis is much smaller than the cost differential between SEMLS and SSA. Although some patients who have SEMLS may need additional orthopedic surgery with associated costs, this is also possible for SSA. Therefore, due to the many benefits of SEMLS, which also include more informed treatment decision-making as well as reduced time away from school and work (for caregivers), SEMLS guided by gait analysis is recommended over SSA for the treatment of gait disorders in children with CP.

PMID: [35576667](#)

24. SETT: A Framework for Capacity Building Partnerships

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Proc North Cent Sect. 2022;2022:36075. Epub 2022 Mar 18.

A contemporary issue for many non-profits is identifying effective ways to build capacity for service delivery. Interdisciplinary processes take time to carry out; herein lies a challenge when working with a university in which the lifecycle of student activity is not aligned (much shorter) that of the project for the alternative education program. In the current work, we describe the pathway of a partnership that improves the ability of nonprofit staff to achieve their mission while simultaneously meeting

the service motivation in an academic setting. This paper describes the "pathway" for a mutually beneficial collaborative relationship between a higher education institution and a non-profit serving students with moderate to severe disabilities for the development of Assistive Technology using the SETT Framework as well as the Stanford BioDesign process.

PMID: [35586728](#)