

Monday 29 February 2016

**Cerebral Palsy Alliance** is delighted to bring you this free weekly bulletin of the latest published research into cerebral palsy. Our organisation is committed to supporting cerebral palsy research worldwide - through information, education, collaboration and funding. Find out more at [research.cerebralpalsy.org.au](http://research.cerebralpalsy.org.au)

**Professor Nadia Badawi AM**

Macquarie Group Foundation Chair of Cerebral Palsy

[Subscribe to CP Research News](#)

## Interventions and Management

### 1. *Acta Bioeng Biomech.* 2015;17(4):67-72.

#### **Dissipation of disturbances seen in the knee joint kinematics of children with cerebral palsy.**

Kurz MJ, Arpin DJ, Davies BL, Gehringer JE.

**PURPOSE:** Children with cerebral palsy (CP) often use a crouch gait pattern that has disturbances in the knee joint kinematics. Although the length and rate of lengthening of the hamstring musculature have been speculated to be the reason that these disturbances are not adequately dissipated, this relationship has not been adequately explored. The purpose of this exploratory investigation was to use simulations of a musculoskeletal model and Floquet analysis to evaluate how the performance of hamstrings musculature during gait may be related to the knee joint instabilities seen in children with CP. **METHODS:** Children with CP and typically developing (TD) children walked on a treadmill as a motion capture system assessed the knee joint kinematics. Floquet analysis was used to quantify the rate that disturbances present at the knee joint were dissipated, and simulations of a musculoskeletal model were used to estimate the in vivo length and velocity of the hamstrings. Pearson correlation coefficients were calculated to determine if there was a relationship between the rate that the disturbances were dissipated and the performance of the hamstring musculature. **RESULTS:** The children with CP had hamstrings that lengthened more slowly than TD children, and required more strides to dissipate disturbances in the knee joint kinematics. There was negative correlation between the rate that the hamstrings lengthened and the rate that the knee joint disturbances were dissipated. **CONCLUSIONS:** Our results suggest that the ability of children with CP to dissipate the knee joint disturbances may be related to the inability to properly control the hamstring musculature.

[PMID: 26900106](#)

### 2. *Dev Med Child Neurol.* 2016 Feb 24. doi: 10.1111/dmcn.13083. [Epub ahead of print]

#### **Relations between muscle endurance and subjectively reported fatigue, walking capacity, and participation in mildly affected adolescents with cerebral palsy.**

Eken MM, Houdijk H, Doorenbosch CA, Kiezebrink FE, van Bennekom CA, Harlaar J, Dallmeijer AJ.

**AIM:** To investigate the relation between muscle endurance and subjectively reported fatigue, walking capacity, and participation in mildly affected adolescents with cerebral palsy (CP) and peers with typical development. **METHOD:** In this case-control study, knee extensor muscle endurance was estimated from individual load-endurance curves as the load corresponding to a 15-repetition maximum in 17 adolescents with spastic CP (six males, 11 females; age 12-19y) and 18 adolescents with typical development (eight males, 10 females; age 13-

19y). Questionnaires were used to assess subjectively reported fatigue (Pediatric Quality of Life Inventory Multidimensional Fatigue Scale) and participation (Life-Habits questionnaire). Walking capacity was assessed using the 6-minute walk test. Relations were determined using multiple regression analyses. RESULTS: Muscle endurance related significantly to subjectively reported fatigue and walking capacity in adolescents with CP, while no relations were found for adolescents with typical development (subjectively reported fatigue: regression coefficient  $\beta$  [95% confidence intervals] for CP=23.72 [6.26 to 41.18], for controls=2.72 [-10.26 to 15.69]; walking capacity  $\beta$  for CP=125m [-87 to 337], for controls=2m [-86 to 89]). The 15-repetition maximum did not relate to participation in adolescents with CP. INTERPRETATION: Subjectively reported fatigue and reduced walking capacity in adolescents with CP are partly caused by lower muscle endurance of knee extensors. Training of muscle endurance might contribute to reducing the experience of fatigue and improving walking capacity. Reduced muscle endurance seems to have no effect on participation.

[PMID: 26915305](#)

### 3. Phys Ther. 2016 Feb 25. [Epub ahead of print]

#### Coactivation During Dynamometry Testing in Adolescents With Spastic Cerebral Palsy.

Eken MM, Dallmeijer AJ, Doorenbosch CA, Dekkers H, Becher JG, Houdijk H.

