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Interventions and Management

1. Front Hum Neurosci. 2015 Jul 22;9:367. doi: 10.3389/fnhum.2015.00367. eCollection 2015.

Multi-scale complexity analysis of muscle coactivation during gait in children with cerebral palsy.

Tao W, Zhang X, Chen X, Wu D, Zhou P.

The objective of this study is to characterize complexity of lower-extremity muscle coactivation and coordination during gait in children with cerebral palsy (CP), children with typical development (TD) and healthy adults, by applying recently developed multivariate multi-scale entropy (MMSE) analysis to surface electromyographic (EMG) signals. Eleven CP children (CP group), eight TD children and seven healthy adults (considered as an entire control group) were asked to walk while surface EMG signals were collected from five thigh muscles and three lower leg muscles on each leg (16 EMG channels in total). The 16-channel surface EMG data, recorded during a series of consecutive gait cycles, were simultaneously processed by multivariate empirical mode decomposition (MEMD), to generate fully aligned data scales for subsequent MMSE analysis. In order to conduct extensive examination of muscle coactivation complexity using the MEMD-enhanced MMSE, 14 data analysis schemes were designed by varying partial muscle combinations and time durations of data segments. Both TD children and healthy adults showed almost consistent MMSE curves over multiple scales for all the 14 schemes, without any significant difference ($p > 0.09$). However, distinct diversity in MMSE curve was observed in the CP group when compared with the control group. There appears to be diverse neuropathological processes in CP that may affect dynamical complexity of muscle coactivation and coordination during gait. The abnormal complexity patterns emerging in the CP group can be attributed to different factors such as motor control impairments, loss of muscle couplings, and spasticity or paralysis in individual muscles. This study expands our knowledge of neuropathology of CP from a novel point of view of muscle co-activation complexity, which might be useful to derive a quantitative index for assessing muscle activation characteristics as well as motor function in CP.

PMID: 26257622

2. Gait Posture. 2015 Jul 23. pii: S0966-6362(15)00731-6. doi: 10.1016/j.gaitpost.2015.07.003. [Epub ahead of print]

Long-term outcomes after multilevel surgery including rectus femoris, hamstring and gastrocnemius procedures in children with cerebral palsy.

Õunpuu S Solomito M, Bell K, DeLuca P, Pierz K.

BACKGROUND/AIMS: Multilevel surgical intervention is a common approach for the correction of gait

abnormalities in children with cerebral palsy (CP). The short-term outcomes for the combination of rectus femoris transfer, hamstring lengthening and gastrocnemius lengthening have been well documented using three-dimensional motion analysis. However, the impact of time, growth, and puberty on these short-term outcomes of this combination of procedures is not well understood. The purpose of this study was to evaluate the long-term outcomes of these procedures on gait in patients with CP. METHODS: Twenty-two patients underwent rectus femoris transfers, medial hamstring lengthenings and gastrocnemius lengthenings in combination with a selection of other soft tissue and/or bony procedures of the lower limb. All patients had a pre-operative motion analysis and post-operative analysis one and 11 years following surgery. RESULTS: Significant changes in both clinical and gait variables from pre to 1 year post surgery confirmed the short-term gait benefits of this combination of surgical procedures. Long-term follow-up data indicated that the passive range of motion gains noted 1 year after surgery were lost at the knee and ankle. However, the improvements in ankle dorsiflexion and knee extension at initial contact were maintained over 11 years. As well, peak ankle dorsiflexion in stance was maintained and peak ankle plantar flexor moments and powers did not show declines long-term. Peak knee flexion showed a decline over the long-term, however, the timing of peak knee flexion in swing was maintained. CONCLUSION: When compared to declines in gait kinematics in persons with CP without surgery, these results demonstrate the possible long-term benefits of surgical intervention.

PMID: 26260009

3. J Neuroeng Rehabil. 2015 Aug 15;12(1):67. doi: 10.1186/s12984-015-0056-y.

Assessment of net knee moment-angle characteristics by instrumented hand-held dynamometry in children with spastic cerebral palsy and typically developing children.

Haberfehlner H, Maas H, Harlaar J, Newsum IE, Becher JG, Buizer AI, Jaspers RT.

