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Professor Nadia Badawi

Macquarie Group Foundation Chair of Cerebral Palsy
PO Box 560, Darlinghurst, New South Wales 2010 Australia

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Interventions and Management

1. Phys Ther. 2014 Feb 20. [Epub ahead of print]

Stability of Serial Range-of-Motion Measurements of the Lower Extremities in Children With Cerebral Palsy: Can We Do Better?

Darrah J1, Wiart L, Gorter JW, Law M.

Serial joint range of motion (ROM) measurements are an important component of assessments for children with cerebral palsy. Most research has studied ROM stability using group data. Examination of longitudinal intra-individual measures may provide more clinically relevant information about measurement variability. Objective: To examine the stability of intra-individual longitudinal measurements of hip abduction (ABD), popliteal angle (POP) and ankle dorsiflexion (ADF) ROM measures of children with cerebral palsy. Design: Secondary data analyses. Methods: The stability patterns of individual serial measurements of ABD, POP and ADF from 85 children (mean age 3.8 years, SD 1.4 yr.) collected at baseline (T1), 3 months (T2), 6 months (T3) and 9 months (T4) were examined using T1 as the anchor and bandwidths of +/- 150 (ABD and POP) and +/-100 (ADF) as acceptable variability. Frequencies of stability categories (00-50, 5.10-100, 10.10-150 and >150) were calculated. Patterns of stability across the four time periods were also examined. Group means (T1-T4) were compared using repeated measures ANOVA. Results: No significant differences in group means except for ABD. Stability patterns revealed that 43.3% to 69.5% of joint measurements were stable with T1 measurements across all three subsequent measurements. Stability category frequencies showed that many measurements (ABD=17%, POP=29.9%, ADF=37.1%) went outside the variability bandwidths even though 39% or more of joint measurements had a change of 50 or less over time. Limitations: Measurement error and true measurement variability cannot be disentangled. The results cannot be extrapolated to other joint ranges. Conclusions: Individual ROM serial measurement exhibits more variability than group data. ROM data must be interpreted with caution clinically and efforts made to ensure standardization of data collection methods.

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2. Clin Biomech (Bristol, Avon). 2014 Jan 31. pii: S0268-0033 (14)00013-8. doi: 10.1016/j.clinbiomech.2014.01.009. [Epub ahead of print]

The impact of simulated ankle plantarflexion contracture on the knee joint during stance phase of gait: A within-subject study.

Leung J1, Smith R2, Harvey LA3, Moseley AM4, Chapparo J5.

BACKGROUND: Ankle plantarflexion contractures are common in adults with neurological disorders and known to cause secondary gait deviations. However, their impact on the knee joint is not fully understood. The aims of this study are to describe the effect of simulated plantarflexion contractures on knee biomechanics during the stance phase and on the spatiotemporal characteristics of gait. **METHODS:** Mild (10-degree plantarflexion) and severe (20-degree plantarflexion) ankle contractures were simulated in thirteen able-bodied adults using an ankle-foot-orthosis. A no contracture condition was compared with two simulated contracture conditions. **FINDINGS:** There was an increase in knee extension, sometimes resulting in hyperextension, throughout stance for the two contracture conditions compared to the no contracture condition (mean increase in knee extension ranged from 5° to 9°; 95% CI 0° to 17°). At the same time, there were reductions in extension moment and power generation at the knee. Simulated plantarflexion contractures also reduced gait velocity, bilateral step length and cadence. All these changes were more pronounced in the severe contracture condition than mild contracture condition. While the majority of participants adopted a foot-flat pattern on landing and exhibited an increase in knee extension during stance, two participants used a toe-walking pattern and exhibited an increase in knee flexion. **INTERPRETATION:** Ankle plantarflexion contractures are associated with an increase in knee extension during stance phase. However, some people with simulated ankle contractures may walk with an increase in knee flexion instead. Ankle plantarflexion contractures also adversely affect gait velocity, step length and cadence.

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3. Res Dev Disabil. 2014 Feb 13. pii: S0891-4222(14)00038-9. doi: 10.1016/j.ridd.2014.01.024. [Epub ahead of print]

Influence of dual task constraints on gait performance and bimanual coordination during walking in children with unilateral Cerebral Palsy.

Hung YC1, Meredith GS2.

The purpose of the current study was to evaluate the effects of dual task constraints on walking and bimanual coordination for children with and without unilateral Cerebral Palsy (CP). Ten children with unilateral CP (age 7-11 years; MACS levels I-II) and ten age-matched typically developed children were asked to first stand still while holding a box level (standing condition), second, to walk along a path (baseline condition), and third to walk again while carrying a box steady and level (dual task condition) at a preferred speed. The results showed that children with unilateral CP decreased their walking speed, stride length, step width, and toe clearance from the floor under dual task constraints when compared to the baseline condition (all p 's<0.05), however, typically developing children did not change. Children with unilateral CP also had less level box carrying, larger vertical box movement, and larger elbow movements when compared to typically developing children under dual task condition (all p 's<0.05). Dual task constraints with a secondary motor task like the current walking with a box task seemed challenging for children with unilateral CP. Therefore, future treatments or assessments should consider using dual task constraints to manipulate the difficulty of tasks.

