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## Interventions and Management

### 1. Home-based virtual reality-enhanced upper limb training system in children with brain injury: a randomized controlled trial

Ja Young Choi, Sook-Hee Yi, Dain Shim, Beomki Yoo, Eun Sook Park, Dong-Wook Rha

Front Pediatr. 2023 May 18;11:1131573. doi: 10.3389/fped.2023.1131573. eCollection 2023.

**Background:** Rehabilitation of upper limb function can be challenging in children with brain lesion. Recent virtual reality (VR) rehabilitation may be an additional treatment option in pediatric rehabilitation. **Objectives:** To assess the feasibility and effectiveness of a home-based VR-enhanced rehabilitation program with wearable multi-inertial measurement unit (IMU) sensors on upper limb functions in children with brain injury. **Methods:** This multicenter single blind randomized controlled trial included 40 children with cerebral palsy (CP) or static brain injury. Subjects were randomized 1:1 to experimental and control group. Both the groups maintained the same therapeutic content and dose of occupational therapy during the intervention period. The experimental group performed additional training at home using the VR-enhanced program for at least 30 min/day, 5 days/week, for 6 weeks. VR training consisted of daily activities or games promoting wrist and forearm articular movements using wearable IMU sensors. The Melbourne Assessment of Unilateral Upper Limb Function-version 2 (MA2), Upper Limb Physician's Rating Scale (ULPRS), Pediatric Evaluation of Disability Inventory-computer adaptive test (PEDI-CAT), computerized 3D motion analysis, and user satisfaction survey were performed. Mann-Whitney U test was used to compare treatment effects between groups, and Friedman and Wilcoxon signed-rank tests were used to compare pre and post intervention. **Results:** Overall 35 children (15 in VR group and 20 in control group) completed the protocol. In the experimental group, an average VR training time was 855 min. The accuracy of motion measured by MA2, segmental movements by ULPRS, daily living capability and social cognitive function by PEDI-CAT, movement time and shoulder movement pattern by motion analysis showed significant improvements. However, there were no significant differences in any of the functional outcome measures compared to the control group. All the children and parents reported positive experiences. **Conclusions:** Home-based VR training though it had limited impact on improving upper limb function, it could help improve social cognitive function, movement pattern, and efficiency in children with brain injury and could be an effective means of extending clinical therapy to the home.

PMID: [37274815](https://pubmed.ncbi.nlm.nih.gov/37274815/)

### 2. Use of volar distal radius plate dorsally for wrist arthrodesis in patients with upper limb spasticity: A retrospective review

Rahul Bamal, Ramy Sultan, Laura Cappuyns, Zahid Hassan, Paul McArthur

J Plast Reconstr Aesthet Surg. 2023 May 7;83:318-325. doi: 10.1016/j.bjps.2023.05.005. Online ahead of print.

Standard wrist arthrodesis implants are generally designed for adult joints with arthritis. They are often too big for patients with limb spasticity who generally tend to have osteopenic and smaller bones for their age, resulting in high complication rates. We previously described the novel use of volar distal radius variable-angle locking plate (APTUS® Wrist distal radius system 2.5, Medartis AG, Basel, Switzerland) on the dorsum for wrist arthrodesis in patients with limb spasticity. This study

aimed to further establish the use of the implant by reporting the outcomes in cohort A (nondistal radius plate) and cohort B (distal radius plate cohort). Patient-reported outcome measures were used to assess the primary outcome, whereas secondary outcomes included implant-related complications and improvement in wrist position and fusion rates. A total of 17 wrist arthrodesis procedures were performed over a period of 4 years in 15 patients for wrist deformity secondary to limb spasticity. There were no complaints of implant prominence, implant or tendon irritation, metacarpal prominence, or extension requiring further treatment in cohort B. Cohort A had a high implant removal rate that is comparable to the published literature. Both groups reported significant improvement in hygiene and wrist position but neither group had any appreciable gain in function. Volar distal radius variable-angle locking plates appear to be safe and have superior patient acceptability and low complication rates when used dorsally for wrist arthrodesis in patients with upper limb spasticity. Comparable overall satisfaction rates in cohort B were reported in relation to the literature and the cohort A in this study.

PMID: [37295156](#)

### **3. Measuring grip strength in adolescents and adults with cerebral palsy in a clinic setting: Feasibility, reliability, and clinical associations**

Tomoko Sugiyama, Daniel G Whitney, Mary Schmidt, Heidi Haapala, Angeline Bowman, Mark D Peterson, Edward A Hurvitz

Dev Med Child Neurol. 2023 Jun 5. doi: 10.1111/dmcn.15662. Online ahead of print.

**Aim:** To determine the feasibility and reliability of measuring grip strength and its association with anthropometrics and diseases among adolescents and adults ( $\geq 16$  years old) with cerebral palsy (CP). **Method:** In this cross-sectional study, individuals with CP, classified in Gross Motor Function Classification System (GMFCS)/Manual Ability Classification System (MACS) levels I to V, were recruited to measure grip strength, anthropometrics, and self-reported current/history of disease during a routine clinical visit. Feasibility was determined as the proportion recruited/consented/completed testing. Test-retest reliability of three maximal effort trials per side was assessed. Linear regression determined associations of grip strength with anthropometrics after adjusting for age, sex, and GMFCS. The predictive ability of GMFCS alone, grip strength alone, GMFCS + grip strength, and GMFCS  $\times$  grip strength for diseases was compared. **Results:** Of 114 individuals approached, 112 participated and 111 successfully completed all tasks. There was good to excellent reliability of test-retest grip strength between trials for dominant and non-dominant sides for the entire cohort and when stratified by each GMFCS and MACS level (intraclass correlation coefficient range 0.83-0.97). Sex, GMFCS, MACS, body mass, and waist circumference were associated with grip strength ( $p < 0.05$ ), but not hip circumference, waist:hip ratio, or triceps skinfold thickness. Modeling grip strength with GMFCS had a higher predictive value for relevant diseases than GMFCS alone. **Interpretation:** Grip strength is a feasible and reliable measurement for CP, and is associated with some demographics and anthropometric measures. Grip strength, in addition to the GMFCS, enhanced prediction of disease outcomes.

