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Interventions and Management

1. *J Neuroeng Rehabil.* 2015 Sep 22;12(1):85. doi: 10.1186/s12984-015-0076-7.

MEG-based neurofeedback for hand rehabilitation.

Foldes ST, Weber DJ, Collinger JL.

BACKGROUND: Providing neurofeedback (NF) of motor-related brain activity in a biologically-relevant and intuitive way could maximize the utility of a brain-computer interface (BCI) for promoting therapeutic plasticity. We present a BCI capable of providing intuitive and direct control of a video-based grasp. **METHODS:** Utilizing magnetoencephalography's (MEG) high temporal and spatial resolution, we recorded sensorimotor rhythms (SMR) that were modulated by grasp or rest intentions. SMR modulation controlled the grasp aperture of a stop motion video of a human hand. The displayed hand grasp position was driven incrementally towards a closed or opened state and subjects were required to hold the targeted position for a time that was adjusted to change the task difficulty. **RESULTS:** We demonstrated that three individuals with complete hand paralysis due to spinal cord injury (SCI) were able to maintain brain-control of closing and opening a virtual hand with an average of 63 % success which was significantly above the average chance rate of 19 %. This level of performance was achieved without pre-training and less than 4 min of calibration. In addition, successful grasp targets were reached in 1.96 ± 0.15 s. Subjects performed 200 brain-controlled trials in approximately 30 min excluding breaks. Two of the three participants showed a significant improvement in SMR indicating that they had learned to change their brain activity within a single session of NF. **CONCLUSIONS:** This study demonstrated the utility of a MEG-based BCI system to provide realistic, efficient, and focused NF to individuals with paralysis with the goal of using NF to induce neuroplasticity.

[PMID: 26392353](#)

2. *Gait Posture.* 2015 Sep 10. pii: S0966-6362(15)00851-6. doi: 10.1016/j.gaitpost.2015.09.003. [Epub ahead of print]

Correction of gait after derotation osteotomies in cerebral palsy: Are the effects predictable?

Böhm H, Hösl M, Dussa CU, Döderlein L.

Derotation osteotomies of the femur and tibia are established procedures to improve transverse plane deformities during walking with inwardly pointing knees and in- and out toeing gait. However, effects of femoral derotation osteotomies on gait were reported to be small, and those for the tibia are not known. Therefore, the aim of the study was to show the relation between the amount of intraoperative rotation and the changes during gait for osteotomies at femur and tibia levels, and predict those for the femur from preoperative clinical and gait data. Forty-four patients with spastic cerebral palsy between 6 and 19 years were included, 33 limbs received rotation only at the femur, 8 only at the tibia and 12 limbs at both levels. Gait

analysis and clinical testing was performed pre- and 21.4 (SD=1.8) months postoperatively. The amount of intraoperative derotation of the femur showed no significant correlation with the change in hip rotation during walking ($R=-0.17$, $p=0.25$), whereas the rotation of the tibia showed an excellent relationship ($R=0.84$, $p<0.001$) with the change in knee rotation. Preoperative hip rotation during walking explained only 18% of the variability of the postoperative change in hip rotation during gait. Strength and passive range of motion in hip extension and abduction as well as hip extension or abduction or foot progression during walking did not show any predictive significance. In conclusion changes of knee rotation during gait is directly predictable from the amount of tibial corrections, contrary the change in hip rotation was not related to the amount of femoral derotation, and prediction was only fair.

[PMID: 26387820](#)

3. Sensors (Basel). 2015 Sep 23;15(9):24514-24529.

Validation of Inter-Subject Training for Hidden Markov Models Applied to Gait Phase Detection in Children with Cerebral Palsy.

Taborri J, Scalona E, Palermo E, Rossi S, Cappa P.