BACKGROUND: The limited range of motion during walking in children with spastic cerebral palsy (SCP) may be the result of altered mechanical characteristics of muscles and connective tissues around the knee joint. Measurement of static net knee moment-angle relation will provide insights into these alterations, for which instrumented hand-held dynamometry may be applied. The aims of this study were: (1) to test the measurement error of the estimated net knee moment-angle characteristics, (2) to determine the correlation between knee extension angle measurement at a standardized knee moment and popliteal angle from common physical examination and (3) to compare net knee moment-angle characteristics in SCP versus typically developing children. METHODS: With the child lying in sideward position, the knee was extended by moving the lower leg by a hand-held force transducer on a low friction cart. Force data were collected for a range of knee angles. Data were excluded when activity (EMG) levels of knee extensor and flexor muscles exceeded the EMG level during rest by more than two standard deviations. The net knee flexion moments were calculated from recorded force data and measured moment arm. Reliability for knee angles corresponding with 0.5, 1, 2, 3, and 4 Nm knee net flexion moments was assessed by standard error of measurements (SEM) and smallest detectable difference (SDD). RESULTS: For between day comparison, SEMs were about 5° and SDDs were below 14° for knee angles at 1-4 Nm net knee flexion moments. In SCP children, the knee angle measured at 4 Nm knee flexion moment was not related to the popliteal angle (r = 0.52). The slope at 4 Nm of the knee moment-angle curve in SCP children was significantly higher than that in typically developing children. CONCLUSIONS: The presented knee hand-held dynamometry allows assessment of net knee flexion moment-knee angle characteristics in typically developing and SCP children and can be used to identify clinically relevant changes as a result of treatment. Overall stiffness of structures that contribute to the net knee flexion moment at the knee (i.e. muscles, tendons, ligaments) is elevated in SCP children.

PMID: 26272620

4. Stud Health Technol Inform. 2015;216:589-593.

CA^{2}JU.

Santos FA, Júnior CA, Teixeira Macedo H, Chella MT, do Nascimento Givigi RC, Barbosa L.

This paper presents CA^{2}JU, a hardware/software tool that aims to help individuals with severe speech or language problems in their communication in order to promote their social and digital inclusion. CA^{2}JU is composed of two applications: CA^{2}JU Accelerated, which makes typing faster by suggesting potential words to the user; and CA^{2}JU Illustrated, which automatically converts a sentence of words into a sequence of pictographic symbols, allowing a user familiar with the symbols to verify whether the written sentence is correct. We have implemented, evaluated in a controlled scenario, and deployed CA^{2}JU in a real environment with children with cerebral palsy. In the controlled settings, the results confirm CA^{2}JU Accelerated speed up typing by reducing the number of clicks made by users, and CA^{2}JU Illustrated obtained high accuracy by suggesting the correct pictograms from sentences. In the real scenario, the two use cases show that the children improved their communication and linguistic abilities.

PMID: 26262119

5. Dev Med Child Neurol. 2015 Aug 14. doi: 10.1111/dmcn.12866. [Epub ahead of print]

Classification systems of communication for use in epidemiological surveillance of children with cerebral palsy.

Virella D, Pennington L, Andersen GL, Andrada MD, Greitane A, Himmelmann K, Prasauskiene A, Rackauskaite G, De La Cruz J, Colver A; Surveillance of Cerebral Palsy in Europe Network.

AIM: Children with cerebral palsy (CP) often experience communication difficulties. We aimed to identify a classification system for communication of children with CP suitable for epidemiological surveillance. METHOD: Systems to classify the communication of children with CP were identified. The Communication Function Classification System (CFCS), Functional Communication Classification System (FCCS), and Viking Speech Scale (VSS) were chosen for further investigation and translated. They were administered to 155 children aged 4 to 13 years with CP (across all motor severity levels) from eight European countries. Children's parents/carers, speech therapists, and other health professionals applied the systems through direct observation. Other professionals applied them from case notes only. The systems were assessed for agreement, stability, ease, and feasibility of application. RESULTS: Test-retest stability was moderate-to-high for VSS (k=0.66-0.88), CFCS (k=uncomputed-0.91), and FCCS (k=0.52-0.91). Overall interrater agreement was fair to very good for every classification system. VSS achieved the best agreement between parents/carers and speech therapists. VSS was considered the easiest instrument to apply. INTERPRETATION: Because of its ease of use by a range of healthcare professionals, the VSS should be considered for CP registers which intend to survey speech intelligibility. For a wider assessment of communication, the CFCS or FCC should be considered.