PMID: [37277918](#)

### **4. Decrease of Muscle Mass in Young Patients With Neuromuscular Disease: Assessment of Sarcopenia**

Jisoo Kim, Haesung Yoon, Hyun Ji Lim, Hyun Woo Kim, Yong June Suk, Kun-Bo Park, Mi-Jung Lee

J Korean Med Sci. 2023 May 29;38(21):e187. doi: 10.3346/jkms.2023.38.e187.

**Background:** Sarcopenia can be associated with the disease etiologies other than degenerative processes, such as neurologic disease including cerebral palsy, myelomeningocele, or Duchenne muscular dystrophy, even in children. Although the relationship between neurologic disease and scoliosis or ambulatory function is known, the mediators affecting scoliosis or gait function in these patients are unclear, an example might be sarcopenia. This study aimed to assess the degree of sarcopenia in young patients with neurologic diseases using computed tomography (CT), and analyze the correlation between sarcopenia and scoliosis or ambulatory function. **Methods:** Pediatric and young adult patients ( $\leq 25$  years old) who underwent whole-spine or lower-extremity CT were retrospectively included. From bilateral psoas muscle areas (PMAs) at the L3 level, the psoas muscle z-score (PMz) and psoas muscle index [ $PMI = PMA / (L3 \text{ height})^2$ ] were calculated. The t-test, Fisher's exact test, and logistic regression analyses were performed. **Results:** A total of 121 patients (56 men, mean age  $12.2 \pm 3.7$  years) were included with 79 neurologic and 42 non-neurologic diseases. Patients with neurologic diseases had lower PMz ( $P = 0.013$ ) and PMI ( $P = 0.026$ ) than patients without. In neurologic disease patients, severe scoliosis patients showed lower PMz ( $P < 0.001$ ) and PMI ( $P = 0.001$ ). Non-ambulatory patients ( $n = 42$ ) showed lower BMI ( $\beta = 0.727$ ,  $P < 0.001$ ) and PMz ( $\beta = 0.547$ ,  $P = 0.025$ ). In non-ambulatory patients, patients with severe scoliosis also showed lower PMz ( $P < 0.001$ ) and PMI ( $P = 0.004$ ). **Conclusion:** Patients with neurologic diseases could have sarcopenia even in young age. Psoas muscle volume was also associated with ambulatory function in these patients. Sarcopenia was more severe in severe scoliosis patients in the non-ambulatory subgroup.

PMID: [37270922](#)

## 5. Morphometric assessment of the hip joint in children aged 2-13 years

Vildan Önal, Ayfer Metin Tellioglu, Yasemin Durum Polat

Clin Anat. 2023 Jun 4. doi: 10.1002/ca.24061. Online ahead of print.

Our study aimed to evaluate the hip joints of healthy children aged 2-13 years morphometrically through radiographic images. Demographic characteristics of 300 healthy children in our study include an average age of 6.4 years old based on the 2-to-13-year-old bracket and sex classified to 133 girls and 167 boys. A total of 600 normal hips from these children were digitally measured based on Acetabular Index, ACM angle, MZ distance, Sharp angle, CE angle, Femoral Head Coverage Ratio, Cranial, and medial joint space (MJS). \* $p < 0.05$ ; \*\* $p < 0.01$  indicated a statistically significant difference. It was found that Acetabular Index, ACM angle, MZ distance, Sharp angle, Cranial, and MJSs decreased with age; Acetabular Depth value and CE angle increased with age; the CE angle differed between the sides (right-left) in the young teens period and in boys; and the cranial joint space (CJS) differed between the sides in girls. In addition, girls had higher values than boys in terms of Acetabular Index, ACM angle, Sharp angle, MZ distance, and Femoral Head Coverage Ratio; CE angle and MJS were higher in girls; and Acetabular Depth Value and CJS did not differ significantly between sexes. Obtaining the normal values will guide in the diagnosis and treatment of many clinical conditions including DDH and Legg-Calve-Perthes disease. It can also be used to compare the hips between healthy children and those diagnosed with Cerebral Palsy.

PMID: [37272199](#)

## 6. Ultrasound Imaging of Hip Displacement in Children With Cerebral Palsy

Thanh-Tu Pham, Lawrence H Le, Thanh-Giang La, John Andersen, Edmond H Lou

Ultrasound Med Biol. 2023 Jun 3;S0301-5629(23)00139-4. doi: 10.1016/j.ultrasmedbio.2023.04.012. Online ahead of print.

