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**Professor Nadia Badawi AM**

Macquarie Group Foundation Chair of Cerebral Palsy

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## Interventions and Management

1. Eur J Paediatr Neurol. 2015 Sep 25. pii: S1090-3798(15)00155-5. doi: 10.1016/j.ejpn.2015.09.005. [Epub ahead of print]

**Hand function assessment in the first years of life in unilateral cerebral palsy: Correlation with neuroimaging and cortico-spinal reorganization.**

Baranello G, Rossi Sebastiano D, Pagliano E, Visani E, Ciano C, Fumarola A, Arnoldi MT, Corlatti A, Foscan M, Marchi A, Erbetta A, Riva D.

**AIM:** The purpose of the present study was to correlate early hand function assessment during the first years of life with neuroimaging findings and the different patterns of cortico-motor reorganization in children with unilateral cerebral palsy (UCP). **METHODS:** We conducted a long prospective observational study, in which 17 children with UCP (8 left-sided hemiplegia; Manual Ability Classification System level 1-3) were first assessed at a mean age of 24 months (range 18-28), and followed up by means of the Besta Scale, a new standardized protocol assessing both unimanual and bimanual hand function. They also underwent Melbourne Assessment of Unilateral Upper Limb Function (MUUL) and single-pulse Transcranial Magnetic Stimulation (TMS) at a mean age of 10 years 5 months (range 9 y 1 m-12 y 8 m). Brain MRIs of all the 17 children were independently assessed and scored by two blinded observers, according to a defined protocol. Possible correlations between hand function at first assessment, neuroimaging and TMS data were analyzed. **RESULTS:** Early hand function impairment significantly correlated with the extension of brain damage ( $\rho = -0.531$ ,  $p = 0.028$ ), number of involved areas ( $\rho = -0.608$ ,  $p = 0.010$ ), presence of radiological signs of cortico-spinal degeneration ( $\rho = -0.628$ ,  $p = 0.007$ ), and basal ganglia involvement ( $\rho = -0.485$ ,  $p = 0.049$ ). Additionally, higher hand function scores (i.e. better hand function) at first assessment significantly correlated with contralateral cortico-spinal projections, while lower scores significantly correlated with either mixed or ipsilateral cortico-spinal projections to the affected hand ( $\chi^2(2) = 11.418$ ,  $p = 0.003$ ; post-hoc tests: contralateral TMS group versus ipsilateral:  $Z = -2.943$ ,  $p = 0.002$  and contralateral TMS group versus mixed:  $Z = -2.775$ ,  $p = 0.006$ ). **CONCLUSIONS:** To our knowledge, this is the first study correlating hand function assessment in the first years of life, and its evolution over time, with neuroimaging and cortico-spinal projection patterns in children with UCP. These findings could contribute to an improved prediction of prognosis and a better delineation of therapeutic interventions in young children with UCP.

[PMID: 26439103](#)

**2. PLoS One. 2015 Oct 9;10(10):e0138608. doi: 10.1371/journal.pone.0138608.**

**Muscle Recruitment and Coordination following Constraint-Induced Movement Therapy with Electrical Stimulation on Children with Hemiplegic Cerebral Palsy: A Randomized Controlled Trial.**

Xu K, He L, Mai J, Yan X, Chen Y.

