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**Professor Nadia Badawi**

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## Interventions and Management

**1. *Pediatr Phys Ther.* 2013 Summer;25(2):168-76. doi: 10.1097/PEP.0b013e318288d370.**

**GMFM in Infancy: Age-Specific Limitations and Adaptations.**

Hielkema T, Hamer EG, Ebbers-Dekkers I, Dirks T, Maathuis CG, Reinders-Messelink HA, Geertzen JH, Hadders-Algra M.

Departments of Paediatrics-Developmental Neurology (Drs Hielkema and Hadders-Algra and Mss Hamer, Ebbers-Dekkers, and Dirks) and Rehabilitation Medicine, Center for Rehabilitation (Drs Hielkema, Maathuis, Reinders-Messelink, and Geertzen), University Medical Center Groningen, University of Groningen, Groningen, the Netherlands; Rehabilitation Center "Revalidatie Friesland" (Dr Reinders-Messelink), Beetsterzwaag, the Netherlands.

**PURPOSE:** To evaluate longitudinal applicability of the Gross Motor Function Measure (GMFM) in infants younger than 2 years. **METHODS:** Twelve infants at very high risk for cerebral palsy were enrolled between 1 and 9 months corrected age. The children were assessed 4 times during 1 year with the GMFM-66, GMFM-88, and other neuromotor tests. **RESULTS:** Longitudinal use of the GMFM in infancy was hampered by age and function-specific limitations. The GMFM-66 differentiated less at lower-ability levels than at higher-ability levels. The GMFM-88 demonstrated flattening of the developmental curve when infants had developed more motor abilities. We formulated adaptations for the longitudinal use of GMFM in infancy. **CONCLUSIONS:** To facilitate use of the GMFM in infancy, an adapted version may be an option. Further research is required to assess reliability and validity, and in particular, the sensitivity to change of the suggested adaptations.

[PMID: 23542195](#) [PubMed - in process]

**2. *Dev Med Child Neurol.* 2013 Mar;55(3):208-9. doi: 10.1111/dmcn.12000. Epub 2012 Nov 28.**

**The evidence for abandoning upper limb stretch interventions in paediatric practice.  
Wallen M, Stewart K.**

Occupational Therapy Department, The Children's Hospital at Westmead, Westmead Kids Rehab, The Children's Hospital at Westmead, Westmead, Australia.

[PMID: 23190120](#) [PubMed - indexed for MEDLINE]

### 3. Qual Life Res. 2013 Mar 31. [Epub ahead of print]

#### **An examination of the PROMIS® pediatric instruments to assess mobility in children with cerebral palsy.**

Kratz AL, Slavin MD, Mulcahey MJ, Jette AM, Tulskey DS, Haley SM.

Department of Physical Medicine and Rehabilitation, University of Michigan, 325 E. Eisenhower Parkway, Suite 300, Ann Arbor, MI, USA, [alkratz@umich.edu](mailto:alkratz@umich.edu).

**PURPOSE:** The Patient-Reported Outcomes Measurement Information System (PROMIS®) provides adult and pediatric self-report measures of health-related quality of life designed for use across medical conditions and the general population. The purpose of this study was to examine the feasibility and validity of the PROMIS® Pediatric Short Form and computer-adaptive test (CAT) mobility measures in children with cerebral palsy (CP). **METHODS:** Eighty-two children with CP completed self-report (PROMIS® Mobility Short Form, PROMIS® Mobility CAT, Pediatric Quality of Life Inventory™) and performance-based assessments of mobility (Timed Up and Go, Gross Motor Function Measure). Parents provided three proxy reports of child mobility (Pediatric Outcomes Data Collection Instrument, Functional Assessment Questionnaire, Shriners Hospitals for Children CP-CAT). Validity of PROMIS® instruments was examined through correlations with other measures and "known groups" analyses determined by Gross Motor Function Classification System (GMFCS). **RESULTS:** On average, the PROMIS® CAT required less than seven items and 2 minutes to administer. Both PROMIS® measures showed moderate to high correlations with child- and parent-proxy report of child mobility; correlations with performance-based measure were small for the PROMIS® Short Form and non-significant for the PROMIS® CAT. All measures except for the PROMIS® CAT were able to distinguish between GMFCS categories. **CONCLUSIONS:** Results support the convergent and discriminant validity of the pediatric PROMIS® Mobility Short Form in children with CP. The PROMIS® Mobility CAT correlates well with child report and parent report of mobility but not with performance-based measures and does not differentiate between known mobility groups.