Objective: An approach to estimation of hip displacement on ultrasound (US) images is described. Its accuracy is validated through numerical simulation, an in vitro study with 3-D-printed hip phantoms and pilot in vivo data. Methods: A diagnostic index, migration percentage (MP), is defined by the ratio of acetabulum-femoral head distance to femoral head width. The acetabulum-femoral head distance could be measured directly on hip US images, while the femoral head width was estimated from the diameter of a best-fit circle. Simulation was performed to evaluate the accuracy of circle fitting with noiseless and noisy data. Surface roughness was also considered. Nine hip phantoms (three different sizes of femur head  $\times$  three MP values) and 10 US hip images were used in this study. Results: The maximum diameter error was  $16.1 \pm 8.5\%$  when the roughness and noise were 20% of the original radius and 20% of the wavelet peak, respectively. In the phantom study, the percentage errors of MPs between the 3-D-design US and X-ray US were 0.3%-6.6% and 0.0%-5.7%, respectively. From the pilot clinical trial, the mean absolute difference between the X-ray-US MPs was  $3.5 \pm 2.8\%$  (1%-9%). Conclusion: This study indicates that the US method can be used to evaluate hip displacement in children.

PMID: [37277305](#)

## 7. Bony hip reconstruction for displaced hips in patients with cerebral palsy: Is postoperative immobilization indicated?

John Amen, Oliver Perkins, Konstantinos Kafchitsas, Daniel Reed, Fabian Norman-Taylor, Michail Kokkinakis

J Child Orthop. 2023 Apr 2;17(3):268-275. doi: 10.1177/18632521231164983. eCollection 2023 Jun.

Purpose: Decisions for postoperative immobilization after bony hip reconstructive surgery in cerebral palsy are controversial in current practice. The aim of this study was to check if choosing not to use any kind of postoperative immobilization is a safe practice. Methods: A retrospective cohort study was conducted in a pediatric orthopedic tertiary referral center. The study included 148 patients (228 hips) with cerebral palsy, who had bony hip surgery. Medical records were reviewed for incidence of complications, methods of pain control, and length of hospital stay. Three radiographic measures (neck-shaft angle, Reimers migration index, and acetabular index) were performed on preoperative and postoperative X-rays. X-rays were also checked for mechanical failure of implant, recurrent dislocation/subluxation, and fractures in the first 6 months postoperatively. Results: In total, 94 (64%) were male and 54 (36%) were female. Seventy-seven (52%) were Gross Motor Function Classification System V, mean age at surgery was 8.6 years (2.5-18.4 years). Length of hospital stay was 6.25 days (SD 4.64 days). Medical complications that may have prolonged hospital stay occurred in 41 patients (27.7%). Radiological measurements showed significant improvement postoperatively ( $p = 0.001$ ). Seven patients (4.7%) had another surgery in first 6 months (three for recurrent dislocation/subluxation, three for implant failure, and one for ipsilateral femur fracture). Conclusion: Avoiding postoperative immobilization following bony hip surgery in cerebral palsy is a safe practice and associated with reduced rate of medical and mechanical problems compared to the current literature. This approach should be utilized with optimal pain and tone management.

PMID: [37288043](#)

## 8. Parent experience with ankle-foot orthoses for their young children with cerebral palsy: a qualitative study

Pegah Firouzeh, Christopher Morris, Lyn K Sonnenberg, Patricia Manns, Lesley Pritchard

Disabil Rehabil. 2023 Jun 3;1-8. doi: 10.1080/09638288.2023.2218651. Online ahead of print.

**Purpose:** This study explored the experiences of parents of young children with cerebral palsy who used Ankle-Foot Orthoses (AFOs). **Materials and methods:** Parents of children with cerebral palsy (n = 11; age range 2-6 years) who used solid or hinged AFOs participated. Interpretive Description, a qualitative methodological approach focused on the application of findings to clinical practice, was used. Semi-structured interviews were conducted, and themes were developed using thematic analysis. **Results:** Four themes described parent experience with their children's AFOs: 1) "Hear what I am saying": Collaborative decision-making with families, 2) "Is my child going to be excluded because of AFOs?": Parent and child adjustment was a journey, 3) AFOs created financial and practical challenges, 4) The perceived benefits of AFO use. **Conclusions:** Adjusting to AFOs was a challenging and time-consuming process for parents and children, which may have resulted in lower frequency and duration of use than anticipated by clinicians. Clinicians must be aware of the physical and psychosocial adjustment process as children and families adapt over time and work with families to ensure AFO use is optimized and individualized.

PMID: [37269309](#)

## 9. Machine learning-based prediction of joint moments based on kinematics in patients with cerebral palsy

Mustafa Erkam Ozates, Derya Karabulut, Firooz Salami, Sebastian Immanuel Wolf, Yunus Ziya Arslan

J Biomech. 2023 May 27;155:111668. doi: 10.1016/j.jbiomech.2023.111668. Online ahead of print.

Joint moments during gait provide valuable information for clinical decision-making in patients with cerebral palsy (CP). Joint moments are calculated based on ground reaction forces (GRF) using inverse dynamics models. Obtaining GRF from patients with CP is challenging. Typically developed (TD) individuals' joint moments were predicted from joint angles using machine learning, but no such study has been conducted on patients with CP. Accordingly, we aimed to predict the dorsi-plantar flexion, knee flexion-extension, hip flexion-extension, and hip adduction-abduction moments based on the trunk, pelvis, hip, knee, and ankle kinematics during gait in patients with CP and TD individuals using one-dimensional convolutional neural networks (CNN). The anonymized retrospective gait data of 329 TD (26 years  $\pm$  14, mass: 70 kg  $\pm$  15, height: 167 cm  $\pm$  89) and 917 CP (17 years  $\pm$  9, mass: 47 kg  $\pm$  19, height: 153 cm  $\pm$  36) individuals were evaluated and after applying inclusion-exclusion criteria, 132 TD and 622 CP patients with spastic diplegia were selected. We trained specific CNN models and evaluated their performance using isolated test subject groups based on normalized root mean square error (nRMSE) and Pearson correlation coefficient (PCC). Joint moments were predicted with nRMSE between 18.02% and 13.58% for the CP and between 12.55% and 8.58% for the TD groups, whereas with PCC between 0.85 and 0.93 for the CP and between 0.94 and 0.98 for the TD groups. Machine learning-based joint moment prediction from kinematics could replace conventional moment calculation in CP patients in the future, but the current level of prediction errors restricts its use for clinical decision-making today.

