

Monday 31 March 2014

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Interventions and Management

1. *Dev Med Child Neurol.* 2014 Mar 26. doi: 10.1111/dmcn.12439. [Epub ahead of print]

Determination of interventions for upper extremity tactile impairment in children with cerebral palsy: a systematic review.

Auld ML1, Russo R, Moseley GL, Johnston LM.

AIM: This study reviewed interventions suitable for treating tactile dysfunction in children with cerebral palsy (CP). **METHOD:** A systematic review was conducted of six databases, searched for population: ('brain injury' OR 'cerebral palsy' OR 'stroke' OR 'cerebrovascular accident') and intervention: ('tactile' OR 'sensation'). Inclusion criteria were: (1) published after 1950 in English; (2) participants older than 4 years with brain injury; (3) upper limb intervention; and (4) examined tactile registration or perception. **RESULTS:** Of 2938 studies identified, 30 met the inclusion criteria. Results from included studies indicated that tactile function improved in adults with stroke after transfer enhanced training ($t[47]=2.75$, $p=0.004$), stimulus specific training ($p<0.001$), ice therapy ($F=5.71$, $p=0.028$), mirror therapy ($F=7.7$, $p=0.009$), and functional deafferentation using an anaesthetic cream ($t=3.76$; $p<0.01$). No intervention reported improvement in tactile dysfunction for children with CP. **INTERPRETATION:** Research is required to develop tactile interventions for children with CP that integrate methodology from effective approaches for adults after stroke. Stimulus specific training, transfer enhanced training, and mirror therapy are promising. Other approaches are less suitable for children because of invasiveness (electrical stimulation), safety (ice therapy), or limitation of bimanual function (eutectic mixture of local anaesthetics, pneumatic cuff).

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[PMID: 24665898](https://pubmed.ncbi.nlm.nih.gov/24665898/) [PubMed - as supplied by publisher]

2. *Res Dev Disabil.* 2014 Mar 23. pii: S0891-4222(14)00075-4. doi: 10.1016/j.ridd.2014.02.007. [Epub ahead of print]

Postural adaptation during arm raising in children with and without unilateral cerebral palsy.

Ledebt A1, Savelsbergh GJ2.

Postural sway during arm movements were related to the size of the base of support (BOS) and the limits of stability (LOS) of children with unilateral cerebral palsy (USCP) and typically developing (TD) children. For half of

the trials the mechanical disturbance due to the rapid arm movement was increased by attaching small weights at the wrists. The participants stood with both feet on a large force plate, which recorded the displacements of the center of pressure (CoP). The results showed that in the children with USCP the LOS forward and toward the non-dominant (more-affected) side were smaller than in the TD children whereas the LOS backward and toward the dominant (less-affected) side did not differ between the two groups. When rapidly moving the arms the children with USCP swayed over a larger portion of their base of support in the forward direction and toward their more-affected side. In addition, the maximal sway toward the more-affected side during arm movement exceeded the LOS while balance was maintained. These effects increased when the movements were performed with the weights at the wrists. These results show that an area of permissible sway, which was not spontaneously explored during the leaning task, was required to maintain balance during the supra-postural task. Training to enlarge the LOS that includes weight shifts toward the more-affected side might reduce the area of the BOS that is self-perceived as less secure.

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[PMID: 24670884](#) [PubMed - as supplied by publisher]

3. J Hand Surg Am. 2014 Mar 24. pii: S0363-5023(14)00257-3. doi: 10.1016/j.jhsa.2014.02.012. [Epub ahead of print]

Early Results of Anterior Elbow Release With and Without Biceps Lengthening in Patients With Cerebral Palsy.

Gong HS1, Cho HE2, Chung CY2, Park MS2, Lee HJ2, Baek GH2.

PURPOSE: To investigate the effect of partial biceps lengthening on elbow flexion posture and active elbow flexion and extension in patients with cerebral palsy. **METHODS:** We retrospectively reviewed 29 patients with cerebral palsy who underwent anterior elbow release as part of multilevel upper extremity surgery. The early series of the patients (N = 14; group 1) had lacertus fibrosus division, brachialis fractional lengthening, and denuding of the pretendinous adventitia off the biceps tendon. The later series of patients (N = 15; group 2) had partial biceps tendon lengthening in addition to the procedures in group 1. We compared the 2 sets of patients for elbow flexion posture, active elbow flexion and extension, forearm rotation, and House scores, with mean follow-ups of 72 months for group 1 and 31 months for group 2. **RESULTS:** The 2 groups were comparable in terms of mean age, number of procedures, and preoperative House scores. Group 2 patients had more improvement in flexion posture (53° vs 44°) and active extension (23° vs 15°) than group 1 postoperatively. However, group 2 had a mean decrease of 7° in active elbow flexion, whereas group 1 had no changes. There was no difference in forearm supination or in the improvement of House scores between groups. **CONCLUSIONS:** Early results of partial lengthening of the biceps tendon showed that it may improve elbow flexion posture and active elbow extension in patients with flexion deformity in cerebral palsy.

TYPE OF STUDY/LEVEL OF EVIDENCE: Therapeutic III.

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4. Clin Biomech (Bristol, Avon). 2014 Mar 5. pii: S0268-0033(14)00047-3. doi: 10.1016/j.clinbiomech.2014.02.005. [Epub ahead of print]

Upper body movements in children with hemiplegic cerebral palsy walking with and without an ankle-foot orthosis.

Schweizer K1, Brunner R2, Romkes J3.