BACKGROUND: Dynamometry has been used extensively to measure knee extensor strength in individuals with cerebral palsy (CP). However, increased co-activation can lead to underestimation of agonist strength, and therefore reduce validity of strength measurements. It is yet unknown to which extent co-activation occurs during dynamometry testing, and whether co-activation is influenced by severity of CP, load levels and fatigue. OBJECTIVE: To investigate co-activation in adolescents with and without CP during dynamometer tests and to assess the effect of Gross Motor Function Classification System (GMFCS) level, load level and fatigue on co-activation. DESIGN: Cross-sectional observational design. METHOD: Sixteen adolescents with CP (GMFCS I/II: N=10/6; age [13-19y]) and fifteen without CP (age [12-19y, N=15]) performed maximal isometric contractions (maximal voluntary torque, MVT) and series of submaximal dynamic contractions at low ( $\pm 65\%$ MVT), medium ( $\pm 75\%$ MVT) and high ( $\pm 85\%$ MVT) load, until fatigue. Co-activation index (CAI) was calculated for each contraction from surface electromyography (EMG) recordings from quadriceps and hamstrings. RESULTS: Adolescents with CP classified in GMFCS-II showed significantly higher CAI than GMFCS-I and TD during maximal and submaximal contractions. No differences were observed between load levels. During series of fatiguing submaximal contractions, CAI remained constant in both groups, except for TD adolescents at the low load condition, which showed a significant decrease. CONCLUSION: Co-activation was higher in adolescents with CP classified in GMFCS-II than TD adolescents and those in GMFCS-I, at different load levels. Within all groups, co-activation was independent of load level and fatigue. In individuals with CP, co-activation can lead to an underestimation of agonist muscle strength, which should be taken into account while interpreting both maximal and submaximal dynamometer tests.

[PMID: 26916928](#)

### 4. Zhongguo Dang Dai Er Ke Za Zhi. 2016 Feb;18(2):123-9.

#### [Effect of botulinum toxin A injection in the treatment of gastrocnemius spasticity in children aged 9-36 months with cerebral palsy: a prospective study]. (Article in Chinese)

Zhu DN, Wang MM, Wang J, Zhang W, Li HZ, Yang P, Xiong HC, Niu GH, Li SS, Zhao YX.

OBJECTIVE: To investigate the long-term clinical efficacy and adverse effects of botulinum toxin-A (BTX-A) injection in the treatment of gastrocnemius spasticity in children aged 9-36 months with cerebral palsy. METHODS: Eighty children aged 9-36 months with cerebral palsy and gastrocnemius spasticity were selected and randomly divided into a BTX-A injection group and a conventional treatment group (n=40 each). The children in the BTX-A injection group received injections of BTX-A guided by color Doppler ultrasound and 4 courses of rehabilitation training after injection. Those in the conventional treatment group received 4 courses of the same rehabilitation training alone. Before treatment and at 1, 2, 3, and 6 months after treatment, the modified Tardieu scale (MTS) was applied to assess the degree of gastrocnemius spasticity, the values in the passive state measured by surface

electromyography (sEMG) were applied to evaluate muscle tension, and the Gross Motor Function Measure (GMFM) was used to evaluate gross motor function. RESULTS: Compared with the conventional treatment group, the BTX-A injection group had significantly greater reductions in MTS score and the values in the passive state measured by sEMG ( $P < 0.05$ ), as well as significantly greater increases in joint angles R1 and R2 in MTS and gross motor score in GMFM ( $P < 0.05$ ). No serious adverse reactions related to BTX-A injection were found. CONCLUSIONS: BTX-A injection is effective and safe in the treatment of gastrocnemius spasticity in children aged 9-36 months with cerebral palsy.

[PMID: 26903058](#)

**5. Arch Phys Med Rehabil. 2016 Feb 19. pii: S0003-9993(16)00104-0. doi: 10.1016/j.apmr.2016.01.029. [Epub ahead of print]**

**Home-based versus laboratory-based robotic ankle training for children with cerebral palsy: A pilot randomized comparative trial.**

Chen K, Wu YN, Ren Y, Liu L, Gaebler-Spira D, Tankard K, Lee J, Song W, Wang M, Zhang LQ.