PMID: [37276682](#)

## 10. Association between lower limb spasticity and cryptorchidism in males with cerebral palsy

Eric M Bortnick, Tanya Logvinenko, Hsin-Hsiao Scott Wang, David J Fogelman, Benjamin J Shore, Caleb P Nelson, Michael P Kurtz

Dev Med Child Neurol. 2023 Jun 7. doi: 10.1111/dmcn.15644. Online ahead of print.

**Aim:** To explore the association between presence and severity of lower limb spasticity (LLS) and risk of orchidopexy for cryptorchidism among people with cerebral palsy (CP) and to further define the cremasteric muscle spasticity theory. **Method:** We queried the Pediatric Health Information System database for male patients with CP, stratified patients into those with/without LLS, and compared groups for orchidopexy occurrence. Comparative statistics were performed using  $\chi^2$  and Mann-Whitney U tests for categorical and continuous variables respectively. The association between orchidopexy and spasticity type was investigated using logistic regression. **Results:** In total, 44 561 males with CP were identified. Of these, 1.6% underwent orchidopexy (median age: 7 years 8 months [interquartile range: 4 years 6 months-11 years 4 months]). LLS presence was significantly associated with higher orchidopexy rate compared to spasticity absence (odds ratio [OR] = 1.33 [1.10-1.59], p = 0.003). Among 7134 patients with LLS, intervention was significantly associated with higher orchidopexy rate (injection procedures: OR = 2.47 [2.27-6.39], p = 0.034; surgical procedure: OR = 2.60 [1.22-6.76], p = 0.026). LLS groin proximity was significantly associated with higher orchidopexy rate (OR = 2.52 [1.42-4.96], p = 0.003). **Interpretation:** A strong association exists between LLS presence and severity and orchidopexy risk among people with CP. These findings support a cremasteric spasticity hypothesis as an important factor of cryptorchidism in CP. Providers should continue to examine for cryptorchidism in males with CP as they age.

PMID: [37282840](#)

### 11. Three-dimensional skeletal muscle architecture in the lower legs of living human infants

Brian V Y Chow, Catherine Morgan, Caroline Rae, Iona Novak, Suzanne Davies, Robert D Herbert, Bart Bolsterlee; MUGgLE Study investigators

J Biomech. 2023 May 26;155:111661. doi: 10.1016/j.jbiomech.2023.111661. Online ahead of print.

Little is known about the skeletal muscle architecture of living humans at birth. In this study, we used magnetic resonance imaging (MRI) to measure the volumes of ten muscle groups in the lower legs of eight human infants aged less than three months. We then combined MRI and diffusion tensor imaging (DTI) to provide detailed, high-resolution reconstructions and measurements of moment arms, fascicle lengths, physiological cross-sectional areas (PCSAs), pennation angles and diffusion parameters of the medial (MG) and lateral gastrocnemius (LG) muscles. On average, the total lower leg muscle volume was 29.2 cm<sup>3</sup>. The largest muscle was the soleus muscle with a mean volume of 6.5 cm<sup>3</sup>. Compared to the LG muscles, the MG muscles had, on average, greater volumes (by ~35%) and greater PCSAs (by ~63%) but similar ankle-to-knee moment arm ratios (~0.1 difference), fascicle lengths (~5.7 mm difference) and pennation angles (~2.7° difference). The MG data were compared with data previously collected from adults. The MG muscles of adults had, on average, a 63-fold greater volume, a 36-fold greater PCSA, and 1.7-fold greater fascicle length. This study demonstrates the feasibility of using MRI and DTI to reconstruct the three-dimensional architecture of skeletal muscles in living human infants. It is shown that, between infancy and adulthood, MG muscle fascicles grow primarily in cross-section rather than in length.

PMID: [37290180](#)

### 12. Anterior distal femoral hemiepiphysiodesis in children with cerebral palsy: Establishing surgical indications and techniques using the modified Delphi method and literature review

Benjamin J Shore, James McCarthy, M Wade Shrader, Kerr Graham, K Matthew Veerkamp, Erich Rutz, Hank Chambers, Jon R Davids, Unni Narayanan, Tom F Novacheck, Kristan Pierz, Thomas Dreher, Jason Rhodes, Jeffery Shilt, Tim Theologis, Anja Van Campenhout, Robert M Kay

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No abstract available

PMID: [37288042](#)

### 13. A synthesis of the characteristics of dance interventions engaging adults with neurodevelopmental disabilities: a scoping review

Jacqueline C Ladwig, Elena M Broeckelmann, Kathryn M Sibley, Jacquie Ripat, Cheryl M Glazebrook

Review Disabil Rehabil. 2023 Jun 5;1-8. doi: 10.1080/09638288.2023.2217384. Online ahead of print.