BACKGROUND: It has previously been discussed that treatment of the hemiplegic arm in patients with cerebral palsy can improve gait parameters in the lower body. Our question was whether improving the ankle rocker with an orthosis has an effect on the upper body during walking. The main aim was to investigate, which trunk and arm kinematics of toe walking children with hemiplegic cerebral palsy are changed by wearing a hinged ankle-foot

orthosis, restoring an initial heel contact. **METHODS:** Specific parameters of the pelvis, thorax, and arm kinematics were investigated. Differences in the hemiplegic side between the barefoot and the orthotic condition were calculated by Students t-tests. Additionally, the 95% confidence intervals were used to explore clinically relevant differences between the controls and the patients and asymmetries within the patients' affected and unaffected sides. **FINDINGS:** Pelvic tilt range of motion (barefoot: 7.5° (6.1-9.0°), orthosis: 6.6° (5.1-8.1) P=0.040) and mean shoulder abduction (barefoot: 14.3° (10.2-18.4°), orthosis: 12.1° (8.4-15.8) P=0.027) were the only two parameters with statistically significant differences, although not clinically relevant, between the barefoot and orthotic conditions. Abnormalities in all three planes were explored between the patients and controls. The entire trunk was more externally rotated, the pelvis stood lower, and the elbow was more flexed on the hemiplegic side compared to the unaffected side. **INTERPRETATION:** A hinged ankle-foot orthosis, restoring the first ankle rocker, had no clinically relevant effects on trunk kinematics. None of the observed upper body gait deviations seemed to be secondary to or caused by toe walking.

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5. Clin Biomech (Bristol, Avon). 2014 Mar 12. pii: S0268-0033(14)00049-7. doi: 10.1016/j.clinbiomech.2014.02.006. [Epub ahead of print]

Movement deviation and asymmetry assessment with three dimensional gait analysis of both upper- and lower extremity results in four different clinical relevant subgroups in unilateral cerebral palsy.

Lundh D1, Coleman S2, Riad J3.

BACKGROUND: In unilateral cerebral palsy, movement pattern can be difficult to define and quantify. The aim was to assess the degree of deviation and asymmetry in upper and lower extremities during walking. **METHODS:** Forty-seven patients, 45 Gross Motor Function Classification Scale (GMFCS) I and 2 patients GMFCS II, mean age 17.1 years (range 13.1 to 24.0) and 15 matched controls were evaluated. Gait profile score (GPS) and arm posture score (APS) were calculated from three-dimensional gait analysis (GA). Asymmetry was the calculated difference in deviation between affected and unaffected sides. **FINDINGS:** The GPS was significantly increased compared to the control group on the affected side (6.93 (2.08) versus 4.23 (1.11) degrees) and on the unaffected side (6.67 (2.14)). The APS was also significantly increased on the affected side (10.39 (5.01) versus 5.52 (1.71) degrees) and on the unaffected side (7.13 (2.23)). The lower extremity asymmetry increased (significantly) in comparison with the control group (7.89 (3.82) versus 3.90 (1.01)) and correspondingly in the upper extremity (9.75 (4.62) versus 5.72 (1.84)). The GPS was not different between affected and unaffected sides, however the APS was different (statistically significant). **INTERPRETATION:** We calculated deviation and asymmetry of movement during walking in unilateral CP, identifying four important clinical groups: close to normal, deviations mainly in the leg, deviations mainly in the arm and those with deviation in the arm and leg. This method can be applied to any patient group, and aid in diagnosing, planning treatment, and prognosis.

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[PMID: 24670612](#) [PubMed - as supplied by publisher]

6. Gait Posture. 2014 Feb 26. pii: S0966-6362(14)00073-3. doi: 10.1016/j.gaitpost.2014.02.009. [Epub ahead of print]

Balance control in gait children with cerebral palsy.

Wallard L1, Dietrich G2, Kerlirzin Y2, Bredin J3.

This study sought to highlight the balance control process during gait in children with cerebral palsy (CP) by analyzing the different strategies used in order to generate forward motion while maintaining balance. Data were collected using a motion analysis system in order to provide a clinical gait analysis for 16 children with CP and 16 children with typical development. Significant differences between the two groups are observed in terms of kinetic data of the propulsive forces of the center of mass (COM) and of the center of pressure (COP) dynamic trajectory and for locomotor parameters. The imbalance generated by divergent trajectories of COM and COP produce the

propulsive forces responsible for human gait initiation. Moreover, we observe in children with CP an "en bloc" postural strategy resulting in increasing divergence between trajectories of COM-COP. This particular strategy of the children with CP is characterized by a greater time duration between the moment of COM-COP trajectory divergence and the moment where the forward propulsive forces became apparent.

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[PMID: 24656683](#) [PubMed - as supplied by publisher]

7. Dev Med Child Neurol. 2014 Mar 28. doi: 10.1111/dmcn.12431. [Epub ahead of print]

Reported outcomes of lower limb orthopaedic surgery in children and adolescents with cerebral palsy: a mapping review.

Wilson NC1, Chong J, Mackey AH, Stott NS.

AIM: Lower limb surgery is often performed in ambulatory children with cerebral palsy (CP) to improve walking ability. This mapping review reports on outcome measures used in the published literature to assess surgical results, determine range and frequency of use, and map each measure to the International Classification of Functioning, Disability and Health. **METHOD:** A mapped review of literature published between 1990 and 2011 was carried out to identify papers reporting the outcomes of lower limb orthopaedic surgery in ambulatory children with CP, aged 0 to 20 years. **RESULTS:** A total of 229 published papers met the inclusion criteria. Thirty-two outcome measures with known psychometric properties were reported in the 229 papers. Twenty measures assess impairments in body structure and function and were used in 91% of studies. Ten measures assess restrictions in activity and participation and were used in 9% of papers. Two measures assessed quality of life. Since 1997, 29% of papers have used the Gross Motor Function Classification System to describe participants. **INTERPRETATION:** The body of literature evaluating outcomes of lower limb orthopaedic surgery in CP is small but increasing. There is a need to develop a suite of outcome measures that better reflect outcomes across the International Classification of Functioning, Disability and Health, including activity and participation.