[PMID: 23543391](#) [PubMed - as supplied by publisher]

### 4. Dev Med Child Neurol. 2013 Apr 4. doi: 10.1111/dmcn.12148. [Epub ahead of print]

#### **Long-term effect of selective dorsal rhizotomy on gross motor function in ambulant children with spastic bilateral cerebral palsy, compared with reference centiles.**

Bolster EA, van Schie PE, Becher JG, van Ouwkerk WJ, Strijers RL, Vermeulen RJ.

Department of Rehabilitation Medicine, Physiotherapy Section, VU University Medical Center, Amsterdam, the Netherlands.

**AIM:** The aim of this study was to evaluate the long-term effect of selective dorsal rhizotomy (SDR) on the gross motor function of ambulant children with spastic bilateral cerebral palsy (CP), compared with reference centiles. **METHOD:** The study used a prospective cohort design and participants comprised 29 children classified using the Gross Motor Function Classification System (GMFCS) in level I (n=7), II (n=4), or III (n=18; 18 males, 11 females; median age at time of surgery 6y 4mo; range 2y 10mo-12y 1mo), who were examined 5 years and 10 years after SDR. We used individual centiles based on Gross Motor Function Measure (GMFM-66) scores and age, corresponding to the GMFCS levels. Individual improvement or deterioration was defined as a change of more than 20 centiles. Side effects experienced and additional treatment received after SDR were also recorded. **RESULTS:** Five years after SDR, 10 out of 28 children showed improvement, and 10 years after SDR 6 out of 20 children had improved. Spinal side effects were noted in two children and hip subluxation in three. Additional treatments included subtalar arthrodesis (n=13), endorotational osteotomy of the tibia (n=5), and botulinum toxin treatment (n=13). **INTERPRETATION:** None of the children showed deterioration of gross motor function based on centile ranking. Five and 10 years after SDR, gross motor function in some children had improved more than would have been expected according to the reference centiles. This suggests, taking the limitations of this study into account, that the applied criteria for selection were adequate. However, the children still required additional treatment after SDR.

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**5. Muscle Nerve. 2013 Apr 5. doi: 10.1002/mus.23866. [Epub ahead of print]****Muscle size, activation and coactivation in adults with cerebral palsy.**

Hussain AW, Onambele GL, Williams AG, Morse CI.

Institute for Performance Research, Department of Exercise and Sport Science, Manchester Metropolitan University Cheshire, United Kingdom.

**Introduction.** Muscle weakness is present in the paretic limbs of individuals with cerebral palsy (CP). We aimed to determine what neuromuscular factors contribute to weakness in adults with CP during isometric maximal voluntary contractions (iMVC). **Method.** Gastrocnemius anatomical cross sectional area (ACSA) and agonist and antagonist activation were measured in 11 CP and 11 control adult men during plantarflexion iMVC. **Results.** Plantarflexion iMVC torque of the paretic leg was 42% and 52% less than the non-paretic and control limbs, respectively. The paretic gastrocnemius ACSA was smaller than the control group only. Paretic agonist activation was less than the non-paretic and control groups, whereas antagonist coactivation was higher. Multiple regression analysis revealed muscle activation accounted for 57% of variation in paretic plantarflexion iMVC torque. **Discussion.** This demonstrates that in individuals with CP, muscle weakness in the paretic limb is attributed primarily to impaired neural activation and, to a lesser degree, ACSA. © 2013 Wiley Periodicals, Inc.

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**6. Pediatr Phys Ther. 2013 Summer;25(2):187-92. doi: 10.1097/PEP.0b013e3182888495.****Treadmill training following orthopedic surgery in lower limbs of children with cerebral palsy.**

Grecco LA, de Freitas TB, Satie J, Bagne E, Oliveira CS, de Souza DR.

Department of Physiotherapy (Mss Grecco, Beline, and Satie, and Mr Bagne), Associação de Assistência à Criança Deficiente, São Paulo, Brazil; Rehabilitation Sciences (Ms Grecco and Dr Santos Oliveira), Nove de Julho University, São Paulo, Brazil; Department of Psychiatrists (Dr Souza), Associação de Assistência à Criança Deficiente, São Paulo, Brazil.