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4. Foot Ankle Clin. 2014 Mar;19(1):1-16. doi: 10.1016/j.fcl.2013.10.002. Epub 2013 Dec 25.**Neuromuscular Problems in Foot and Ankle: Evaluation and Workup.**

Hunt KJ1, Ryu JH2.

It is essential to determine the functional goals of the patient during the workup and treatment planning stages of neuromuscular disorders involving the foot and ankle. Accurate diagnosis, and informed discussion of treatment options, must be in the context of the patient's disease, cognition, comorbidities, functional attributes, and family environment. A thorough history and physical examination aid in appropriate diagnostic workup and optimal orthopedic management of each patient. In this article, general considerations in the workup of suspected neuromuscular disorders and issues pertinent to specific congenital and acquired neuromuscular disorders affecting foot and ankle function are reviewed.

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[PMID: 24548505](#) [PubMed - as supplied by publisher]**5. Dev Med Child Neurol. 2014 Feb 16. doi: 10.1111/dmcn.12399. [Epub ahead of print]****Sleep disturbances in Malaysian children with cerebral palsy.**

Atmawidjaja RW1, Wong SW, Yang WW, Ong LC.

AIM: The aim of the study was to compare the frequency and type of sleep disturbances in a group of Malaysian children aged 4 to 18 years with cerebral palsy (CP) with their nearest-age, able-bodied siblings and to identify factors associated with sleep disturbances. **METHOD:** The study was a case-control study of 109 children with CP (61 males, 48 females; mean age 9y, SD 3y 11mo, range 4-18y) and their healthy siblings (56 males, 53 females; mean age 10y, SD 3y 9mo, range 4-18y). The Sleep Disturbances Scale for Children (SDSC) questionnaire was completed by the main caregiver. In children with CP, multiple regression analysis was used to determine factors related to higher Total SDSC sleep scores. **RESULTS:** Ninety-seven children (89%) had spastic CP, 10 (9%) had dyskinetic CP, and two (2%) had mixed CP. Based on the Gross Motor Function Classification System (GMFSC), 34 patients (31%) were at GMFSC level I or II, 10 patients (9%) at level III, and 65 patients (60%) at level IV or V. Children with CP scored significantly higher than their siblings on Total SDSC and four SDSC subscale scores - difficulty in initiating and maintaining sleep, sleep breathing disorders, sleep-wake transition disorders, and sleep hyperhidrosis. Caregiver sleep duration of less than 7 hours ($p=0.02$) and caregiver sleep latency of more than 30 minutes ($p=0.03$) were significantly associated with higher Total SDSC scores. Co-sleeping was not a significant factor. **INTERPRETATION:** Sleep disturbances are more common in children with CP than in their siblings. Attention should be given to caregiver sleep when evaluating sleep disturbances in children with CP as this factor was shown to be associated with higher Total SDSC scores.

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[PMID: 24528212](#) [PubMed - as supplied by publisher]**6. Occup Ther Health Care. 2014 Feb 20. [Epub ahead of print]****Use of Computer Access Technology as an alternative to Writing for a Pre-School Child with Athetoid Cerebral Palsy-A Case Report.**

Dhas BN1, Samuel PS, Manigandan C.

The purpose of this study was to demonstrate the use of an outcome-driven model of decision-making in the implementation of computer access technology (CAT) for a pre-school child with athetoid cerebral palsy. The child did not have the fine motor skills required to hold a pencil but had the cognitive abilities to learn to write; therefore, we explored the use of a CAT device to enable written communication. Case study methodology was used to describe the selection process, child-level outcomes, and clinical challenges faced by the therapist in the use of a consortium model that was designed for an outcome-driven model of decision-making. The critical role of an

occupational therapist in this process using a family-centered approach is discussed.

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7. Res Dev Disabil. 2014 Feb 13. pii: S0891-4222(14)00030-4. doi: 10.1016/j.ridd.2014.01.016. [Epub ahead of print]

Cognitive precursors of arithmetic development in primary school children with cerebral palsy.

Van Rooijen M1, Verhoeven L2, Smits DW3, Dallmeijer AJ4, Becher JG5, Steenbergen B6.