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[PMID: 24673603](#) [PubMed - as supplied by publisher]

8. Ann Phys Rehabil Med. 2014 Mar 7. pii: S1877-0657(14)00019-0. doi: 10.1016/j.rehab.2014.02.004. [Epub ahead of print]

Dynamic EMG of peroneus longus in hemiplegic children with equinovarus.

Boulay C1, Jacquemier M2, Pomeroy V2, Castanier E2, Authier G2, Chabrol B3, Bollini G2, Jouve JL2, Viehweger E2.

OBJECTIVE: In hemiplegic children the appearance of equinovarus is correlated with premature electromyography (EMG) activity of the gastrocnemius medialis (GM) prior to initial contact. The goal was to analyze the onset of EMG activation in the GM and, more particularly, the peroneus longus (PL) in cases of equinovarus: is PL activity likewise premature? **MATERIAL AND METHODS:** As 15 hemiplegic children (age 5 years±1.5) with equinovarus walked, their PL and GM EMG activity was being recorded. The latter was normalized in terms of gait cycle percentage (0-100%) and detected through semi-automatic selection with activation threshold set at 20µV. A paired t-test compared activation onset of the PL versus the GM muscles. **RESULTS:** As regards the healthy limb, activity onset of the GM (+14.55%) and the PL (+19.2%) muscles occurred only during the ST. In cases of equinovarus, activation of the GM (-5.2%) and the PL (-6.1%) occurred during the SW and was premature. For each muscle, comparison between the healthy and the hemiplegic side was highly significant (P<0.001). **CONCLUSION:** Premature PL and GM EMG activity preceding initial contact corresponds not to a disorder secondary to imbalance but rather, more probably, to motor command dysfunction. While the PL consequently contributes to equinus deformity, its possible role in varus genesis is less evident. EMG study needs to be completed by comparing PL and tibialis posterior strength while taking foot bone morphology into full account.

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9. Gait Posture. 2014 Mar 2. pii: S0966-6362(14)00077-0. doi: 10.1016/j.gaitpost.2014.02.013. [Epub ahead of print]

Rectus femoris transfer in cerebral palsy patients with stiff knee gait.

Lee SY1, Kwon SS2, Chung CY3, Lee KM3, Choi Y3, Kim TG4, Shin WC3, Choi IH5, Cho TJ5, Yoo WJ5, Park MS6.

BACKGROUND: Although several studies have reported on the outcomes of rectus femoris transfer (RFT), few have investigated the multiple factors that could affect the results. Therefore, we evaluated the outcomes of RFT and analyzed factors that influence improvement and annual change in knee motion after surgery in patients with cerebral palsy (CP). **METHODS:** We reviewed ambulatory patients with CP who were followed up after they had undergone RFT as part of a single-event multilevel surgery (SEMLS) and who had undergone preoperative and postoperative three-dimensional (3D) gait analysis between January 1995 and December 2012. Relevant kinematic values, including peak knee flexion, knee range of motion, and timing of peak knee flexion in the swing phase and gait deviation index (GDI) score, were the outcome measures. Improvements in rate of angle and GDI score were adjusted by multiple factors such as sex, Gross Motor Function Classification System (GMFCS) level, anatomic type of CP, and concomitant surgeries as the fixed effects, and follow-up duration, laterality, and each subject as the random effects, all of which was performed using a linear mixed model. **RESULTS:** A total of 290 patients (487 limbs) and 612 3D gait analysis (2-4 per patient) results were finally included in this study. At 2 years after RFT, estimated mean peak knee flexion (1.2° , $p=0.005$), estimated mean knee range of motion (10.7° , $p<0.001$), and estimated mean GDI score (7.3 , $p<0.001$) increased significantly. Peak knee flexion in the swing phase occurred 5.4% earlier after surgery compared with that at baseline ($p<0.001$). In serial postoperative gait analyses, peak knee flexion in the swing phase occurred 0.8% earlier per year in patients with GMFCS level I or II ($p=0.021$). **CONCLUSIONS:** RFT as part of a SEMLS was effective in treating stiff knee gait. In serial postoperative gait analyses, patients with GMFCS level I or II showed better prognosis than those with level III with regard to timing of peak knee flexion in the swing phase.

LEVEL OF EVIDENCE: Prognostic level IV.

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[PMID: 24656919](#) [PubMed - as supplied by publisher]

10. Ortop Traumatol Rehabil. 2013 Oct 24;15(6):649-51. doi: 10.5604/15093492.1091551.

Unusual operative treatment and outcome of femoral shaft fracture in a non-ambulatory Cerebral Palsy patient.

Hassanein M, Taylor D, Sturdee S.

Cerebral palsy patients are prone to spontaneous fractures due to poor bone quality. The treatment options of femoral fractures include conservative and operative management which is tailored according to the patient's needs, co-morbidities and the presence of skilled surgeon. We present a 20 year old non-ambulatory CP patient who had a fractured femoral shaft which was treated by surgical excision of the fracture which is a surgical modality that according to our knowledge hasn't been addressed before in literature.