Gait-phase recognition is a necessary functionality to drive robotic rehabilitation devices for lower limbs. Hidden Markov Models (HMMs) represent a viable solution, but they need subject-specific training, making data processing very time-consuming. Here, we validated an inter-subject procedure to avoid the intra-subject one in two, four and six gait-phase models in pediatric subjects. The inter-subject procedure consists in the identification of a standardized parameter set to adapt the model to measurements. We tested the inter-subject procedure both on scalar and distributed classifiers. Ten healthy children and ten hemiplegic children, each equipped with two Inertial Measurement Units placed on shank and foot, were recruited. The sagittal component of angular velocity was recorded by gyroscopes while subjects performed four walking trials on a treadmill. The goodness of classifiers was evaluated with the Receiver Operating Characteristic. The results provided a goodness from good to optimum for all examined classifiers ($0 < G < 0.6$), with the best performance for the distributed classifier in two-phase recognition ($G = 0.02$). Differences were found among gait partitioning models, while no differences were found between training procedures with the exception of the shank classifier. Our results raise the possibility of avoiding subject-specific training in HMM for gait-phase recognition and its implementation to control exoskeletons for the pediatric population.

[PMID: 26404309](#)

4. Arch Phys Med Rehabil. 2015 Sep 18. pii: S0003-9993(15)01190-9. doi: 10.1016/j.apmr.2015.08.434. [Epub ahead of print]

Site-specific transmission of a floor-based, high-frequency, low-magnitude vibration stimulus in children with spastic cerebral palsy.

Singh H, Whitney DG, Knight CA, Miller F, Manal K, Kolm P, Modlesky CM.

OBJECTIVE: To determine the degree to which a high-frequency, low-magnitude vibration (HLV) signal emitted by a floor-based platform transmits to the distal tibia and distal femur of children with spastic cerebral palsy (CP) during standing. **DESIGN:** Cross-sectional study **SETTING:** University research laboratory **PARTICIPANTS:** 4 to 12 year-old children with spastic CP who could stand independently ($n=18$) and typically developing children ($n=10$) participated in the study. **INTERVENTION:** Not applicable **MAIN OUTCOME MEASURES:** The vibration signal at the HLV platform (~ 33 Hz and 0.3 g), distal tibia and distal femur was measured using accelerometers. Degree of plantar flexor spasticity was assessed using the Modified Ashworth Scale. **RESULTS:** The HLV signal was greater ($p<0.001$) at the distal tibia than at the platform in children with CP (0.36 ± 0.06 vs. 0.29 ± 0.05 g) and controls (0.40 ± 0.09 vs. 0.24 ± 0.07 g). Although the HLV signal was also higher at the distal femur (0.35 ± 0.09 g, $p<0.001$) than at the platform in controls, it was lower in children with CP (0.20 ± 0.07 g, $p<0.001$). The degree of spasticity was negatively related to the HLV signal transmitted to the distal tibia ($rs=-0.547$) and distal femur ($rs=-0.566$) in children with CP (both $p<0.05$). **CONCLUSIONS:** An HLV signal from a floor-based platform was amplified at the distal tibia, attenuated at the distal femur and inversely related to the degree of muscle spasticity in children with spastic CP. Whether this transmission pattern affects the adaptation of their bones to HLV requires further investigation.

[PMID: 26392035](#)

5. *Pediatr Phys Ther.* 2015 Winter;27(4):349-54. doi: 10.1097/PEP.000000000000171.

Effect of Dynamic Elastomeric Fabric Orthoses on Postural Control in Children With Cerebral Palsy.

Bahramizadeh M, Rassafiani M, Aminian G, Rashedi V, Farmani F, Mirbagheri SS.

PURPOSE: The aim of this study was to evaluate the effect of dynamic elastomeric fabric orthoses (DEFOs) on postural control in children with cerebral palsy (CP). **METHODS:** Ten children with spastic diplegic CP and 10 children with typical development participated. Knee extension was measured using electrogoniometry. The standard deviation of excursion and phase plane portraits of velocity in the anteroposterior and mediolateral directions were calculated from force platform signals as center of pressure parameters with or without a DEFO. **RESULTS:** Maximum standing knee extension for children with CP improved after 6 weeks of wearing DEFOs ($P < .05$). Center of pressure parameters did not improve when comparing pre- to 6 weeks post-DEFO use ($P < .05$). **CONCLUSION:** The DEFO can reduce the crouch position without any negative effect on postural stability in children with CP. However, postural control does not improve in a 6-week timeframe.