**PURPOSE:** To determine the effect of treadmill training on gross motor function and functional mobility in children with cerebral palsy (CP) receiving physical therapy following orthopedic surgery for the lower limbs. **METHODS:** Children with CP between 8 and 15 years of age participated and were divided into 2 groups: those having undergone soft tissue surgery and those having undergone both soft tissue and bone surgery. The program consisted of 12 weeks of treadmill training without partial weight support at a frequency of one 30-minute session per week. **RESULTS:** Significant improvements were found on the Gross Motor Function Measure-88 after treadmill training; distance traveled on the 6 Meter Walk Test; and time tolerated on the treadmill. **CONCLUSIONS:** Treadmill training during physical therapy is beneficial for children with CP who undergo orthopedic surgery in the lower limbs.

[PMID: 23542199](#) [PubMed - in process]

**7. Pediatr Phys Ther. 2013 Summer;25(2):193. doi: 10.1097/PEP.0b013e318288d391.****Commentary on "treadmill training following orthopedic surgery in lower limbs of children with cerebral palsy".**

Corr B, Harbourne R.

University of Nebraska Medical Center Omaha, Nebraska.

[PMID: 23542200](#) [PubMed - in process]

**8. Spine J. 2013 Mar 28. pii: S1529-9430(13)00168-X. doi: 10.1016/j.spinee.2013.02.011. [Epub ahead of print]****Analysis of sagittal spinopelvic parameters in cerebral palsy.**

Suh SW, Suh DH, Kim JW, Park JH, Hong JY.

Department of Orthopedics, Scoliosis Research Institute, Korea University Guro Hospital, 80 Guro-dong, Guro-gu, Seoul 152-703, South Korea.

**BACKGROUND CONTEXT:** Knowledge of sagittal spinopelvic parameters is important for the treatment of cerebral palsy (CP) because they differ in the normal population and can induce symptoms. **PURPOSE:** To analyze the sagittal spinal alignment and the pelvic orientation in CP. **STUDY DESIGN:** Radiological analysis of patients with CP. **METHODS:** The study and control groups comprised 57 CP patients and 24 healthy volunteers, respectively. All the patients underwent lateral radiography of the whole spine including hip joints. The radiographic parameters examined were sacral slope (SS), pelvic tilt (PT), pelvic incidence (PI), S1 overhang (OH), thoracic kyphosis (TK), thoracolumbar kyphosis (TLK), lumbar lordosis (LL1 and 2), and sagittal balance (SB). Statistical analysis was performed to identify the significant differences between the two study groups. In addition, correlations were sought between the parameters and symptoms. **RESULTS:** The PT and OH were significantly smaller in the CP patients, whereas SS, TLK, LL1, LL2, and SB were significantly greater ( $p < .05$ ). Correlation analysis revealed significant relationships between the sagittal parameters. Specifically, PI was found to be associated with SS, PT, and OH, whereas the spinal parameters LL1 and LL2 were found to be related to TK and SB. Between spine and pelvic parameters, LL1 and LL2 were found to be related to SS, PT, PI, and OH and in addition, SB was found to be related to TLK, LL1, and LL2. An analysis of relations between the symptoms and parameters revealed a positive correlation between the severities of symptoms and PT, OH, and TLK ( $r = 0.300$ ,  $p = .023$ ;  $r = 0.306$ ,  $p = .020$ ;  $r = 0.289$ ,  $p = .029$ , respectively). **CONCLUSIONS:** A significant difference was observed in the sagittal spinopelvic parameters in the CP and normal control groups and was possibly related to the symptoms. The study shows that the evaluations of sagittal spinopelvic parameters could be useful during the treatment of disorders associated with CP.

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**9. Dev Med Child Neurol. 2013 Mar 29. doi: 10.1111/dmcn.12147. [Epub ahead of print]****Evidence for outcomes of motivational rehabilitation interventions for children and adolescents with cerebral palsy: an American Academy for Cerebral Palsy and Developmental Medicine systematic review.**

Tatla SK, Sauve K, Virji-Babul N, Holsti L, Butler C, Van Der Loos HF.