OBJECTIVE: To examine the outcomes of a home-based robotic rehabilitation and compare it to a laboratory-based robotic rehabilitation for the treatment of impaired ankles in children with cerebral palsy DESIGN: A randomized comparative trial design comparing a home-based training group and a laboratory-based training group. SETTING: Home versus a laboratory within a research hospital PARTICIPANTS: Forty-one children with cerebral palsy with Gross Motor Function Classification System level I, II or III were randomly assigned to two groups. The children in the home-based and laboratory-based groups were  $8.7 \pm 2.8$  (mean  $\pm$  standard deviation) ( $n=23$ ) and  $10.7 \pm 6.0$  ( $n=18$ ) years old, respectively. INTERVENTIONS: Six-week combined passive stretching and active movement intervention of impaired ankle in a laboratory or home environment with a portable rehabilitation robot. PRIMARY OUTCOME MEASURES: Active dorsiflexion range of motion (as the primary outcome), mobility (6-minute walk test and timed up and go), balance (Pediatric Balance Scale), Selective Motor Control Assessment of the Lower Extremity (SCALE), spasticity Modified Ashworth Scale (MAS), passive range of motion, strength and joint stiffness. RESULTS: Significant improvements were found for the home-based group in all biomechanical outcome measures except for passive range of motion and all clinical outcomes except the MAS. The laboratory-based group also showed significant improvements in all of the biomechanical outcome measures and all clinical outcome measures except the MAS. There were no significant differences in the outcome measures between the two groups. CONCLUSION: These findings suggest that translation of repetitive, goal directed, biofeedback training through motivating games from the laboratory into the home environment is feasible. The benefits of home-based robotic therapy were similar to those of laboratory-based robotic therapy.

[PMID: 26903143](#)

**6. Pediatr Phys Ther. 2016 Feb 19. [Epub ahead of print]**

**The Effect of Ankle-Foot Orthoses on Community-Based Walking in Cerebral Palsy: A Clinical Pilot Study.**

Bjornson K, Zhou C, Fatone S, Orendurff M, Stevenson R, Rahid S.

PURPOSE: To examine the effect of ankle-foot orthoses (AFO) on walking activity in children with cerebral palsy (CP). METHODS: We used a randomized cross-over design with 11 children with bilateral CP, mean age 4.3 years. Subjects were randomized to current AFO-ON or AFO-OFF for 2 weeks and then crossed over. Walking activity (average total steps/day), intensity, and stride rate curves were collected via an ankle accelerometer. Group effects were examined with the Wilcoxon signed-rank test and within-subject effects examined for more than 1 standard deviation change. RESULTS: No significant group difference was found in average total daily step count between treatment conditions ( $P = .48$ ). For the AFO-ON condition, 2 subjects (18%) increased total steps/day; 4 (36%) increased walking time; 2 (18%) had more strides at a rate of more than 30 strides/min; and 2 (18%) reached higher peak intensity. CONCLUSIONS: Clinically prescribed AFO/footwear did not consistently enhance walking activity levels or intensity. Larger studies are warranted.

[PMID: 26901534](#)

**7. Coll Antropol. 2015 Sep;39(3):663-6.****The Comparison of Malocclusion Prevalence Between Children with Cerebral Palsy and Healthy Children.**

Bakarcic D, Lajnert V, Maricic BM, Jokić NI, Vrancic ZR, Grzić R, Prpić I.

This study sets out to examine the prevalence of malocclusion and habits in a group of children with cerebral palsy and to compare it with a control group of healthy children. The presence of an anterior open bite was statistically significantly higher in the cerebral palsied group. The presence of a posterior crossbite was not significantly different between the examined groups, as was the case for a lingual crossbite. The occurrence of visceral swallowing, incompetent lips and oral respiration was significantly higher in the cerebral palsied group. The current study cannot satisfactorily sustain the issue of a higher prevalence of posterior and lingual crossbite in children with cerebral palsy because of no significant differences between groups, but it certainly can for an anterior openbite. The present study also adds to the evidence that there is an increased prevalence of oral breathing, visceral swallowing and lip incompetence in children with cerebral palsy.

[PMID: 26898063](#)

## Prevention and Cure

### 8. Early Hum Dev. 2016 Feb 17;95:9-13. doi: 10.1016/j.earlhumdev.2016.01.019. [Epub ahead of print]

#### Specific characteristics of abnormal general movements are associated with functional outcome at school age.

Hamer EG, Bos AF, Hadders-Algra M.

**BACKGROUND:** Assessing the quality of general movements (GMs) is a non-invasive tool to identify at early age infants at risk for developmental disorders. **AIM:** To investigate whether specific characteristics of definitely abnormal GMs are associated with developmental outcome at school age. **STUDY DESIGN:** Observational cohort study (long-term follow-up). **SUBJECTS:** Parents of 40 children (median age 8.3years, 20 girls) participated in this follow-up study. In infancy (median corrected age 10weeks), the children (median gestational age 30.3weeks; birth weight 1243g) had shown definitely abnormal GMs according to Hadders-Algra (2004). Information on specific GM characteristics such as the presence of fidgety movements, degree of complexity and variation, and stiff movements, was available (see Hamer et al. 2011). **OUTCOME MEASURES:** A standardised parental interview (presence of CP, attendance of school for special education, Vineland Adaptive Behavior Scale to determine functional performance) and questionnaires (Developmental Coordination Disorder Questionnaire [DCD-Q] to evaluate mobility and Child Behavior Checklist to assess behaviour) were used as outcome measures. **RESULTS:** Six children had cerebral palsy (CP), ten children attended a school for special education, and eight children had behavioural problems. Both the absence of fidgety movements and the presence of stiff movements were associated with CP ( $p=0.001$ ;  $p=0.003$ , respectively). Stiff movements were also related to the need of special education ( $p=0.009$ ). A lack of movement complexity and variation was associated with behavioural problems ( $p=0.007$ ). None of the GM characteristics were related to DCD-Q scores. **CONCLUSIONS:** The evaluation of fidgety movements and movement stiffness may increase the predictive power of definitely abnormal GMs for motor outcome - in particular CP. This study endorses the notion that the quality of GMs reflects the integrity of the infant's brain, assisting prediction of long-term outcome.