PMID: 26272847

6. Dev Med Child Neurol. 2015 Aug 10. doi: 10.1111/dmcn.12863. [Epub ahead of print]

Classifying communication ability in cerebral palsy.

Cockerill H.

PMID: 26259835

7. Dev Med Child Neurol. 2015 Aug 12. doi: 10.1111/dmcn.12871. [Epub ahead of print]

Advanced neuroimaging of cerebral palsy following extremely preterm birth.

Kumar R.

Commentary only.

PMID: 26265228

8. Am J Phys Med Rehabil. 2015 Aug 7. [Epub ahead of print]

Comment on: Evaluation of Stress and Pain in Young Children with Cerebral Palsy During Early Developmental Intervention Programs.

Commentary only.

Rivenburgh T.

9. Aust Occup Ther J. 2015 Aug 9. doi: 10.1111/1440-1630.12215. [Epub ahead of print]

Social participation experiences of mothers of children with cerebral palsy in an Iranian context.

Dehghan L, Dalvandi A, Rassafiani M, Hosseini SA, Dalvand H, Baptiste S.

BACKGROUND/AIM: Social participation is increasingly of interest in research that investigates the impact of caring for a child with a disability. Little has been investigated about the social participation experiences of mothers of children with cerebral palsy (CP). This study explored social participation among Iranian mothers of children with CP.
METHODS: The conventional qualitative content analysis method was utilised. Data were collected via in-depth semi-structured interviews with 14 mothers (aged 26-45 years) of children with CP with the gross motor function classification system expanded & revised levels III-V. Constant comparative analysis was deployed for data analysis.
RESULTS: The results were identified and classified into three main themes: (i) polarisation of positive and negative feelings; (ii) challenges to mothers' social activity; and (iii) striving to engage in society. CONCLUSION: In the Iranian context, mothers of children with CP are facing many challenges to social participation and seem to have been neglected by the health-care system. One of the priorities of Iranian health policy makers may be developing, establishing and implementing social support to enable the mothers to participate in social activities. Furthermore, occupational therapists can contribute and guide mothers' social participation by creating programs to develop and utilise skills for them.

10. Behav Neurol. 2015;2015:341023. doi: 10.1155/2015/341023. Epub 2015 Jul 14.

Social Attitudes toward Cerebral Palsy and Potential Uses in Medical Education Based on the Analysis of Motion Pictures.

Jóźwiak M, Chen BP, Musielak B, Fabiszak J, Grzegorzewski A.

This study presents how motion pictures illustrate a person with cerebral palsy (CP), the social impact from the media, and the possibility of cerebral palsy education by using motion pictures. 937 motion pictures were reviewed in this study. With the criteria of nondocumentary movies, possibility of disability classification, and availability, the total number of motion pictures about CP was reduced to 34. The geographical distribution of movie number ever produced is as follows: North America 12, Europe 11, India 2, East Asia 6, and Australia 3. The CP incidences of different motor types in real world and in movies, respectively, are 78-86%, 65% (Spastic); 1.5-6%, 9% (Dyskinetic); 6.5-9%, 26% (Mixed); 3%, 0% (Ataxic); 3-4%, 0% (Hypotonic). The CP incidences of different Gross Motor Function Classification System (GMFCS) levels in real world and in movies, respectively, are 40-51%, 47% (Level I + II); 14-19%, 12% (Level III); 34-41%, 41% (Level IV + V). Comparisons of incidence between the real world and the movies are surprisingly matching. Motion pictures honestly reflect the general public's point of view to CP patients in our real world. With precise selection and medical professional explanations, motion pictures can play the suitable role making CP understood more clearly.

11. Dev Med Child Neurol. 2015 Aug 10. doi: 10.1111/dmcn.12869. [Epub ahead of print]

The quest for patterns in dyskinetic cerebral palsy.

Commentary only.

Himmelmann K.

12. J Child Neurol. 2015 Aug 13. pii: 0883073815599260. [Epub ahead of print]

Persistence of Cerebral Palsy Diagnosis: Assessment of a Low-Birth-Weight Cohort at Ages 2, 6, and 9 Years.

Korzeniewski SJ, Feldman JF, Lorenz JM, Pinto-Martin JA, Whitaker AH, Paneth N.