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This study reviewed evidence regarding the effect of motivational rehabilitation interventions on outcomes in children with cerebral palsy. Six databases were searched for literature published up to May 2012. Included studies measured the purported motivating effects of motor-based rehabilitation interventions and the measured impact on outcomes. The American Academy for Cerebral Palsy and Developmental Medicine (AAPDM) systematic review methodology was used as a framework. Eight studies evaluated outcomes of studies using virtual reality interventions and one in a functional therapy context. Conflicting evidence from three (level II and level III) studies exists about the impact of these motivating interventions on motor outcomes measured in body functions. No statistical evidence regarding activity and participation outcomes exists. A single level II study found no significant difference in participants' motivation between motivational and conventional interventions. This review revealed a paucity of research on the effects of motivational interventions. Weaknesses include a lack of consistency in the examination of motivational interventions, limited use of definitions or theories to ground the concept of motivation, and reliance on non-validated methodological tools. This body of evidence would be strengthened by the use and development of robust outcome measures of motivation.

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**10. BMJ Open. 2013 Apr 3;3(4). pii: e002500. doi: 10.1136/bmjopen-2012-002500. Print 2013.**

**Executive functioning in children with unilateral cerebral palsy: protocol for a cross-sectional study.**

Bodimeade HL, Whittingham K, Lloyd O, Boyd RN.

Discipline of Paediatrics and Child Health, School of Medicine, Queensland Cerebral Palsy and Rehabilitation Research Centre, The University of Queensland, Brisbane, Australia.

**INTRODUCTION:** Early brain injury, as found in children with unilateral cerebral palsy (CP), may cause deficits in higher-order cognitive tasks known as executive functions (EF). EF has been conceptualised as comprised of four distinct yet inter-related components: (1) attentional control, (2) cognitive flexibility, (3) goal setting and (4) information processing. The aim of this study was to examine EF in children with unilateral CP and compare their performance with a typically developing reference group (TDC). The potential laterality effects of unilateral CP on EF will be explored, as will the relationship between the cognitive measures of EF, behavioural manifestations of EF, psychological functioning and clinical features of unilateral CP. **METHODS AND ANALYSIS:** This cross-sectional study aims to recruit a total of 42 children with unilateral CP (21 right unilateral CP and 21 left unilateral CP) and 21 TDC aged between 8 and 16 years. Clinical severity will be described for gross motor function and manual ability. Outcomes for cognitive EF measures will include subtests from the Wechsler Intelligence Scale for Children-Fourth Edition, Delis-Kaplan Executive Function System, Rey Complex Figure Test and the Test of Everyday Attention for Children. Behavioural manifestations of EF will be assessed using the Behaviour Rating Inventory of Executive Function, Parent and Teacher versions. Psychological functioning will be examined using the Strengths and Difficulties Questionnaire. Between-groups differences will be examined in a series of one-way analyses of covariance and followed up using linear comparisons. An overall composite of cognitive EF measures will be created. Bivariate correlations between the EF composite and psychological measures will be calculated. **ETHICS AND DISSEMINATION:** This protocol describes a study that, to our knowledge, is the first to examine multiple components of EF using a cohort of children with unilateral CP. Exploration of potential laterality effects of EF among children with a congenital, unilateral brain injury is also novel. Possible relationships between EF and psychological functioning will also be investigated. Ethics have been obtained through the University of Queensland School of Psychology Ethics Committee and the Queensland Children's Health Services Human Research Ethics Committee. Results will be disseminated in peer reviewed publications and presentations at national and international conferences. This study is registered with the Australian New Zealand Clinical Trials Registry (ACTRN12611000263998).

[PMID: 23558736](#) [PubMed - in process]

**11. Int J Paediatr Dent. 2013 Apr 4. doi: 10.1111/ipd.12030. [Epub ahead of print]**

**Assessing salivary osmolality as a caries risk indicator in cerebral palsy children.**

Santos MT, Ferreira MC, Mendes FM, de Oliveira Guaré R.

Persons with Disabilities Division, School of Dentistry, Universidade Cruzeiro do Sul, São Paulo, Brazil.

**BACKGROUND:** Salivary osmolality reflects the hydration status of individuals with cerebral palsy (CP) necessary for an adequate unstimulated salivary flow rate. **AIM:** To investigate whether salivary osmolality could serve as a potential indicator of caries risk in children with spastic CP by displaying a stronger association with caries occurrence than salivary flow rate. **DESIGN:** The convenience sample consisted of 65 children with CP aged 6-13 years old. Unstimulated whole saliva was collected using cotton roll, and salivary osmolality was measured using a freezing point depression osmometer. The children's oral motor performance was evaluated during the feeding process using the Oral Motor Assessment Scale. Caries occurrence was also evaluated according the World Health Organization criteria. **RESULTS:**

Motor skills were significantly associated with caries experience. Regarding the salivary parameters, osmolality presented a stronger association with caries experience than did the salivary flow rate. Children with worse oral motor performance presented a higher rate of caries occurrence. **CONCLUSION:** Osmolality exhibited a stronger association with caries occurrence than did salivary flow rate. This parameter, therefore, could be a potential caries risk indicator for spastic cerebral palsy children.