**OBJECTIVE:** To investigate changes of muscle recruitment and coordination following constraint-induced movement therapy, constraint-induced movement therapy plus electrical stimulation, and traditional occupational therapy in treating hand dysfunction. **METHODS:** In a randomized, single-blind, controlled trial, children with hemiplegic cerebral palsy were randomly assigned to receive constraint-induced movement therapy (n = 22), constraint-induced movement therapy plus electrical stimulation (n = 23), or traditional occupational therapy (n = 23). Three groups received a 2-week hospital-based intervention and a 6-month home-based exercise program following hospital-based intervention. Constraint-induced movement therapy involved intensive functional training of the involved hand during which the uninvolved hand was constrained. Electrical stimulation was applied on wrist extensors of the involved hand. Traditional occupational therapy involved functional unimanual and bimanual training. All children underwent clinical assessments and surface electromyography (EMG) at baseline, 2 weeks, 3 and 6 months after treatment. Surface myoelectric signals were integrated EMG, root mean square and cocontraction ratio. Clinical measures were grip strength and upper extremity functional test. **RESULTS:** Constraint-induced movement therapy plus electrical stimulation group showed both a greater rate of improvement in integrated EMG of the involved wrist extensors and cocontraction ratio compared to the other two groups at 3 and 6 months, as well as improving in root mean square of the involved wrist extensors than traditional occupational therapy group ( $p < 0.05$ ). Positive correlations were found between both upper extremity functional test scores and integrated EMG of the involved wrist as well as grip strength and integrated EMG of the involved wrist extensors ( $p < 0.05$ ). **CONCLUSIONS:** Constraint-induced movement therapy plus electrical stimulation is likely to produce the best outcome in improving muscle recruitment and coordination in children with hemiplegic cerebral palsy compared to constraint-induced movement therapy alone or traditional occupational therapy. **TRIAL REGISTRATION:** [chictr.org](http://chictr.org) ChiCTR-TRC-13004041.

[PMID: 26452230](https://pubmed.ncbi.nlm.nih.gov/26452230/)

**3. Yonsei Med J. 2015 Nov;56(6):1703-13. doi: 10.3349/ymj.2015.56.6.1703.**

**Effect of Rhythmic Auditory Stimulation on Hemiplegic Gait Patterns.**

Shin YK, Chong HJ, Kim SJ, Cho SR.

**PURPOSE:** The purpose of our study was to investigate the effect of gait training with rhythmic auditory stimulation (RAS) on both kinematic and temporospatial gait patterns in patients with hemiplegia. **MATERIALS AND METHODS:**

Eighteen hemiplegic patients diagnosed with either cerebral palsy or stroke participated in this study. All participants underwent the 4-week gait training with RAS. The treatment was performed for 30 minutes per each session, three sessions per week. RAS was provided with rhythmic beats using a chord progression on a keyboard. Kinematic and temporospatial data were collected and analyzed using a three-dimensional motion analysis system. **RESULTS:** Gait training with RAS significantly improved both proximal and distal joint kinematic patterns in hip adduction, knee flexion, and ankle plantar flexion, enhancing the gait deviation index (GDI) as well as ameliorating temporal asymmetry of the stance and swing phases in patients with hemiplegia. Stroke patients with previous walking experience demonstrated significant kinematic improvement in knee flexion in mid-swing and ankle dorsiflexion in terminal stance. Among stroke patients, subacute patients showed a significantly increased GDI score compared with chronic patients. In addition, household ambulators showed a significant effect on reducing anterior tilt of the pelvis with an enhanced GDI score, while community ambulators significantly increased knee flexion in mid-swing phase and ankle dorsiflexion in terminal stance phase. **CONCLUSION:** Gait training with RAS has beneficial effects on both kinematic and temporospatial patterns in patients with hemiplegia, providing not only clinical implications of locomotor rehabilitation with goal-oriented external feedback using RAS but also differential effects according to ambulatory function.

[PMID: 26446657](https://pubmed.ncbi.nlm.nih.gov/26446657/)

4. *Front Pediatr.* 2015 Sep 10;3:74. doi: 10.3389/fped.2015.00074. eCollection 2015.

**Myofascial Structural Integration Therapy on Gross Motor Function and Gait of Young Children with Spastic Cerebral Palsy: A Randomized Controlled Trial.**

Loi EC, Buysse CA, Price KS, Jaramillo TM, Pico EL, Hansen AB, Feldman HM.