**Purpose:** Dance can encourage physical activity and promote physical, cognitive, and social development for adults who have neurodevelopmental disabilities (NDD). Dance is defined as a form of expression that may be structured, exploratory, and/or cultural. Current literature supports the benefits of participation in dance for persons with NDD, however less is known about what characteristics support participation in dance. **Materials and methods:** A scoping review was conducted to synthesize the characteristics of dance interventions, teaching strategies, and outcome measures used to assess the efficacy of dance interventions. Searches were conducted across six databases and the results were screened according to: i) adults ≥18yrs of age with a diagnosed NDD, and ii) the program incorporated activities that fall within our definition of dance. **Results:** A range of dance forms and NDDs were represented across the fourteen studies reviewed. Few provided explicit details of the dance interventions, nor how instruction was adapted. All studies that measured fitness, mobility, balance, posture, and functional activity showed significant improvement. Studies that measured psychosocial and well-being focused on autistic characteristics and showed mixed results. **Conclusions:** Details of interventions, instructions, measures of movement performance, and the relationship between outcomes and the interventions require further development and research. **IMPLICATIONS FOR REHABILITATION** Dance is a multimodal activity that can improve aerobic capacity, postural control, passive ROM, and strength in adults with neurodevelopmental disability at all levels of function. Participation in dance may be recommended as an option for recreational physical activity as current evidence supports dance as an effective physical activity, and/or supplement to therapeutic goals, with physiological as well as psychosocial benefits. When considering dance as a recreational activity it is important to consider the program and instructors approach, as well as the experience and training of the instructor, in order to best match the goals of the dancer with the goals of the specific program.

PMID: [37272778](#)



#### 14. Changing Practice: Clinical Application of Resistance Training Evidence for Children With Cerebral Palsy

James B Hedgecock, Nicole M Harris, Mary Jane Rapport

*Pediatr Phys Ther.* 2023 Jun 9. doi: 10.1097/PEP.0000000000001023. Online ahead of print.

**Purpose:** Describe the development and application of a progressive resistance exercise (PRE) program for children with cerebral palsy (CP), which became a standard care model at an urban specialty hospital network. **Summary of key points:** Muscle structure and performance have been shown to impact function and participation in children with CP. Use of PRE to achieve function and participation goals is supported by a growing body of evidence. A novel guideline, focused on individualized, goal-focused PRE dosing, professional development, program monitoring, and outcome measures use, facilitated application of a new clinical practice. **Conclusions:** Practice change was accomplished by translating evidence using a clinical guideline resulting in positive child function and participation outcomes. **Recommendations for clinical practice:** This Special Communication provides an example of addressing goal-related muscle performance impairments in children with CP. Clinicians should consider updating long-standing physical therapy intervention strategies by incorporating goal-specific PRE into practice.

PMID: [37289202](#)

#### 15. The Effect of Eight Weeks of Aquatic Exercises on Muscle Strength in Children with Cerebral Palsy: A Case Study

Mehrnoosh Esmailiyan, Seyed Mohamad Marandi, Maryam Darvishi, Shaghayegh Haghjooy Javanmard, Atefeh Amerizadeh

*Adv Biomed Res.* 2023 Apr 25;12:87. doi: 10.4103/abr.abr\_363\_21. eCollection 2023.

**Background:** Cerebral palsy in children is considered a non-progressive brain injury due to abnormal brain development. The aim of this study was to investigate the effect of eight weeks of aquatic exercises on muscle strength in children with cerebral palsy. **Materials and methods:** This study was performed on three boys with cerebral palsy with a mean age of 6.5 years. In this research, a single case study method with A1-B-A2 design has been used. After determining the position of the baseline, the intervention began and during 24 sessions of individual intervention, aquatic exercises were presented to the subjects and all three subjects were followed up for 2 consecutive weeks and one month after the end of the intervention. The strength of the flexor muscles of the arms and legs was measured by a power track dynamometer made by JTECK with a threshold of 4.4 N. **Results:** Based on the indicators of descriptive statistics and visual analysis, the intervention was effective for all three participants in muscle strength, and the strength of individuals after the intervention has improved compared to the baseline stage (percentage). Information overlap for the first and second participant in the strength of right thigh flexors was 75% and for the third participant was 100%. The strength of the upper and lower torso muscles improved after the end of the training compared to the basic stage. **Conclusion:** Aquatic exercises can increase the strength of children with cerebral palsy and provide a favorable environment for children with cerebral palsy.

PMID: [37288010](#)

#### 16. A Serious Game for the Assessment of Visuomotor Adaptation Capabilities during Locomotion Tasks Employing an Embodied Avatar in Virtual Reality

Vladimiro Suglia, Antonio Brunetti, Guido Pasquini, Mariapia Caputo, Tommaso Maria Marvulli, Elena Sibilano, Sara Della Bella, Paola Carrozza, Chiara Beni, David Naso, Vito Monaco, Giovanna Cristella, Vitoantonio Bevilacqua, Domenico Buongiorno

*Sensors (Basel).* 2023 May 24;23(11):5017. doi: 10.3390/s23115017.