We examined the stability of nondisabling and disabling cerebral palsy at age 2 in a longitudinally followed tri-county low-birth-weight (<2000 g) birth cohort. A total of 1105 newborns were enrolled, 901 (81.5%) survived to age 2, and 86% (n = 777) were followed up. Of the 113 cerebral palsy diagnoses at age 2, 61 (9% of the cohort, n = 61/777) had disabling cerebral palsy and 52 (7%, n = 52/777) had nondisabling cerebral palsy. Of 48 followed children diagnosed with disabling cerebral palsy at age 2, 98% were again classified as having cerebral palsy at school age, and 1 had an uncertain cerebral palsy status. By contrast, 41% (n = 17) of the 43 children diagnosed with nondisabling cerebral palsy at age 2 were classified as not having cerebral palsy. Of the 517 followed children who were not diagnosed with cerebral palsy at age 2, 7% (n = 35) were classified as having late emerging nondisabling cerebral palsy at school age.

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13. Res Dev Disabil. 2015 Aug 7;45-46:178-187. doi: 10.1016/j.ridd.2015.07.030. [Epub ahead of print]

Relationship between characteristics on magnetic resonance imaging and motor outcomes in children with cerebral palsy and white matter injury.

Reid SM, Ditchfield MR, Bracken J, Reddihough DS.

In a population cohort of children with white matter injury (WMI) and cerebral palsy (CP), we aimed to describe the magnetic resonance imaging (MRI) characteristics, identify key structure-function relationships, and classify the severity of WMI in a clinically relevant way. Stratified on MRI laterality/symmetry, variables indicating the extent and location of cerebral abnormalities for 272 children with CP and WMI on chronic-phase MRI were related to gross motor function and motor topography using univariable and multivariable approaches. We found that symmetrical involvement, severe WM loss in the hemispheres and corpus callosum, and cerebellar involvement were the strongest predictors of poor gross motor function, but the final model explained only a small proportion of the variability. Bilateral, extensive WM loss was more likely to result in quadriplegia, whereas volume loss in the posterior-mid WM more frequently resulted in diplegia. The extent and location of MRI abnormalities differed according to laterality/symmetry; asymmetry was associated with less extensive hemispheric involvement than symmetrical WMI, and unilateral lesions were more focal and located more anteriorly. In summary, laterality/symmetry of WMI, possibly reflecting different pathogenic mechanisms, together with extent of WM loss and cerebellar abnormality predicted gross motor function in CP, but to a limited extent.

Antenatal Magnesium and Cerebral Palsy in Preterm Infants.

Hirtz DG, Weiner SJ, Bulas D, DiPietro M, Seibert J, Rouse DJ, Mercer BM, Varner MW, Reddy UM, Iams JD, Wapner RJ, Sorokin Y, Thorp JM Jr, Ramin SM, Malone FD, Carpenter MW, O'Sullivan MJ, Peaceman AM, Hankins GD, Dudley D, Caritis SN; Eunice Kennedy Shriver National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network.

OBJECTIVE: To evaluate the relationship of maternal antenatal magnesium sulfate (MgSO4) with neonatal cranial ultrasound abnormalities and cerebral palsy (CP). STUDY DESIGN: In a randomized trial of MgSO4 or placebo in women at high risk of preterm delivery, up to 3 cranial ultrasounds were obtained in the neonatal period. Images were reviewed by at least 2 pediatric radiologists masked to treatment and other clinical conditions. Diagnoses were predefined for intraventricular hemorrhage, periventricular leukomalacia, intracerebral echolucency or echodensity, and ventriculomegaly. CP was diagnosed at 2 years of age by standardized neurologic examination. RESULTS: Intraventricular hemorrhage, periventricular leukomalacia, intracerebral echolucency or echodensity, and ventriculomegaly were all strongly associated with an increased risk of CP. MgSO4 administration did not affect the risk of cranial ultrasound abnormality observed at 35 weeks postmenstrual age or later. However, for the 82% of infants born at <32 weeks gestation, MgSO4 was associated with a reduction in risk of echolucency or echodensity. The reduction in risk for echolucency explained 21% of the effect of MgSO4 on CP (P = .04), and for echodensity explained 20% of the effect (P = .02). CONCLUSIONS: MgSO4 given prior to preterm delivery was associated with decreased risk of developing echodensities and echolucencies at <32 weeks gestation. However, this effect can only partially explain the effect of MgSO4 on CP at 2 years of age. TRIAL REGISTRATION: ClinicalTrials.gov: NCT00014989.