[PMID: 24662911](#) [PubMed - in process]

11. Iran J Child Neurol. 2013 Fall;7(4):12-9.**The impacts of hinged and solid ankle-foot orthoses on standing and walking in children with spastic diplegia.**

Dalvand H1, Dehghan L1, Feizi A2, Hosseini SA1, Amirsalari S3.

OBJECTIVE: The purpose of this study was to examine the impacts of hinged and solid anklefoot orthoses (AFOs) on standing and walking abilities in children with spastic diplegia. **MATERIALS & METHODS:** In a quasi-experimental design, 30 children with spastic diplegia, aged 4-6 years were recruited. They were matched in terms of age, IQ, and level of GMFCS E&R. Children were randomly assigned into 3 groups: a hinged AFO group (n=10) plus occupational therapy (OT), a solid AFO group (n=10) plus OT, a control group who used only OT for three months. Gross motor abilities were measured using Gross Motor Measure Function (GMFM). **RESULTS:** We obtained statistically significant differences in the values between baseline and after treatment in all groups. The groups were also significantly different in total GMFM after intervention. Furthermore, there were differences between hinged AFOs and solid AFOs groups, and between hinged AFOs and control groups. **CONCLUSION:** We concluded that gross motor function was improved in all groups; however, hinged AFOs group appears to improve the gross motor function better than solid AFOs and control groups.

[PMID: 24665312](#) [PubMed] [PMCID: PMC3943047](#) Free PMC Article

12. Pediatr Phys Ther. 2014 Summer;26(2):253-64. doi: 10.1097/PEP.000000000000023.**Serial casting for neuromuscular flatfoot and vertical talus in an adolescent with hereditary spastic paraplegia.**

Sweet LA1, O'neill LM, Dobbs MB.

PURPOSE: The purpose of this report is to explore assessment and serial casting intervention for painful rigid flatfoot deformities with vertical talus in an adolescent girl with hereditary spastic paraplegia who was nonambulatory. **SUMMARY OF KEY POINTS:** The participant's right foot underwent 2 phases of casting with correction first toward hindfoot inversion and then dorsiflexion. Because of a vertical talus, her left foot required an intermediate casting toward plantar flexion, inversion, and forefoot adduction prior to casting toward dorsiflexion. **STATEMENT OF CONCLUSIONS:** The patient improved despite the underlying progressive neuromuscular disorder. Pain ameliorated and she returned to supported standing and transfers. Spasticity decreased bilaterally and the flexibility of her foot deformities improved to allow orthotic fabrication in subtalar neutral. Results were maintained at 12 and 16 months. **RECOMMENDATIONS FOR CLINICAL PRACTICE:** Individualized multiphase serial casting requires further investigation with patients such as those with hereditary spastic paraplegia.

[PMID: 24675132](#) [PubMed - in process]

13. Pediatr Phys Ther. 2014 Summer;26(2):223-9. doi: 10.1097/PEP.000000000000025.**Postural orientation during standing in children with bilateral cerebral palsy.**

Lidbeck CM1, Gutierrez-Farewik EM, Broström E, Bartonek A.

PURPOSE: To investigate postural orientation and maintenance of joint position during standing in children with bilateral spastic cerebral palsy (BSCP). **METHODS:** Standing was examined with 3-D motion analysis in 26 children with BSCP, and 19 children typically developing (TD). Two groups of children with cerebral palsy (CP) were analyzed: 15 who were able to maintain standing without support and 11 who needed support. **RESULTS:** Children with CP stood with more flexion than children TD. In the CP groups, children standing without support stood more asymmetrically with less hip and knee flexion and less movement than those who required support. **CONCLUSION:** Children with CP had varying abilities to stand and maintain standing posture with or without support. Both CP groups stood with more flexion than their potential passive joint angle, more obvious in children requiring support. Investigations on how muscle strength and spatial perception influence posture remains to be explored.

[PMID: 24675124](#) [PubMed - in process]

14. *Pediatr Phys Ther.* 2014 Summer;26(2):229. doi: 10.1097/PEP.000000000000026.

Commentary on "postural orientation during standing in children with bilateral cerebral palsy".

Ordorica J1, Rohnert L.

[PMID: 24675125](#) [PubMed - in process]

15. *Pediatr Phys Ther.* 2014 Summer;26(2):201-13. doi: 10.1097/PEP.000000000000035.

Measuring advanced motor skills in children with cerebral palsy: further development of the challenge module.

Glazebrook CM1, Wright FV.

PURPOSE: Since previous testing of the Challenge Module revealed that response scales should assess performance speed as well as skill accomplishment, this study sought to develop empirically based dual-criterion (accomplishment and time) response options. **METHODS:** Challenge items were tested with a convenience sample of 34 children who were typically developing (4-10 years) to obtain time cut-points that could be applied to children/youth with cerebral palsy. Median/lower quartile item performance times were calculated within younger (<7.5 years) and older child (≥7.5 years) groups, and used as benchmarks for response option cut-points. Children's scores were recalculated using these cut-points to verify that differences in younger and older children's abilities and times were captured. **RESULTS:** Mean scores were 48.9% and 87.2% for younger and older groups, reflecting expected developmental progression. Further response revision captured high-level movement control older children exhibited. **CONCLUSION:** The revised Challenge measures skill accomplishment, speed, and quality.

[PMID: 24675120](#) [PubMed - in process]

16. *Pediatr Phys Ther.* 2014 Summer;26(2):213. doi: 10.1097/PEP.000000000000036.

Commentary on "measuring advanced motor skills in children with cerebral palsy: further development of the challenge module".

Sargent B1, Fetters L.