The study of visuomotor adaptation (VMA) capabilities has been encompassed in various experimental protocols aimed at investigating human motor control strategies and/or cognitive functions. VMA-oriented frameworks can have clinical applications, primarily in the investigation and assessment of neuromotor impairments caused by conditions such as Parkinson's disease or post-stroke, which affect the lives of tens of thousands of people worldwide. Therefore, they can enhance the understanding of the specific mechanisms of such neuromotor disorders, thus being a potential biomarker for recovery, with the aim of being integrated with conventional rehabilitative programs. Virtual Reality (VR) can be entailed in a framework targeting VMA since it allows the development of visual perturbations in a more customizable and realistic way. Moreover, as has been demonstrated in previous works, a serious game (SG) can further increase engagement thanks to the use of full-body embodied avatars. Most studies implementing VMA frameworks have focused on upper limb tasks and have utilized a cursor as visual feedback for the user. Hence, there is a paucity in the literature about VMA-oriented frameworks targeting locomotion tasks. In this article, the authors present the design, development, and testing of an SG-based framework that addresses VMA in a locomotion activity by controlling a full-body moving avatar in a custom VR environment. This workflow includes a set of metrics to quantitatively assess the participants' performance. Thirteen healthy children were recruited to evaluate the framework. Several quantitative comparisons and analyses were run to validate the different types of introduced visuomotor perturbations and to evaluate the ability of the proposed metrics to describe the difficulty caused by

such perturbations. During the experimental sessions, it emerged that the system is safe, easy to use, and practical in a clinical setting. Despite the limited sample size, which represents the main limitation of the study and can be compensated for with future recruitment, the authors claim the potential of this framework as a useful instrument for quantitatively assessing either motor or cognitive impairments. The proposed feature-based approach gives several objective parameters as additional biomarkers that can integrate the conventional clinical scores. Future studies might investigate the relation between the proposed biomarkers and the clinical scores for specific disorders such as Parkinson's disease and cerebral palsy.

PMID: [37299744](#)

### **17. Quantitative identification of ventral/dorsal nerves through intraoperative neurophysiological monitoring by supervised machine learning**

Wenbin Jiang, Qijia Zhan, Junlu Wang, Min Wei, Sen Li, Rong Mei, Bo Xiao

Front Pediatr. 2023 May 18;11:1118924. doi: 10.3389/fped.2023.1118924. eCollection 2023.

**Objective:** This study aimed to investigate the electro-neurophysiological characteristics of the ventral and dorsal nerves at the L2 segment in a quantitative manner. **Methods:** Medical records of consecutive patients who underwent single-level approach selective dorsal rhizotomy (SDR) from June 2019 to January 2022 were retrospectively reviewed. Intraoperative electro-neurophysiological data were analyzed. **Results:** A total of 74 males and 27 females were included in the current study with a mean age of 6.2 years old. Quadriceps and adductors were two main muscle groups innervated by L2 nerve roots in both ventral and dorsal nerve roots. Dorsal roots have a higher threshold than that of the ventral ones, and muscles that first reached 200  $\mu$ V innervated by dorsal roots have longer latency and smaller compound muscle action potential (CMAP) than those of the ventral ones. Supervised machine learning can efficiently distinguish ventral/dorsal roots using threshold + latency or threshold + CMAP as predictors. **Conclusion:** Electro-neurophysiological parameters could be used to efficiently differentiate ventral/dorsal fibers during SDR.

PMID: [37274819](#)

### **18. Balancing Memorization and Generalization in RNNs for High Performance Brain-Machine Interfaces**

Joseph T Costello, Hisham Temmar, Luis H Cubillos, Matthew J Mender, Dylan M Wallace, Matthew S Willsey, Parag G Patil, Cynthia A Chestek

bioRxiv. 2023 May 28;2023.05.28.542435. doi: 10.1101/2023.05.28.542435. Preprint

Brain-machine interfaces (BMIs) can restore motor function to people with paralysis but are currently limited by the accuracy of real-time decoding algorithms. Recurrent neural networks (RNNs) using modern training techniques have shown promise in accurately predicting movements from neural signals but have yet to be rigorously evaluated against other decoding algorithms in a closed-loop setting. Here we compared RNNs to other neural network architectures in real-time, continuous decoding of finger movements using intracortical signals from nonhuman primates. Across one and two finger online tasks, LSTMs (a type of RNN) outperformed convolutional and transformer-based neural networks, averaging 18% higher throughput than the convolution network. On simplified tasks with a reduced movement set, RNN decoders were allowed to memorize movement patterns and matched able-bodied control. Performance gradually dropped as the number of distinct movements increased but did not go below fully continuous decoder performance. Finally, in a two-finger task where one degree-of-freedom had poor input signals, we recovered functional control using RNNs trained to act both like a movement classifier and continuous decoder. Our results suggest that RNNs can enable functional real-time BMI control by learning and generating accurate movement patterns.

PMID: [37292755](#)

### **19. Psychosocial experiences of mothers caring for children with cerebral palsy in the eThekweni district**

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Health SA. 2023 May 22;28:2072. doi: 10.4102/hsag.v28i0.2072. eCollection 2023.

**Background:** Cerebral palsy (CP) is the most prevalent neurological illness in children, and it can cause permanent sensory, motor and cognitive problems for the rest of one's life. Raising a child with special needs necessitates extensive resources. Women in the middle and lower income brackets are more likely to care for children with CP. **Aim:** To explore and describe the psychosocial experiences of mothers of children with CP in eThekweni. **Setting:** This study was conducted at KwaZulu-Natal Children's Hospital and rehabilitation centre. **Methods:** The research methods were exploratory and descriptive in nature, with a qualitative approach. Purposive convenience sampling was used to select 12 participants who were parents of children with CP under the age of 18. For data collection, semistructured interviews were utilised. The purpose of thematic analysis is to

uncover, analyse and summarise themes and patterns within a data set. Semistructured interviews were used to collect data. Results: The psychosocial experiences of mothers of children with CP revealed three key themes. Themes included the burden of care, a lack of social support and the impact of children with CP on mothers. Conclusion: Participants whose children with CP experienced physical, emotional, psychological and social issues, including inaccessible services and buildings and social isolation from family, friends and the community. Contribution: This study helps to strengthen the development and review of policies on care, support interventions and mother empowerment for children with CP.