Though the cause of motor abnormalities in cerebral palsy is injury to the brain, structural changes in muscle and fascia may add to stiffness and reduced function. This study examined whether myofascial structural integration therapy, a complementary treatment that manipulates muscle and fascia, would improve gross motor function and gait in children <4 years with cerebral palsy. Participants (N = 29) were enrolled in a randomized controlled trial (NCT01815814, <https://goo.gl/TGxvwd>) or Open Label Extension. The main outcome was the Gross Motor Function Measure-66 assessed at 3-month intervals. Gait (n = 8) was assessed using the GAITRite® electronic walkway. Parents completed a survey at study conclusion. Comparing Treatment (n = 15) and Waitlist-Control groups (n = 9), we found a significant main effect of time but no effect of group or time × group interaction. The pooled sample (n = 27) showed a main effect of time, but no significantly greater change after treatment than between other assessments. Foot length on the affected side increased significantly after treatment, likely indicating improvement in the children's ability to approach a heel strike. Parent surveys indicated satisfaction and improvements in the children's quality of movement. MSI did not increase the rate of motor skill development, but was associated with improvement in gait quality.

[PMID: 26442234](#)

5. *BMC Neurol.* 2015 Oct 8;15(1):188. doi: 10.1186/s12883-015-0441-y.

**Muscle strength does not explain standing ability in children with bilateral spastic cerebral palsy: a cross sectional descriptive study.**

Lidbeck C, Tedroff K, Bartonek Å.

**BACKGROUND:** In bilateral cerebral palsy (CP) muscle strength is considered important for development of gross motor functions, but its influence on standing ability has not been explored. Our aims were to examine muscle strength with respect to the ability to stand with (SwS) or without (SwoS) hand support, asymmetrical weight bearing (WB), and whether the ability to produce strength was influenced by different seated conditions.

**METHODS:** In this cross sectional descriptive study standing posture was recorded with 3D motion analysis, and muscle strength was measured with a hand-held dynamometer, in 25 children with bilateral CP, GMFCS levels II-III, SwS (n = 14, median age 11.4 years), or SwoS, (n = 11, median age 11.4 years). Strength measurements were taken in the hip flexors, knee extensors, dorsiflexors and plantarflexors, in two seated conditions; a chair with arm- and backrests, and a stool.

**RESULTS:** Compared to SwoS, children SwS stood with a more flexed posture, but presented with equal strength in the hip flexors, dorsiflexors and plantarflexors, and with somewhat more strength in the knee extensors. Despite asymmetric WB during standing, both limbs were equally strong in the two groups. No differences in strength were measured between the two seated conditions. **CONCLUSIONS:** Despite challenges measuring muscle strength in CP, the lower limb muscle strength cannot be considered an explanatory factor for variations in standing in this group of children with bilateral CP. The findings rather strengthen our hypothesis that deficits in the sensory systems could be as determinant for standing as muscle weakness in children with bilateral spastic CP.

[PMID: 26449859](#)

6. J Clin Diagn Res. 2015 Aug;9(8):YC01-3. doi: 10.7860/JCDR/2015/11639.6399. Epub 2015 Aug 1.

**Changes in Capacity and Performance in Mobility Across Different Environmental Settings in Children with Cerebral Palsy: An Exploratory Study.**

Diwan S, Diwan J, Bansal AB, Patel PR.