[PMID: 24675121](#) [PubMed - in process]

17. *Pediatr Phys Ther.* 2014 Summer;26(2):169-79. doi: 10.1097/PEP.000000000000012.

Plyometric training: effectiveness and optimal duration for children with unilateral cerebral palsy.

Johnson BA1, Salzberg C, Macwilliams BA, Shuckra AL, D'astous JL.

PURPOSE: To evaluate the optimal duration and effects of plyometric training on the gross motor abilities of 3 boys with unilateral spastic cerebral palsy (9 years 11 months, 10 years, and 8 years 9 months). **METHODS:** This was a multiple-baseline, multiple-probe, single-subject experiment. The intervention followed the National Strength and Conditioning Association's guidelines for youth. The Gross Motor Function Measure 66, 10×5-m sprint, 20-m run, throw ball, broad jump, and vertical jump tests were used to evaluate gross motor abilities, agility, running speed, and power. **RESULTS:** Improvements were found in upper extremity power, Gross Motor Function Measure 66 scores, and agility. Findings for lower extremity power and running speed were inconsistent. Training duration ranged from 8 to 14 weeks. **CONCLUSIONS:** This study suggests that plyometric training improves gross motor ability, agility, and upper extremity power in boys with unilateral cerebral palsy. Treatment duration should be determined by an individual's capacity, the task, and the outcome measure.

[PMID: 24675114](#) [PubMed - in process]

18. *Pediatr Phys Ther.* 2014 Summer;26(2):179. doi: 10.1097/PEP.000000000000013.

Commentary on "plyometric training: effectiveness and optimal duration for children with unilateral cerebral palsy".

Carey H1, Heathcock JC.

[PMID: 24675115](#) [PubMed - in process]

19. *BMC Musculoskelet Disord.* 2014 Mar 21;15(1):96. [Epub ahead of print]

Hip joint pain in children with cerebral palsy and developmental dysplasia of the hip: why are the differences so huge?

Grzegorzewski A, Jó Wiak M, Pawlak M, Modrzewski T, Buchcic P, Mas O A.

Backgrounds: Non-traumatic hip dislocation in children is most often observed in the course of developmental dysplasia of the hip (DDH) and infantile cerebral palsy. The risk of pain sensations from dislocated hip joint differentiates the discussed groups of patients. Will every painless hip joint in children with cerebral palsy painful in the future? **METHODS:** Material included 34 samples of joint capsule and 34 femoral head ligaments, collected during open hip joint reduction from 19 children with CP, GMFCS level V and from 15 children with DDH and unilateral hip dislocation. All the children were surgically treated. The density of nociceptive fibres was compared between the children with CP and DDH, using S-100 and substance P monoclonal antibodies. **RESULTS:** More frequent positive immunohistochemical reaction to S-100 protein concerned structures of the femoral head ligaments in children with CP and cartilage losses on the femoral head, when compared to the same structures in children with DDH ($p = 0.010$). More frequent were found positive immunohistochemical reactions for S-100 protein in the joint capsules of children with cartilage losses ($p = 0.031$) and pain ailments vs. the children with DDH ($p = 0.027$). More frequent positive reaction to substance P concerned in femoral head ligaments in CP children and cartilage lesions ($p = 0.002$) or with pain ailments ($p = 0.001$) vs. the DDH children. **CONCLUSIONS:** Surgical treatment of hip joint dislocation should be regarded as a prophylactics of pain sensations, induced by tissue sensitisation, inflammatory process development or articular cartilage defects.

[PMID: 24656137](#) [PubMed - as supplied by publisher]

20. *Spine J.* 2014 Mar 21. pii: S1529-9430(14)00299-X. doi: 10.1016/j.spinee.2014.03.025. [Epub ahead of print]

Analysis of Hip Dysplasia and Spino-Pelvic Alignment in Cerebral Palsy.

Suh DH1, Hong JY2, Suh SW3, Park JW1, Lee SH1.

BACKGROUND: Knowledge of sagittal spino-pelvic parameters and hip dysplasia is important in cerebral palsy patients because these parameters differ from those found in the general population and can be related to symptoms. **PURPOSE:** The purpose of this study was to analyze sagittal spino-pelvic alignment and determine its relation to hip dysplasia in cerebral palsy patients. **STUDY DESIGN:** Radiological analysis was conducted of patients with cerebral palsy. **PATIENT SAMPLE:** 54 patients with cerebral palsy and 24 normal controls were included in this study. **OUTCOME MEASURES:** Participants underwent radiographs of the whole spine. **METHODS:** The patient and control groups were composed of 54 cerebral palsy patients and 24 volunteers, respectively. All underwent lateral radiography of the whole spine and hip joint antero-posterior radiography. The radiographic parameters examined were: sacral slope, pelvic tilt, pelvic incidence, S1 overhang, thoracic kyphosis, thoraco-lumbar kyphosis, lumbar lordosis, sagittal balance, center edge angle, acetabular angle, and migration index. Statistical analysis was performed to identify significant differences and correlations between the two groups. **RESULTS:** Sacral slope, thoraco-lumbar kyphosis, lumbar lordosis, sagittal balance, acetabular angle and migration index were significantly higher in cerebral palsy patients, whereas pelvic tilt, S1 overhang and center edge angle were significantly lower ($P < 0.05$). Correlation analysis revealed pelvic incidence, sacral slope, pelvic tilt, and S1 overhang were related to each other, and that thoraco-lumbar kyphosis was related to the thoracic kyphosis and lumbar lordosis ($P < 0.05$). For spinal and pelvic parameters, lumbar lordosis was related to sacral slope, pelvic incidence, pelvic tilt, and S1 overhang; for hip dysplasia parameters, center edge angle and acetabular angle were

found to be inter-related ($P < 0.05$). Regarding symptoms, pelvic tilt, S1 overhang, and thoraco-lumbar kyphosis were found to be correlated with symptom severity in patients. However, no hip dysplasia parameters were found to be related to hip or spinal symptoms. **CONCLUSION:** This study found significant differences between cerebral palsy patients and normal controls in terms of spino-pelvic alignment and hip dysplasia. Furthermore, relationships were found between the sagittal spino-pelvic parameters and hip dysplasia, and correlations were found between sagittal spino-pelvic parameters and pain.