PMID: [37292233](#)

## 20. Brewing Evidence for Pharmacotherapy in Dyskinetic Cerebral Palsy: A Step in the Right Direction

Aakash M, Biswaroop Chakrabarty

Editorial Indian J Pediatr. 2023 Jun 6. doi: 10.1007/s12098-023-04670-1. Online ahead of print.

No abstract available

PMID: [37277685](#)

## 21. Foreign body Swallows with Airway Affection in Pediatrics

Mohammed Elrabie Ahmed, Bahaa Mohammed Refaie, Mona Elrabie Ahmed, Al Hussein Awad Ali, Khaled Gamal Dahy

Indian J Otolaryngol Head Neck Surg. 2023 Jun;75(2):287-291. doi: 10.1007/s12070-022-03156-4. Epub 2022 Nov 4.

Aims: The current work aimed at evaluating how FBI can cause respiratory distress and stridor as well as their severity according to age, gender, lodgment site, and type of the object. Factors influencing morbidity and mortality among studied patients will be deliberated as well. Methods: It is a hospital-based descriptive study where all children between birth and 16 years of age who were admitted to Sohag University Hospital, Egypt from January 1st, 2018, to December 31st, 2020, for FBs removal were analyzed. All cases were subjected to complete history taking, physical, radiological, and bronchoscopic examination. Results: A total of fourteen [14] patients were presented with FBI based on a full history, examination, and essential investigation. The vast majority 92.9% of presented cases (13 out of 14) were less than 6 years old. 50% of them (50%) (7 out of 14) were less than one year old. Most cases presented early within a few hours after ingestion (71.4%). Two [2] patients had predisposing conditions like mental retardation and cerebral palsy. 28.6% of cases presented late (> 24 h after aspiration). Except for one case where a cervical oesophageal approach was needed. Endoscopic extractions of foreign bodies were successfully done. 50% of patients required admissions to the Pediatric Intensive Care Unit (PICU). The mortality rate was 14.3%. Conclusion: FBI is a common clinical emergency in children younger than 6 years. A high index of suspicion is the keystone for diagnosis. Early detection and management are crucial for a positive outcome.

PMID: [37275045](#)

## 22. PMM2 -CDG T237M Mutation in a Patient with Cerebral Palsy-Like Phenotypes Reported from South India

N Sreedevi, N Swapna, Santosh Maruthy, H S Meghavathi, Charles Sylvester

Case Reports Glob Med Genet. 2023 Jun 1;10(2):105-108. doi: 10.1055/s-0043-1769494. eCollection 2023 Jun.

Congenital disorder of glycosylation (CDG) is an autosomal recessively inherited disorder. Hypotonia, stroke-like episodes, and peripheral neuropathy are also associated with the condition that typically develops during infancy. The patient, a 12-year-old girl born to healthy consanguineous parents, was diagnosed with cerebral palsy as a child. The affected patient has hypotonia, inadequate speech, strabismus, and developmental delay with mild mental retardation, which are key symptoms of CDG. Whole-exome sequencing (WES) identified the known missense pathogenic variant PMM2 c.710 C > T, p.T237M in the patient coding for the phosphomannomutase 2 (PMM2) confirming molecular testing of CDG. The patient's parents carried heterozygous PMM2 c.710 C > T variants. This study highlights the importance of WES in patients with a developmental disability or other neurological conditions, which is also useful in screening risk factors in couples with infertility or miscarriage issues.

PMID: [37274081](#)

## 23. Preliminary Pilot-Testing of Social Determinants of Health Screener for Individuals With Intellectual and Developmental Disabilities in Med-Peds

Emily Hotez, Kristine J Chua, Nathan Samras, Andrew M Smith, Alice Kuo



Cureus. 2023 May 4;15(5):e38541. doi: 10.7759/cureus.38541. eCollection 2023 May.

In the United States, one in six children has an intellectual and/or developmental disability (I/DD), including attention deficit hyperactivity disorder (ADHD), autism, cerebral palsy, learning disabilities, seizures, and developmental delays, with or without intellectual impairment. Individuals with I/DDs experience disproportionate rates of immune, metabolic, cardiovascular, and neurological disorders, as well as anxiety, depression, functional somatic symptoms, and other co-occurring physical and mental health conditions. During the coronavirus disease 2019 (COVID-19) pandemic, having an I/DD emerged as one of the strongest predictors of contracting and dying from COVID-19. These findings spurred increased attention toward the myriad health inequities affecting this population well before the pandemic. While inequities for individuals with I/DD can be traced to many factors, social determinants of health (SDOH) - the underlying social, economic, and environmental conditions that lead to poor health outcomes and high healthcare costs - are key contributors. Our interdisciplinary combined internal medicine and pediatrics (Med-Peds) team of physicians, psychologists, and researchers within a large, diverse, academic health system aimed to pilot-test the implementation of a five-item SDOH screener within a Med-Peds specialty clinic focused on the developmental needs of individuals with I/DD and their families (Leadership Education in Neurodevelopmental Disabilities {LEND}) and a general primary care practice (PCP). The SDOH screener tested in this initiative includes five items from the Accountable Health Communities (AHC) Health-Related Social Needs Screening Tool (HRSN) assessing social isolation, food insecurity, transportation, and paying for basic needs, such as housing and medical care. In this study, we describe the process of implementing this screener and collecting initial pilot data from 747 patients between October 2022 and April 2023 across the LEND and the primary care practice. We also highlight the challenges and opportunities identified during the mid-way point of implementation and pilot testing. The results of this pilot study revealed low response rates among SDOH screeners, spurring several measures to increase uptake, including increasing the accessibility of the screener and ensuring the screener results in effective referrals. We call on additional Med-Peds healthcare teams without universal SDOH screening protocols in place - particularly those serving the I/DD population - to consider adopting these practices.