**BACKGROUND:** Children with cerebral palsy, although having similar diagnosis, varies in their abilities & level of functioning within & across different environmental context e.g. home, school or community setting. Capacity (what a child can do in standardized, controlled environment) may or may not be the same as performance (what a child actually does do in her/her daily environment). **MATERIALS AND METHODS:** After getting approval from Institutional Ethic's Committee (IEC), 63 children with cerebral palsy (4-16 year, mean 7.4 year with SD 0.39) of all clinical types, Gross Motor Functional Classification System (GMFCS) level I-V were examined for mobility using Gross Motor Functional Measure 88 (GMFM). Motor capacity was assessed in clinical setting by highest of 3 GMFM items attained, i.e., crawling (44), walks with support (68) & walks without support (70). Motor performance was measured by Functional Mobility Scale version 2. **RESULT:** On analysis of motor capacity 42.85% children were walking without support, 15.87% were able to crawl & 26.98% were able walk with support in clinical setting. Spearman's Correlation was done between GMFM item 70 with FMS 5 (home setting) to check correlation of capacity with performance & was found to be significantly correlated ( $r=0.586$ ,  $p=0.04$ ). All three GMFM items were correlated with FMS 5, 50, 500 & found positively correlated. For community setting (FMS 500), 52.38% children were lifted by parents & only 6.34% were using wheel chair mobility. A total of 21.87% patients were able to walk with or without support & still lifted by parents in school or community setting. **CONCLUSION:** Change in capacity and performance of mobility exists mainly in school and community setting in studied population. Context should be given importance to prioritize rehabilitation process.

[PMID: 26436034](#)

7. Front Integr Neurosci. 2015 Sep 8;9:48. doi: 10.3389/fnint.2015.00048. eCollection 2015.

**NeuroControl of movement: system identification approach for clinical benefit.**

Meskens CG, de Groot JH, de Vlugt E, Schouten AC.

Progress in diagnosis and treatment of movement disorders after neurological diseases like stroke, cerebral palsy (CP), dystonia and at old age requires understanding of the altered capacity to adequately respond to physical obstacles in the environment. With posture and movement disorders, the control of muscles is hampered, resulting in aberrant force generation and improper impedance regulation. Understanding of this improper regulation not only requires the understanding of the role of the neural controller, but also attention for: (1) the interaction between the neural controller and the "plant", comprising the biomechanical properties of the musculoskeletal system including the viscoelastic properties of the contractile (muscle) and non-contractile (connective) tissues: neuromechanics; and (2) the closed loop nature of neural controller and biomechanical system in which cause and effect interact and are hence difficult to separate. Properties of the neural controller and the biomechanical system need to be addressed synchronously by the combination of haptic robotics, (closed loop) system identification (SI), and neuro-mechanical modeling. In this paper, we argue that assessment of neuromechanics in response to well defined environmental conditions and tasks may provide for key parameters to understand posture and movement disorders in neurological diseases and for biomarkers to increase accuracy of prediction models for functional outcome and effects of intervention.

[PMID: 26441563](#)

8. *BMC Pediatr.* 2015 Oct 7;15(1):146. doi: 10.1186/s12887-015-0459-8.

**Application of the Gross Motor Function Measure-66 (GMFM-66) in Dutch clinical practice: a survey study.**

Beckers LW, Bastiaenen CH.

**BACKGROUND:** The Gross Motor Function Measure-66 (GMFM-66) is an observational clinical measure designed to evaluate gross motor function in children with Cerebral Palsy (CP). It is a shortened version of the GMFM-88. A free computer program, the Gross Motor Ability Estimator (GMAE), is required to calculate the interval level total score of the GMFM-66. The aim of this study was to explore pediatric physiotherapists' experiences with the GMFM-66 and application of the measure in Dutch clinical practice. **METHODS:** An explorative cross-sectional survey study was performed. Dutch pediatric physiotherapists were invited to complete an online survey. Data-analysis merely consisted of frequency tables, cross-tabulations and data-driven qualitative analysis. **RESULTS:** Fifty-six respondents were included in the analysis. In general, the therapists expressed a positive opinion on the GMFM-66, in particular regarding its user-friendly administration and benefits of the GMAE. The majority of questions revealed that therapists deviate from the guidelines provided by the manual to a greater or lesser extent though. The most worrisome finding was that 28.8 % (15/52) of the therapists calculate the total score of the GMFM-66 using the score form of the GMFM-88 instead of the GMAE. **DISCUSSION:** The consequences of the high number of therapists who stated that they calculate the total score of the GMFM-66 with the GMFM-88 score form are far-reaching; it has a misleading impact on the opinion of rehabilitation teams and parents on the development of the child, on decision-making in rehabilitation, and ultimately on the development of the child. **CONCLUSIONS:** Information currently available on psychometric properties, motor growth curves and percentiles cannot be generalized to clinical practice in the Netherlands, as they were generated in highly controlled testing conditions, which do not hold in clinical practice.