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**12. Dent Res J (Isfahan). 2012 Sep;9(5):651-4.**

**Infantile hemiplegia in pediatric dental set-up.**

Syed G, Benni D, Naik SV, Surendra P.

Department of Pedodontics and Preventive Dentistry, AECS Maaruthi College of Dental Sciences and Research Centre, Bangalore, India.

Infantile hemiplegia refers to brain injuries that occur before or at birth and lead to hemiplegia/ total paralysis of one side of the body, including the face, arm and leg. The main purpose of this article is to provide valuable information to pediatric dentists about the review and treatment alternatives for patients with infantile hemiplegia. This article reports the case of a 12-year-old girl with a hemiplegia of left side of the body suffering with tooth ache and gum inflammation. The treatment performed was rehabilitation with oral prophylaxis and extractions of root stumps followed by thorough preventive regimen with periodic check-ups.

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## Prevention and Cure

**13. Acta Paediatr. 2013 Mar 28. doi: 10.1111/apa.12240. [Epub ahead of print]**

**Sex differences in cerebral palsy incidence and functional ability - a total population study.**

Chounti A, Hägglund G, Wagner P, Westbom L.

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AIM: To describe gender difference in a total population of children with cerebral palsy (CP), related to subtype, gross and fine motor function, and to compare CP incidence trends in girls and boys METHODS: All 590 children with CP born in southern Sweden 1990-2005 were included. CP subtype was classified according to the Surveillance of Cerebral Palsy in Europe, gross motor function according to Gross Motor Function Classification System (GMFCS) and manual ability according to Manual Ability Classification System (MACS). Trends in CP incidence by birth year were analyzed using Poisson regression modeling RESULTS: There was a male predominance in all levels of GMFCS except level II, in all levels of MACS and in all CP subtypes except ataxic CP. There was no statistically significant difference between males and females regarding gross motor function or manual ability The CP incidence trends in boys compared to girls did not change during the period 1990-2005 CONCLUSION: No equalization was detected in the incidence of CP between girls and boys during recent years in this total population. We could not confirm any consistent sex difference in motor function levels. Male sex is a risk factor for CP. © 2013 Foundation Acta Paediatrica. Published by Blackwell Publishing Ltd.

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**14. Brain. 2013 Apr;136(Pt 4):998-1011. doi: 10.1093/brain/aws334.****Limitations on the developing preterm brain: impact of periventricular white matter lesions on brain connectivity and cognition.**

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Brain lesions to the white matter in peritrigonal regions, periventricular leukomalacia, in children who were born prematurely represent an important model for studying limitations on brain development. The lesional pattern is of early origin and bilateral, that constrains the compensatory potential of the brain. We suggest that (i) topography and severity of periventricular lesions may have a long-term predictive value for cognitive and social capabilities in preterm birth survivors; and (ii) periventricular lesions may impact cognitive and social functions by affecting brain connectivity, and thereby, the dissociable neural networks underpinning these functions. A further pathway to explore is the relationship between cerebral palsy and cognitive outcome. Restrictions caused by motor disability may affect active exploration of surrounding and social participation that may in turn differentially impinge on cognitive development and social cognition. As an outline for future research, we underscore sex differences, as the sex of a preterm newborn may shape the mechanisms by which the developing brain is affected.

[PMID: 23550112](#) [PubMed - in process]

**15. Dev Med Child Neurol. 2013 Apr 1. doi: 10.1111/dmcn.12122. [Epub ahead of print]****Diffusion-weighted imaging changes in cerebral watershed distribution following neonatal encephalopathy are not invariably associated with an adverse outcome.**

Harteman JC, Groenendaal F, Toet MC, Benders MJ, Van Haastert IC, Nieuvelstein RA, Koopman-Elseboom C, de Vries LS.

Department of Neonatology, Wilhelmina Children's Hospital, University Medical Centre, Utrecht, the Netherlands.