PMID: [37273312](#)

#### **24. Cerebral Palsy and Difficult Birth. A Scoping Review**

P C Hirides, S C Hirides, C Hirides

Review J Neonatal Perinatal Med. 2023 May 30. doi: 10.3233/NPM-230043. Online ahead of print.

Background: Despite evidence on the prenatal pathogenesis of Cerebral Palsy (CP), there are many instances where obstetricians face litigation for malpractice. Objective: A scoping review of research on the association of CP with "difficult" delivery in term neonates. Design: For the purposes of this review an internet search was performed using credible electronic databases. Results: There are more than 32,500 citations under the keyword cerebral palsy, the majority of which, focus on diagnosis and treatment. Only 451 citations were included in the final review, associated with perinatal asphyxia, birth trauma, difficult delivery and obstetric litigations. Additionally, 139 medical books from various specialties were included in the research. Discussion: The sequence of events is hereby presented, through which the original connection between CP and delivery, has gradually been cut off. Meanwhile, all contributing factors of difficult delivery are evaluated. Persistent abnormal fetal attitude seems to be strongly connected to the difficult birth in affected term neonates. Vaginal delivery is accomplished only after sufficient passive flexion of the fetal head, achieved by additional expulsive efforts by both the mother and the assisting personnel. This additional force is perceived by the parents to be as the principal etiology of CP in their infant. In the past decades, there has been increasing evidence pertaining fetal perceptual abilities and cognitive functions. Conclusions: Difficult birth may be the first, amongst the early manifestations of neonatal encephalopathy.

PMID: [37270817](#)

#### **25. Optimizing the management of acute, prolonged decelerations and fetal bradycardia based on the understanding of fetal pathophysiology**

Edwin Chandrachan, Tullio Ghi, Stefania Fieni, Yan-Ju Jia

Review Am J Obstet Gynecol. 2023 Jun;228(6):645-656. doi: 10.1016/j.ajog.2022.05.014.

Any acute and profound reduction in fetal oxygenation increases the risk of anaerobic metabolism in the fetal myocardium and, hence, the risk of lactic acidosis. On the contrary, in a gradually evolving hypoxic stress, there is sufficient time to mount a catecholamine-mediated increase in the fetal heart rate to increase the cardiac output and redistribute oxygenated blood to maintain an aerobic metabolism in the fetal central organs. When the hypoxic stress is sudden, profound, and sustained, it is not possible to continue to maintain central organ perfusion by peripheral vasoconstriction and centralization. In case of acute deprivation of oxygen, the immediate chemoreflex response via the vagus nerve helps reduce fetal myocardial workload by a sudden drop of the baseline fetal heart rate. If this drop in the fetal heart rate continues for >2 minutes (American College of Obstetricians and Gynecologists' guideline) or 3 minutes (National Institute for Health and Care Excellence or physiological guideline), it is termed a prolonged deceleration, which occurs because of myocardial hypoxia, after the initial chemoreflex.

The revised International Federation of Gynecology and Obstetrics guideline (2015) considers the prolonged deceleration to be a "pathologic" feature after 5 minutes. Acute intrapartum accidents (placental abruption, umbilical cord prolapse, and uterine rupture) should be excluded immediately, and if they are present, an urgent birth should be accomplished. If a reversible cause is found (maternal hypotension, uterine hypertonus or hyperstimulation, and sustained umbilical cord compression), immediate conservative measures (also called intrauterine fetal resuscitation) should be undertaken to reverse the underlying cause. In reversible causes of acute hypoxia, if the fetal heart rate variability is normal before the onset of deceleration, and normal within the first 3 minutes of the prolonged deceleration, then there is an increased likelihood of recovery of the fetal heart rate to its antecedent baseline within 9 minutes with the reversal of the underlying cause of acute and profound reduction in fetal oxygenation. The continuation of the prolonged deceleration for >10 minutes is termed "terminal bradycardia," and this increases the risk of hypoxic-ischemic injury to the deep gray matter of the brain (the thalami and the basal ganglia), predisposing to dyskinetic cerebral palsy. Therefore, any acute fetal hypoxia, which manifests as a prolonged deceleration on the fetal heart rate tracing, should be considered an intrapartum emergency requiring an immediate intervention to optimize perinatal outcome. In uterine hypertonus or hyperstimulation, if the prolonged deceleration persists despite stopping the uterotonic agent, then acute tocolysis is recommended to rapidly restore fetal oxygenation. Regular clinical audit of the management of acute hypoxia, including the "the onset of bradycardia to delivery interval," may help identify organizational and system issues, which may contribute to poor perinatal outcomes.

PMID: [37270260](#)