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[PMID: 24662207](#) [PubMed - as supplied by publisher]

21. Brain Inj. 2014 Mar 24. [Epub ahead of print]

The effects of motivating interventions on rehabilitation outcomes in children and youth with acquired brain injuries: A systematic review.

Tatla SK1, Sauve K, Jarus T, Virji-Babul N, Holsti L.

Primary objective: To systematically review the evidence of the effects of motivating rehabilitation interventions on outcomes in children with acquired brain injury (ABI). **Methods:** A literature search of six databases was conducted to identify intervention studies published until July 2013. The American Academy for Cerebral Palsy and Developmental Medicine (AAPDM) systematic review methodology was used as a framework. Two reviewers independently extracted data and assessed level of evidence and quality of studies. **Results:** Of 891 records initially retrieved, 166 were screened by abstract and 31 by full text; 10 studies comprised of five randomized controlled trials, two case series and three single subject research design studies met the inclusion criteria. Studies fell into three intervention categories: (1) token economy based interventions; (2) virtual reality (VR); and (3) memory and attention interventions. **Conclusions:** A paucity of evidence has examined the effects of rehabilitation interventions with a motivational component. Token economies can significantly enhance memory and response inhibition performance in children with ABI. VR systems are motivating, yet findings are limited by the lack of use and availability of psychometrically evaluated measures of motivation. Findings point to the need for further research to evaluate the effects of motivation-based interventions.

[PMID: 24661000](#) [PubMed - as supplied by publisher]

22. Int J Pediatr. 2014;2014:204386. doi: 10.1155/2014/204386. Epub 2014 Jan 23.

Factors related to psychosocial quality of life for children with cerebral palsy.

Tessier DW1, Hefner JL1, Newmeyer A2.

Background. Current health services interventions focus on the treatment of the musculoskeletal impairments of cerebral palsy (CP). The goal of this study was to explore whether the severity of physical symptoms correlates with psychosocial quality of life (QOL) among pediatric patients with CP. **Methods.** A sample of 53 caregivers of children with CP was surveyed and health status information was extracted from patient medical records. Descriptive analysis explored the association between the main outcome variable, psychosocial QOL (CP QOL-child), and patient demographics, comorbidity (e.g., visual, hearing and feeding impairments, language delays, and epilepsy), CP severity (GMFCS), and the receipt of family centered care (MPOC-20). **Results.** Child psychosocial QOL decreased with increasing comorbidity but was not associated with CP symptom severity or any measured demographic factors. Reporting high levels of family centered care (FCC) was associated with higher psychosocial QOL in univariate analysis but was not significant when controlling for comorbidities. **Conclusion.** There is no clear connection between symptom severity and psychosocial QOL in children with CP. Comorbidity however is strongly associated with psychosocial QOL. Focusing on reducing CP comorbidities could have a positive impact on psychosocial QOL.

[PMID: 24678321](#) [PubMed]

23. Int J Speech Lang Pathol. 2014 Mar 27. [Epub ahead of print]**Implementing two treatment approaches to childhood dysarthria.**

Levy ES.

The paucity of evidence and detail in the literature regarding speech treatment for children with dysarthria due to cerebral palsy (CP) renders it difficult for researchers to replicate studies and make further inroads into this area in need of exploration. Furthermore, for speech-language pathologists (SLPs) wishing to follow treatments that the literature indicates have promise, little guidance is available on the details of the treatments that yielded the positive results. The present article details the implementation of two treatment approaches in speech treatment research for children with dysarthria: Speech Systems Intelligibility Treatment (SSIT) and the Lee Silverman Voice Treatment LOUD (LSVT LOUD). Specific strategies, primarily for treatment, but also for outcome measurement and acoustic analysis of dysarthric speech, are described. These techniques are provided for researchers and clinicians to consider implementing in order to advance speech treatment for this population. New data from research using these approaches are presented, including findings of acoustic vowel space changes following both speech treatments.

[PMID: 24673184](#) [PubMed - as supplied by publisher]

24. Semin Pediatr Neurol. 2014 Mar;21(1):42-9. doi: 10.1016/j.spen.2014.01.003. Epub 2014 Jan 4.**The interaction of malnutrition and neurologic disability in Africa.**

Kerac M1, Postels DG2, Mallewa M3, Alusine Jalloh A4, Voskuil WP5, Groce N6, Gladstone M7, Molyneux E8.

Malnutrition and neurodisability are both major public health problems in Africa. This review highlights key areas where they interact. This happens throughout life and starts with maternal malnutrition affecting fetal neurodevelopment with both immediate (eg, folate deficiency causing neural tube defects) and lifelong implications (eg, impaired cognitive function). Maternal malnutrition can also increase the risk of perinatal problems, including birth asphyxia, a major cause of neurologic damage and cerebral palsy. Macronutrient malnutrition can both cause and be caused by neurodisability. Mechanisms include decreased food intake, increased nutrient losses, and increased nutrient requirement. Specific micronutrient deficiencies can also lead to neurodisability, for example, blindness (vitamin A), intractable epilepsy (vitamin B6), and cognitive impairment (iodine and iron). Toxin ingestion (eg, from poorly processed cassava) can cause neurodisability including a peripheral polyneuropathy and a spastic paraparesis. We conclude that there is an urgent need for nutrition and disability programs to work more closely together.