[PMID: 26397077](#)

6. *Pediatr Phys Ther.* 2015 Winter;27(4):355. doi: 10.1097/PEP.000000000000192.

Commentary on "Effect of Dynamic Elastomeric Fabric Orthoses on Postural Control in Children With Cerebral Palsy".

Ly K, Patel S.

Commentary only.

[PMID: 26397078](#)

7. *Clin Biomech (Bristol, Avon).* 2015 Sep 8. pii: S0268-0033(15)00245-4. doi: 10.1016/j.clinbiomech.2015.09.004. [Epub ahead of print]

Does long-term passive stretching alter muscle-tendon unit mechanics in children with spastic cerebral palsy?

Theis N, Korff T, Mohagheghi AA.

BACKGROUND: Cerebral palsy causes motor impairments during development and many children may experience excessive neural and mechanical muscle stiffness. The clinical assumption is that excessive stiffness is thought to be one of the main reasons for functional impairments in cerebral palsy. As such, passive stretching is widely used to reduce stiffness, with a view to improving function. However, current research evidence on passive stretching in cerebral palsy is not adequate to support or refute the effectiveness of stretching as a management strategy to reduce stiffness and/or improve function. The purpose was to identify the effect of six weeks passive ankle stretching on muscle-tendon unit parameters in children with spastic cerebral palsy. **METHODS:** Thirteen children (8-14y) with quadriplegic/diplegic cerebral palsy were randomly assigned to either an experimental group (n=7) or a control group (n=6). The experimental group underwent an additional six weeks of passive ankle dorsiflexion stretching for 15min (per leg), four days per week, whilst the control group continued with their normal routine, which was similar for the two groups. Measures of muscle and tendon stiffness, strain and resting length were acquired pre- and post-intervention. **FINDINGS:** The experimental group demonstrated a 3° increase in maximum ankle dorsiflexion. This was accompanied by a 13% reduction in triceps surae muscle stiffness, with no change in tendon stiffness. Additionally, there was an increase in fascicle strain with no changes in resting length, suggesting muscle stiffness reductions were a result of alterations in intra/extra-muscular connective tissue. **INTERPRETATION:** The results demonstrate that stretching can reduce muscle stiffness by altering fascicle strain but not resting fascicle length.

[PMID: 26403361](#)

8. J Med Assoc Thai. 2015 Jun;98 Suppl 5:S92-6.**Effects of Thai Massage on Spasticity in Young People with Cerebral Palsy.**

Malila P, Seeda K, Machom S, Eungpinithpong W.

OBJECTIVE: To determine the effects of Thai massage on muscle spasticity in young people with cerebral palsy.

MATERIAL AND METHOD: Young people with spastic diplegia, aged 6-18 years old, were recruited from the Srisungwan School in Khon Kaen Province. Spasticity of right quadriceps femoris muscles was measured using Modified Ashworth Scale (MAS) at pre- and immediately post 30-minute session of Thai massage. Thai massage was applied on the lower back and lower limbs. Wilcoxon Signed Ranks test was used to compare the outcome between pre- and post treatment. **RESULTS:** Seventeen participants with spastic diplegia aged 13.71 +/- 3.62 years old participated. A significant difference of MAS was observed between pre- and post treatment (1+, 1; p<0.01). No adverse events were reported. **CONCLUSION:** Thai massage decreased muscle spasticity and is suggested to be an alternative treatment for reducing spasticity in young people with cerebral palsy.

[PMID: 26387418](#)

9. Augment Altern Commun. 2015 Sep 24:1-15. [Epub ahead of print]**AAC and Early Intervention for Children with Cerebral Palsy: Parent Perceptions and Child Risk Factors.**

Smith AL, Hustad KC.