[PMID: 26896696](#)

### 9. J Matern Fetal Neonatal Med. 2016 Feb 26:1-6. [Epub ahead of print]

#### Risk factors for cerebral palsy in PPRM and preterm delivery with intact membranes.

Accordino F, Consonni S, Fedeli T, Kullman G, Moltrasio F, Ghidini A, Locatelli A.

**OBJECTIVE:** Gestational age (GA) at delivery and spontaneous prematurity are independent risk factors for cerebral palsy (CP). The aim of this study is to investigate perinatal risk factors for CP in spontaneous preterm delivery. **METHODS:** A retrospective cohort study of all single pregnancies complicated by spontaneous preterm labor (PTL) or PPRM with delivery at <34 weeks from January 2006 to December 2012 was performed. We compared demographic, obstetric, neonatal, and placental histology variables in cases of spontaneous preterm birth in reference to the development of CP. Statistical analysis included chi-square, one-way ANOVA and logistic regression analysis.  $p < 0.05$  was considered significant. **RESULTS:** Two hundred sixty-one women were included for this study. Of 249 survivors, 5 babies died during the first year of life, 52 did not fulfill the inclusion criteria for neurologic follow-up, and 24 were lost to follow up. Thus 168 infants in the study cohort underwent neurologic follow-up. We observed 26 cases of CP. Factors related to CP were lower GA at PROM ( $p = 0.007$ ) and longer latency from PPRM to delivery ( $p = 0.002$ ) in the PPRM group, lower GA at delivery ( $p < 0.001$ ) and presence of funisitis ( $p < 0.001$ ) in the PTL group. **CONCLUSIONS:** GA at membrane rupture in PPRM and GA at delivery in PTL are significantly associated with CP. A process leading to neurological damage may be initiated at the moment of membranes rupture in cases of PPRM and at the time of PTL in the group with intact membranes.

[PMID: 26919411](#)

10. *Acta Obstet Gynecol Scand.* 2016 Feb 22. doi: 10.1111/aogs.12885. [Epub ahead of print]

**Antecedents of cerebral palsy according to severity of motor impairment.**

Ahlin K, Himmelmann K, Nilsson S, Sengpiel V, Jacobsson B.

**INTRODUCTION:** The purpose of this study was to determine whether antecedents and neuroimaging patterns vary according to the severity of motor impairment in children with cerebral palsy. **MATERIAL AND METHODS:** A population-based study in which all 309 term-born children with spastic and dyskinetic cerebral palsy born 1983-1994 and 618 matched controls were studied. Antecedents were retrieved from obstetric records. Information on neuroimaging was retrieved from the cerebral palsy Register of Western Sweden. Cases were grouped by severity of motor impairment: mild (walks without aids), moderate (walks with aids) or severe (dependent on wheelchair). Binary logistic regression, the Cochran-Armitage test for trends, interaction analyses and interrelationship analyses were performed. **RESULTS:** Antecedents associated with mild motor impairment were antepartum (placental weight, maternal weight and antibiotic therapy) or intra- and postpartum adverse events (meconium-stained amniotic fluid, low Apgar score, admission to neonatal intensive care unit and neonatal encephalopathy). Antecedents associated with severe motor impairment were antepartum (congenital infection, small head circumference and brain maldevelopment) or intra- and postpartum (emergency cesarean section and maternal antibiotic therapy). Comparisons between mild and severe motor impairment revealed congenital infection, maldevelopment, neonatal encephalopathy and meconium aspiration syndrome significantly more often in the group with severe motor impairment ( $p < 0.05$ ). White matter injury was the most common neuroimaging pattern in mild motor impairment, while maldevelopment and cortical/subcortical lesions were most common in the severe motor impairment group. **CONCLUSIONS:** Our results suggest a variation in antecedents associated with cerebral palsy, related to severity of motor impairment. Timing of antecedents corresponded to neuroimaging patterns.

[PMID: 26910364](#)