**AIM:** Patterns of injury in term-born infants with neonatal encephalopathy following hypoxia-ischaemia are seen earlier and are more conspicuous on diffusion-weighted magnetic resonance imaging (DW-MRI) than on conventional imaging. Although the prognostic value of DW-MRI in infants with basal ganglia and thalamic damage has been established, data in infants in whom there is extensive injury in a watershed distribution are limited. The aim of this study was to assess cognitive and functional motor outcome in a cohort of infants with changes in a predominantly watershed distribution injury on neonatal cerebral MRI, including DWI. **METHOD:** DW-MRI findings in infants with neonatal encephalopathy following hypoxia-ischaemia were evaluated retrospectively. Twenty-two infants in whom DWI changes exhibited a predominantly watershed distribution were enrolled in the study (10 males, 12 females; mean birthweight 3337g, 2830-3900g; mean gestational age 40.5wks, 37.9-42.1wks). Follow-up MRI data at the age of 3 months (n=15) and over the age of 18 months (n=7) were analysed. In survivors, neurodevelopmental outcome was assessed with the Griffiths Mental Development Scales at the age of at least 18 months. Amplitude-integrated electroencephalography was used to score background patterns and the occurrence of epileptiform activity. **RESULTS:** DW-MRI revealed abnormalities that were bilateral in all infants and symmetrical in 10. The posterior regions were more severely affected in five infants and the anterior regions in three. Watershed injury occurred in isolation in 10 out of 22 infants and was associated with involvement of the basal ganglia and thalami in the other 12, of whom seven died. Cystic evolution, seen on MRI at age 3 months, occurred in three of the 15 surviving infants. Neurodevelopmental assessment of the surviving infants was performed at a median age of 35 months (range 18-48mo). Of the five survivors with basal ganglia and thalamic involvement, two developed cerebral palsy, one had a developmental quotient of less than 85, and two had a normal outcome. Of the 10 infants with isolated watershed injury, nine had an early normal motor and cognitive outcome. In all infants with a favourable outcome, background recovery was seen on amplitude integrated EEG within 48 hours after birth. **CONCLUSION:** Extensive DWI changes in a watershed distribution in term-born neonates are not invariably associated with adverse sequelae, even in the presence of cystic evolution. Associated lesions of the basal ganglia and thalami are a better predictor of adverse sequelae than the extent and severity of the watershed abnormalities seen on DW-MRI.

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**16. J Obstet Gynaecol Res. 2013 Apr 3. doi: 10.1111/jog.12036. [Epub ahead of print]**

**Labor induction by transcervical balloon catheter and cerebral palsy associated with umbilical cord prolapse.**

Yamada T, Cho K, Yamada T, Morikawa M, Minakami H.

Department of Obstetrics, Hokkaido University Graduate School of Medicine, Sapporo, Japan.

**AIM:** The aim of this study was to determine whether the use of transcervical balloon catheter (TCBC) for induction of labor (IOL) is a risk factor for cerebral palsy (CP) associated with umbilical cord prolapse (UCP-CP) in singleton pregnancies with cephalic presentation. **MATERIAL AND METHODS:** Among all 102 infants with CP who were preliminarily determined as caused by antenatal and/or intrapartum hypoxemia by the Japan Council for Quality Health Care until April 2012, all 56 infants who met all of the following criteria were studied: cephalic singleton pregnancy, reassuring fetal status on electronic cardiotocogram at time of admission to obstetric facilities for labor pains, ruptured fetal membranes, and/or IOL, and hypoxic-ischemic encephalopathy at birth. Clinical backgrounds were compared between six infants with UCP-CP and the remaining 50 infants with CP not associated with UCP (non-UCP-CP). **RESULTS:** Frequencies of IOL (83% [5/6] vs 32% [16/50],  $P = 0.0236$ ), use of TCBC (67% [4/6] vs 10% [5/50],  $P = 0.0044$ ), and amniotomy (67% [4/6] vs 24% [12/50],  $P = 0.0494$ ) were significantly higher in the UCP-CP than the non-UCP-CP group. Only TCBC was a risk factor significantly associated with UCP-CP after logistic regression analysis, yielding an odds ratio of 18.0 (95% confidence interval, 2.6-124;  $P = 0.003$ ). Saline volumes of 80-150 mL were used for TCBC inflation in the four UCP-CP patients. **CONCLUSION:** Use of TCBC with a saline volume  $\geq 80$  mL was a significant risk factor for UCP-CP; however, the absolute risk of UCP-CP was estimated to be very low, approximately one in 7875 TCBC users.

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