The current study examined parent perceptions of communication, the focus of early intervention goals and strategies, and factors predicting the implementation of augmentative and alternative communication (AAC) for 26 two-year-old children with cerebral palsy. Parents completed a communication questionnaire and provided early intervention plans detailing child speech and language goals. Results indicated that receptive language had the strongest association with parent perceptions of communication. Children who were not talking received a greater number of intervention goals, had a greater variety of goals, and had more AAC goals than children who were emerging and established talkers. Finally, expressive language had the strongest influence on AAC decisions. Results are discussed in terms of the relationship between parent perceptions and language skills, communication as an emphasis in early intervention, AAC intervention decisions, and the importance of receptive language.

[PMID: 26401966](#)

10. Am J Phys Med Rehabil. 2015 Sep 18. [Epub ahead of print]**RE: EVALUATION OF STRESS AND PAIN IN YOUNG CHILDREN WITH CEREBRAL PALSY DURING EARLY DEVELOPMENTAL INTERVENTION PROGRAMS.**

Zhao X, Chen M, Li X.

Letter to the editor.

[PMID: 26390391](#)

11. Acta Paediatr. 2015 Sep 24. doi: 10.1111/apa.13224. [Epub ahead of print]**Analgesia by cooling vibration during venipuncture in children with cognitive impairment.**

Schreiber S, Cozzi G, Rutigliano R, Assandro P, Tubaro M, Cortellazzo Wiel L, Ronfani L, Barbi E.

AIM: Children with cognitive impairment experience pain more frequently than healthy children and are more likely to require

venipuncture or intravenous cannulation for various procedures. They are frequently unable to report pain and often receive poor pain assessment and management. This study assessed the effectiveness of physical analgesia during vascular access in children with cognitive impairments. **METHODS:** We conducted a prospective randomised controlled study at a tertiary level children's hospital in Italy from April to May 2015 to assess whether a cooling vibration device called Buzzy decreased pain during venipuncture and intravenous cannulation in children with cognitive impairment. None of the children had verbal skills and the main cognitive impairments were cerebral palsy, epileptic encephalopathy and genetic syndromes. **RESULTS:** We tested 70 children with a median age of nine years: 34 in the Buzzy group and 36 in the no intervention group. Parents were trained in the use of the Non-Communicating Children's Pain Checklist - Postoperative Version scale and they reported no or mild procedural pain in 32 cases (91.4%) in the Buzzy group and in 22 cases (61.1%) in the no intervention group ($p=0.003$). **CONCLUSION:** Cooling vibration analgesia during vascular access reduced pain in children with cognitive impairment.

[PMID: 26401633](#)

12. Dev Med Child Neurol. 2015 Sep 23. doi: 10.1111/dmcn.12930. [Epub ahead of print]

Comparison of lumbar epidural bupivacaine with fentanyl or clonidine for postoperative analgesia in children with cerebral palsy after single-event multilevel surgery.

Chalkiadis GA, Sommerfield D, Low J, Orsini F, Dowden SJ, Tay M, Penrose S, Pirpiris M, Graham HK.