The aim of this study was to examine the development of arithmetic performance and its cognitive precursors in children with CP from 7 till 9 years of age. Previous research has shown that children with CP are generally delayed in arithmetic performance compared to their typically developing peers. In children with CP, the developmental trajectory of the ability to solve addition- and subtraction tasks has, however, rarely been studied, as well as the cognitive factors affecting this trajectory. Sixty children (M=7.2 years, SD=.23 months at study entry) with CP participated in this study. Standardized tests were administered to assess arithmetic performance, word decoding skills, non-verbal intelligence, and working memory. The results showed that the ability to solve addition- and subtraction tasks increased over a two year period. Word decoding skills were positively related to the initial status of arithmetic performance. In addition, non-verbal intelligence and working memory were associated with the initial status and growth rate of arithmetic performance from 7 till 9 years of age. The current study highlights the importance of non-verbal intelligence and working memory to the development of arithmetic performance of children with CP.

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8. Infant Behav Dev. 2014 Feb 11;37(2):131-154. doi: 10.1016/j.infbeh.2013.12.009. [Epub ahead of print]

Are parenting interventions effective in improving the relationship between mothers and their preterm infants?

Evans T1, Whittingham K2, Sanders M3, Colditz P4, Boyd RN5.

AIM: To systematically review the efficacy of parenting interventions in improving the quality of the relationship between mothers and preterm infants. METHOD: Randomized or quasi-randomized controlled trials (RCT) of parenting interventions for mothers of preterm infants where mother-infant relationship quality outcomes were reported. Databases searched: The Cochrane Library, PubMed, CINAHL, PsycINFO and Web of Science. RESULTS: Seventeen studies met the inclusion criteria, 14 with strong methodological quality. Eight parenting interventions were found to improve the quality of the mother-preterm infant relationship. CONCLUSIONS: Heterogeneity of the interventions calls for an integrated new parenting program focusing on cue-based, responsive care from the mother to her preterm infant to improve the quality of the relationship for these mother-preterm infant dyads.

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9. Phys Ther. 2014 Feb 20. [Epub ahead of print]

The Continuum of Care for Individuals With Lifelong Disabilities: Role of the Physical Therapist.

Orlin MN1, Cicirello NA, O'Donnell AE, Doty AK.

Many individuals with lifelong disabilities (LLD) of childhood onset are living longer, participating in adult roles, and seeking comprehensive healthcare services including physical therapy (PT) with greater frequency than in the past.

Individuals with LLD have the same goals of health and wellness as those without disabilities. Aging with a chronic lifelong disability is not yet well understood, however impairments such as pain, fatigue, and osteoporosis often present earlier than in typically aging adults. Persons with LLD, especially those living with developmental disabilities such as cerebral palsy, myelomeningocele, Down syndrome and intellectual disabilities, frequently have complex and multiple body system impairments and functional limitations that can, 1) be the cause of numerous and varied secondary conditions, 2) limit overall earning power, 3) diminish insurance coverage, and 4) create unique challenges for accessing healthcare. Collaboration between adult and pediatric practitioners is encouraged to facilitate smooth transitions to health practitioners including PT. A collaborative client-centered emphasis to support the transition to adult-oriented facilities and promote strategies to increase accessibility should become standard parts of examination, goal setting and intervention. This paper identifies barriers individuals with selected LLD experience in accessing healthcare, including PT. Strategies are suggested including establishment of niche practices, physical accessibility improvement, and inclusion of more specific curriculum content in entry-level doctorate PT schools.

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Prevention and Cure

10. Dev Med Child Neurol. 2014 Feb 17. doi: 10.1111/dmcn.12407. [Epub ahead of print]

Early intervention after perinatal stroke: opportunities and challenges.

Basu AP.

Perinatal stroke is the most common cause of hemiplegic cerebral palsy. No standardized early intervention exists despite evidence for a critical time window for activity-dependent plasticity to mould corticospinal tract development in the first few years of life. Intervention during this unique period of plasticity could mitigate the consequences of perinatal stroke to an extent not possible with later intervention, by preserving the normal pattern of development of descending motor pathways. This article outlines the broad range of approaches currently under investigation. Despite significant progress in this area, improved early detection and outcome prediction remain important goals.

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11. J Pediatr. 2014 Feb 12. pii: S0022-3476(13)01597-7. doi: 10.1016/j.jpeds.2013.12.051. [Epub ahead of print]

Sex Differences in Outcome and Associations with Neonatal Brain Morphology in Extremely Preterm Children.

Skiöld B1, Alexandrou G2, Padilla N2, Blennow M3, Vollmer B2, Adén U4.