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[PMID: 24655404](#) [PubMed - in process]

25. Telemed J E Health. 2014 Mar 24. [Epub ahead of print]**International Telemedicine Consultations for Neurodevelopmental Disabilities.**

Pearl PL1, Sable C, Evans S, Knight J, Cunningham P, Lotrecchiano GR, Gropman A, Stuart S, Glass P, Conway A, Ramadan I, Paiva T, Batshaw ML, Packer RJ.

Background: A telemedicine program was developed between the Children's National Medical Center (CNMC) in Washington, DC, and the Sheikh Khalifa Bin Zayed Foundation in the United Arab Emirates (UAE). A needs assessment and a curriculum of on-site training conferences were devised preparatory to an ongoing telemedicine consultation program for children with neurodevelopmental disabilities in the underserved eastern region of the UAE. Materials and Methods: Weekly telemedicine consultations are provided by a multidisciplinary faculty. Patients are presented in the UAE with their therapists and families. Real-time (video over Internet protocol; average connection, 768 kilobits/s) telemedicine conferences are held weekly following previews of medical records. A full consultation report follows each telemedicine session. Results: Between February 29, 2012 and June 26, 2013, 48 weekly 1-h live interactive telemedicine consultations were conducted on 48 patients (28 males, 20

females; age range, 8 months-22 years; median age, 5.4 years). The primary diagnoses were cerebral palsy, neurogenetic disorders, autism, neuromuscular disorders, congenital anomalies, global developmental delay, systemic disease, and epilepsy. Common comorbidities were cognitive impairment, communication disorders, and behavioral disorders. Specific recommendations included imaging and DNA studies, antiseizure management, spasticity management including botulinum toxin protocols, and specific therapy modalities including taping techniques, customized body vests, and speech/language and behavioral therapy. Improved outcomes reported were in clinician satisfaction, achievement of therapy goals for patients, and requests for ongoing sessions. Conclusions: Weekly telemedicine sessions coupled with triannual training conferences were successfully implemented in a clinical program dedicated to patients with neurodevelopmental disabilities by the Center for Neuroscience at CNMC and the UAE government. International consultations in neurodevelopmental disabilities utilizing telemedicine services offer a reliable and productive method for joint clinical programs.

[PMID: 24660879](#) [PubMed - as supplied by publisher]

Prevention and Cure

26. Semin Pediatr Neurol. 2014 Mar;21(1):30-5. doi: 10.1016/j.spen.2014.01.001. Epub 2014 Jan 8.

Pediatric cerebral palsy in Africa: a systematic review.

Donald KA1, Samia P2, Kakooza-Mwesige A3, Bearden D4.

Cerebral palsy is a common neurologic problem in children and is reported as occurring in approximately 2-2.5 of 1000 live births globally. As is the case with many pediatric neurologic conditions, very little has been reported on this condition in the African context. Resource-limited settings such as those found across the continent are likely to result in a different spectrum of etiologies, prevalence, severity as well as management approaches. This review aims to establish what has been reported on this condition from the African continent so as to better define key clinical and research questions.

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[PMID: 24655402](#) [PubMed - in process]

27. J Cereb Blood Flow Metab. 2014 Mar 26. doi: 10.1038/jcbfm.2014.41. [Epub ahead of print]

Mechanisms of perinatal arterial ischemic stroke.

Fernández-López D1, Natarajan N2, Ashwal S3, Vexler ZS1.

The incidence of perinatal stroke is high, similar to that in the elderly, and produces a significant morbidity and severe long-term neurologic and cognitive deficits, including cerebral palsy, epilepsy, neuropsychological impairments, and behavioral disorders. Emerging clinical data and data from experimental models of cerebral ischemia in neonatal rodents have shown that the pathophysiology of perinatal brain damage is multifactorial. These studies have revealed that, far from just being a smaller version of the adult brain, the neonatal brain is unique with a very particular and age-dependent responsiveness to hypoxia-ischemia and focal arterial stroke. In this review, we discuss fundamental clinical aspects of perinatal stroke as well as some of the most recent and relevant findings regarding the susceptibility of specific brain cell populations to injury, the dynamics and the mechanisms of neuronal cell death in injured neonates, the responses of neonatal blood-brain barrier to stroke in relation to systemic and local inflammation, and the long-term effects of stroke on angiogenesis and neurogenesis. Finally, we address translational strategies currently being considered for neonatal stroke as well as treatments that might effectively enhance repair later after injury.

[PMID: 24667913](#) [PubMed - as supplied by publisher]

28. J Exerc Rehabil. 2014 Feb 28;10(1):9-14. doi: 10.12965/jer.140084. eCollection 2014.

Effects of endurance exercise on expressions of glial fibrillary acidic protein and myelin basic protein in developing rats with maternal infection-induced cerebral palsy.

Kim K1, Shin MS2, Cho HS2, Kim YP3.