[PMID: 26445947](#)

9. *Braz J Phys Ther.* 2015 Aug;19(4):311-9. doi: 10.1590/bjpt-rbf.2014.0127. Epub 2015 Sep 1.

**Moderating effect of the environment in the relationship between mobility and school participation in children and adolescents with cerebral palsy.**

Furtado SR, Sampaio RF, Kirkwood RN, Vaz DV, Mancini MC.

**BACKGROUND:** The literature demonstrates that the social participation of children with disabilities is influenced by both their functional skills repertoire and environmental factors. However, it is not yet known whether the effect of functional limitations on social participation is minimized or enhanced by the environmental facilitators and barriers. This study aimed to test this hypothesis. **OBJECTIVE:** To investigate the moderating effect of environmental factors in the relationship between mobility and school participation of children and adolescents with cerebral palsy (CP). **METHOD:** Participants were 102 elementary school children and adolescents with CP, aged 6 to 17 years, classified as levels I, II, and III according to the Gross Motor Classification System, along with their parents or caregivers and teachers. School participation and parents' perceptions of barriers were evaluated using the School Function Assessment and the Craig Hospital Inventory of Environmental Factors (CHIEF), respectively. **RESULTS:** The regression model failed to reveal a moderating effect of environmental factors in the relationship between mobility and school participation. While mobility was a strong predictor of participation, environmental factors demonstrated a weak predictive effect on the latter. The CHIEF subscale school/work showed the factors which were greatest barrier to children's participation, while the subscale attitude/support had the least impact. **CONCLUSION:** The absence of moderation on the tested relationship suggests that, when investigated under the negative perspective of environmental barriers, the contextual factors do not modify the relationship between mobility and school participation. Factors specific to the school environment might add to the present study's results regarding the effect of school participation in this population.

[PMID: 26443979](#)

10. Res Dev Disabil. 2015 Oct 1;47:185-198. doi: 10.1016/j.ridd.2015.09.002. [Epub ahead of print]

**Instruments for the evaluation of motor abilities for children with severe multiple disabilities: A systematic review of the literature.**

Mensch SM, Rameckers EA, Echteld MA, Evenhuis HM.

Based on a systematic review, psychometric characteristics of currently available instruments on motor abilities of children with disabilities were evaluated, with the aim to identify candidates for use in children with severe multiple (intellectual and motor) disabilities. In addition, motor abilities are essential for independent functioning, but are severely compromised in these children. The methodological quality of all studies was evaluated with the Consensus Based Standards for the Selection of Health Status Measurement Instruments (COSMIN) Checklist; overall levels of evidence per instrument were based on the Cochrane Back Review Group strategy. As a result, 18 studies with a total of eight instruments, developed for children with cerebral palsy (CLA, GMFM-88 and LE85), spinal muscular atrophy (MHFMS), neuromuscular diseases (MFM), disabilities 0-6 years (VAB, WeeFIM), and one developed specifically for children with severe multiple disabilities (TDMMT) were found. Strong levels of evidence were found for construct validity of LE85 and MFM and for responsiveness of WeeFIM, but reliability studies of these instruments had a limited methodological quality. Up to now studies of the TDMMT resulted in limited and unknown evidence for structural validity due to the poor methodological quality of reliability studies. In a next step, the clinical suitability of the instruments for children with severe multiple disabilities will be evaluate.

[PMID: 26436614](#)

## Prevention and Cure

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