AIM: To compare diazepam use, muscle spasm, analgesia, and side effects when clonidine or fentanyl are added to epidural bupivacaine in children with cerebral palsy after multilevel orthopaedic surgery. **METHOD:** Fifty children were prospectively randomized to receive clonidine ($n=24$, mean age 10y 10mo [SD 2y 11mo]) or fentanyl ($n=26$, mean age 10y 11mo [SD 2y 10mo]). **RESULTS:** There was no difference in primary outcome measures: median diazepam use (fentanyl 0, interquartile range [IQR] 0-0; clonidine 0, IQR 0-0; $p=0.46$), any muscle spasm (no muscle spasms in: fentanyl, 36%; clonidine, 62%; $p=0.11$), painful muscle spasm (fentanyl 40%; clonidine 25%; $p=0.46$), or pain score ≥ 6 (none: fentanyl 44%; clonidine 42%; $p=0.29$). There were differences in secondary outcome measures: no vomiting (clonidine 63%; fentanyl 20%); vomiting occurred more frequently with fentanyl (32% vomited more than three times; clonidine none; $p=0.001$). Fentanyl resulted in more oxygen desaturation (at least two episodes: fentanyl 20%; clonidine 0; $p<0.001$). Clonidine resulted in lower mean (SD) area under the curve for systolic blood pressure (fentanyl 106.5 [11.0]; clonidine 95.7mmHg [7.9]) and heart rate (fentanyl 104.9 beats per minute [13.6]; clonidine 85.3 [11.5]; $p<0.001$). **INTERPRETATION:** Clonidine and fentanyl provide adequate analgesia with low rates of muscle spasm, resulting in low diazepam use. The choice of epidural additive should be based upon the most tolerable side-effect profile.

[PMID: 26400818](#)

13. Toxicon. 2015 Sep 21. pii: S0041-0101(15)30079-9. doi: 10.1016/j.toxicon.2015.09.020. [Epub ahead of print]

Evidence-Based Review of Safety and Efficacy in Cerebral Palsy.

Tilton AH.

The introduction of botulinum toxin has been a major advance in the care of children with cerebral palsy. Clinically the positive effects of treatment with botulinum toxin are seen in patients with all levels of GMFCS. Botulinum toxin has been established in multiple studies to reduce spasticity in the upper and lower extremities, although there is some conflicting evidence regarding function. The medication is felt to be generally safe with a low incidence of adverse events which are temporary and self-limited. However there is the recognition that severe weakness may rarely occur. Ultimately it is incumbent upon the physician to consider both risks and benefits in determining the best treatment plan for the individual patient.

[PMID: 26403867](#)

Prevention and Cure

14 Int J Dev Neurosci. 2015 Sep 19. pii: S0736-5748(15)30077-0. doi: 10.1016/j.ijdevneu.2015.08.004. [Epub ahead of print]

The need for improved brain lesion segmentation techniques for children with cerebral palsy: a review.

Pagnozzi AM, Gal Y, Boyd RN, Fiori S, Fripp J, Rose S, Dowson N.

Cerebral palsy (CP) describes a group of permanent disorders of posture and movement caused by disturbances in the developing brain. Accurate diagnosis and prognosis, in terms of motor type and severity, is difficult to obtain due to the heterogeneous appearance of brain injury and large anatomical distortions commonly observed in children with CP. There is a need to optimise treatment strategies for individual patients in order to lead to lifelong improvements in function and capabilities. Magnetic resonance imaging (MRI) is critical to non-invasively visualizing brain lesions, and is currently used to assist the diagnosis and qualitative classification in CP patients. Although such qualitative approaches under-utilise available data, the quantification of MRIs is not automated and therefore not widely performed in clinical assessment. Automated brain lesion segmentation techniques are necessary to provide valid and reproducible quantifications of injury. Such techniques have been used to study other neurological disorders, however the technical challenges unique to CP mean that existing algorithms require modification to be sufficiently reliable, and therefore have not been widely applied to MRIs of children with CP. In this paper, we present a review of a subset of available brain injury segmentation approaches that could be applied to CP, including the detection of cortical malformations, white and grey matter lesions and ventricular enlargement. Following a discussion of strengths and weaknesses, we suggest areas of future research in applying segmentation techniques to the MRI of children with CP. Specifically, we identify atlas-based priors to be ineffective in regions of substantial malformations, instead propose relying on adaptive, spatially consistent algorithms, with fast initialisation mechanisms to provide additional robustness to injury. We also identify several cortical shape parameters that could be used to identify cortical injury, and shape modelling approaches to identify anatomical injury. The benefits of automatic segmentation in CP is important as it has the potential to elucidate the underlying relationship between image derived features and patient outcome, enabling better tailoring of therapy to individual patients.

[PMID: 26394278](#)