OBJECTIVE: To investigate sex differences in neurologic and developmental outcomes in extremely preterm (EPT) children and explore associations with neonatal brain morphology. **STUDY DESIGN:** A population-based cohort of infants born at <27 weeks gestation underwent magnetic resonance imaging (MRI) at term equivalent age (n = 107). Voxel-based morphometry (n = 27) and tract-based spatial statistics (n = 29) were performed in infants with normal MRI findings. Neurologic and developmental assessment (using the Bayley Scales of Infant and Toddler Development-Third Edition [BSITD-III]) was performed at 30 months corrected age (n = 91). **RESULTS:** EPT boys had lower mean cognitive composite scores (P = .03) and lower mean language composite scores (P = .04) compared with EPT girls. Rates of cerebral palsy were similar in the 2 sexes. No perinatal factor explained the variance in outcomes. Visual inspection of T1- and T2-weighted MRI images found that delayed myelination was found more frequently in boys, whereas cerebellar abnormalities were more common in girls. In the subgroup of children with normal MRI findings (n = 27), boys had poorer cognitive function (P = .015) and language function (P = .008), despite larger volumes of cerebellar tissue (P = .029). In boys, cerebellar volume was positively correlated with BSITD-III cognitive and motor scores (P = .04 for both). In girls, white matter volume (P = .02) and cortical gray

matter volume ($P = .03$) were positively correlated with BSITD-III language score. At the regional level, significant correlations with outcomes were found only in girls. **CONCLUSION:** Cognitive and language outcomes at age 30 months were poorer in boys. Sex-related differences were observed on neonatal structural MRI, including differences in the patterns of correlations between brain volumes and developmental scores at both global and regional levels.

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12. J Perinatol. 2014 Feb 20. doi: 10.1038/jp.2014.21. [Epub ahead of print]

Predictors of neurodevelopmental outcomes in preterm infants with intraparenchymal hemorrhage.

Tsai AJ1, Lasky RE1, John SD2, Evans PW1, Kennedy KA1.

Objective: To determine which neuroimaging, clinical and sociodemographic factors predict neurodevelopment at 18-22 months age among extremely preterm infants with intraparenchymal hemorrhage (IPH). **Study Design:** Cranial ultrasounds performed before 42 days of age and cranial ultrasounds/magnetic resonance images of the brain performed near discharge were reviewed for hemorrhage location and other abnormalities. Clinical and sociodemographic factors were extracted from existing databases. The primary outcome was presence of cerebral palsy (CP) and the secondary outcome was cognitive development (Bayley Scales of Infant Development). **Result:** Of 1168 infants (<1000 g or <27 weeks), 141 infants had an IPH and 48 infants were seen in follow-up. All infants with extensive hemorrhages (involving three or more lobes) developed CP. In early imaging (before 42 days of age), ventriculomegaly, intraventricular hemorrhage (IVH) and extensive hemorrhage were predictors of CP. In imaging performed near discharge, ventriculomegaly, intraventricular echodensity and having a ventricular shunt were predictors of CP. Clinical, imaging and sociodemographic factors were not associated with low cognitive score. **Conclusion:** In preterm infants surviving with IPH, extensive hemorrhage, ventriculomegaly, IVH and having a shunt increased the risk of developing CP.

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13. PLoS One. 2014 Feb 14;9(2):e88962. doi: 10.1371/journal.pone.0088962. eCollection 2014.

TrkB Agonist Antibody Pretreatment Enhances Neuronal Survival and Long-Term Sensory Motor Function Following Hypoxic Ischemic Injury in Neonatal Rats.

Kim GS1, Cho S2, Nelson JW3, Zipfel GJ4, Han BH5.

Perinatal hypoxic ischemia (H-I) causes brain damage and long-term neurological impairments, leading to motor dysfunctions and cerebral palsy. Many studies have demonstrated that the TrkB-ERK1/2 signaling pathway plays a key role in mediating the protective effect of brain-derived neurotrophic factor (BDNF) following perinatal H-I brain injury in experimental animals. In the present study, we explored the neuroprotective effects of the TrkB-specific agonist monoclonal antibody 29D7 on H-I brain injury in neonatal rats. First, we found that intracerebroventricular (icv) administration of 29D7 in normal P7 rats markedly increased the levels of phosphorylated ERK1/2 and phosphorylated AKT in neurons up to 24 h. Second, P7 rats received icv administration of 29D7 and subjected to H-I injury induced by unilateral carotid artery ligation and exposure to hypoxia (8% oxygen). We found that 29D7, to a similar extent to BDNF, significantly inhibited activation of caspase-3, a biochemical hallmark of apoptosis, following H-I injury. Third, we found that this 29D7-mediated neuroprotective action persisted at least up to 5 weeks post-H-I injury as assessed by brain tissue loss, implicating long-term neurotrophic effects rather than an acute delay of cell death. Moreover, the long-term neuroprotective effect of 29D7 was tightly correlated with sensorimotor functional recovery as assessed by a tape-removal test, while 29D7 did not significantly improve rotarod performance. Taken together, these findings demonstrate that pretreatment with the TrkB-selective agonist 29D7 significantly increases neuronal survival and behavioral recovery following neonatal hypoxic-ischemic brain injury.

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