Periventricular leukomalacia (PVL) is a common white matter lesion affecting the neonatal brain. PVL is closely associated with cerebral palsy (CP) and characterized by increase in the number of astrocytes, which can be detected by positivity for glial fibrillary acidic protein (GFAP). Change in myelin basic protein (MBP) is an early sign of white matter abnormality. Maternal or placental infection can damage the neonatal brain. In the present study, we investigated the effects of treadmill walking exercise on GFAP and MBP expressions in rats with maternal lipopolysaccharide (LPS)-induced PVL. Immunohistochemistry was performed for the detection of GFAP and MBP. The present results showed that intracervical maternal LPS injection during pregnancy increased GFAP expression in the striatum and decreased MBP expression in the corpus callosum of rats. The results also showed that treadmill walking exercise suppressed GFAP expression and enhanced MBP expression in the brains of rats with maternal LPS-induced PVL. The present study revealed that treadmill walking exercise is effective for the suppressing astrogliosis and hypomyelination associated with PVL. Here in this study, we showed that treadmill walking exercise may be effective therapeutic strategy for alleviating the detrimental effects of CP.

[PMID: 24678499](#) [PubMed]

29. Front Hum Neurosci. 2014 Mar 17;8:158. eCollection 2014.

Development of Human Somatosensory Cortical Functions - What have We Learned from Magnetoencephalography: A Review.

Nevalainen P1, Lauronen L1, Pihko E2.

The mysteries of early development of cortical processing in humans have started to unravel with the help of new non-invasive brain research tools like multichannel magnetoencephalography (MEG). In this review, we evaluate, within a wider neuroscientific and clinical context, the value of MEG in studying normal and disturbed functional development of the human somatosensory system. The combination of excellent temporal resolution and good localization accuracy provided by MEG has, in the case of somatosensory studies, enabled the differentiation of activation patterns from the newborn's primary (SI) and secondary somatosensory (SII) areas. Furthermore, MEG has shown that the functioning of both SI and SII in newborns has particular immature features in comparison with adults. In extremely preterm infants, the neonatal MEG response from SII also seems to potentially predict developmental outcome: those lacking SII responses at term show worse motor performance at age 2 years than those with normal SII responses at term. In older children with unilateral early brain lesions, bilateral alterations in somatosensory cortical activation detected in MEG imply that the impact of a localized insult may have an unexpectedly wide effect on cortical somatosensory networks. The achievements over the last decade show that MEG provides a unique approach for studying the development of the somatosensory system and its disturbances in childhood. MEG well complements other neuroimaging methods in studies of cortical processes in the developing brain.

[PMID: 24672468](#) [PubMed - as supplied by publisher]

30. Iran J Child Neurol. 2013 Fall;7(4):41-6.

Neuroimaging in cerebral palsy - report from north India.

Aggarwal A1, Mittal H1, Kr Debnath S2, Rai A2.

OBJECTIVE: Only few Indian reports exist on neuroimaging abnormalities in children with cerebral palsy (CP) from India. **MATERIALS & METHODS:** We studied the clinico-radiological profile of 98 children diagnosed as CP at a tertiary centre in North India. Relevant investigations were carried out to determine the etiology. **RESULTS:** Among the 98 children studied, 80.5% were males and 22.2% were premature. History of birth asphyxia was present in 41.9%. Quadriplegic CP was seen in 77.5%, hemiplegic in 11.5%, and diplegic in 10.5%. Other abnormalities were

microcephaly (60.5%), epilepsy (42%), visual abnormality (37%), and hearing abnormality (20%). Neuroimaging was abnormal in 94/98 (95.91%). Abnormalities were periventricular white matter abnormalities (34%), deep grey matter abnormalities (47.8%), malformations (11.7%), and miscellaneous lesions (6.4%). Neuroimaging findings did not relate to the presence of birth asphyxia, sex, epilepsy, gestation, type of CP, or microcephaly. CONCLUSIONS: Neuroimaging is helpful for etiological diagnosis, especially malformations.

[PMID: 24665317](#) [PubMed] PMID: PMC3943052 Free PMC Article

31. Neurology. 2014 Mar 21. [Epub ahead of print]

Stroke and nonstroke brain attacks in children.

Mackay MT1, Chua ZK, Lee M, Yock-Corrales A, Churilov L, Monagle P, Donnan GA, Babl FE.

OBJECTIVES: To determine symptoms, signs, and etiology of brain attacks in children presenting to the emergency department (ED) as a first step for developing a pediatric brain attack pathway. **METHODS:** Prospective observational study of children aged 1 month to 18 years with brain attacks (defined as apparently abrupt-onset focal brain dysfunction) and ongoing symptoms or signs on arrival to the ED. Exclusion criteria included epilepsy, hydrocephalus, head trauma, and isolated headache. Etiology was determined after review of clinical data, neuroimaging, and other investigations. A random-effects meta-analysis of similar adult studies was compared with the current study. **RESULTS:** There were 287 children (46% male) with 301 presentations over 17 months. Thirty-five percent arrived by ambulance. Median symptom duration before arrival was 6 hours (interquartile range 2-28 hours). Median time from triage to medical assessment was 22 minutes (interquartile range 6-55 minutes). Common symptoms included headache (56%), vomiting (36%), focal weakness (35%), numbness (24%), visual disturbance (23%), seizures (21%), and altered consciousness (21%). Common signs included focal weakness (31%), numbness (13%), ataxia (10%), or speech disturbance (8%). Neuroimaging included CT imaging (30%), which was abnormal in 27%, and MRI (31%), which was abnormal in 62%. The most common diagnoses included migraine (28%), seizures (15%), Bell palsy (10%), stroke (7%), and conversion disorders (6%). Relative proportions of conditions in children significantly differed from adults for stroke, migraine, seizures, and conversion disorders.

[PMID: 24658929](#) [PubMed - as supplied by publisher]