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Interventions and Management

1. *Dev Med Child Neurol.* 2011 Nov 24. doi: 10.1111/j.1469-8749.2011.04143.x. [Epub ahead of print]

Single-event multilevel surgery for children with cerebral palsy: a systematic review.

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Aim: To conduct a systematic review of single-event multilevel surgery (SEMLS) for children with cerebral palsy, with the aim of evaluating the quality of the evidence and developing recommendations for future research. **Method:** The systematic review was conducted using standard search and extraction methods in Medline, EMBASE, CINAHL, and Cochrane electronic databases. For the purposes of this review, SEMLS was defined as two or more soft-tissue or bony surgical procedures at two or more anatomical levels during one operative procedure, requiring only one hospital admission and one period of rehabilitation. Studies were included if: (1) the primary focus was to examine the effect of SEMLS in children with cerebral palsy; (2) the results focused on multiple anatomic levels and reported findings of one or more World Health Organization International Classification of Functioning, Disability and Health (ICF) domains. Studies that focused on a single intervention or level, or on the utility of a specific outcome measure were excluded. Study quality was appraised with the Methodological Index for Non-Randomized Studies (MINORS) and the Oxford Centre for Evidence-Based Medicine scale. The review also examined the reporting of surgery, adverse events, and rehabilitation. Results Thirty-one studies fulfilled the criteria for inclusion, over the period 1985 to October 2010. The MINORS score for these studies varied from 4 to 19, with marked variation in the quality of reporting. Study quality has improved over recent years. Valid measures of gait and function have been introduced and several of the most recent studies have addressed multiple dimensions of the ICF. A statistical synthesis of the outcome data was not conducted, although a trend towards favourable outcomes in gait was evident. Caution is advised with interpretation owing to the variable study quality. Uncontrolled studies may have resulted in an overestimation of treatment efficacy. **Interpretation:** The design and reporting of studies of SEMLS are improving with the development of multidisciplinary teamwork and frameworks such as the ICF. However, the evidence base is limited by the lack of randomized clinical trials, especially when compared with other surgical interventions such as selective dorsal rhizotomy.

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2. J Pediatr Orthop. 2011 Dec;31(8):858-63.

Surgical Management of Hip Subluxation and Dislocation in Children With Cerebral Palsy: Isolated VDRO or Combined Surgery?

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BACKGROUND: Controversy exists regarding surgical treatment of hip subluxation/dislocation in children with cerebral palsy (CP). The purpose of this study was to compare isolated varus derotational osteotomy (VDRO) and VDRO combined with open hip reduction and/or pelvic osteotomy in children with CP and hip subluxation/dislocation. **METHODS:** Retrospective review was performed of 75 patients with CP (116 hips) and hip subluxation/dislocation treated surgically, with a minimum of 2 years follow-up. Ninety-two hips had undergone VDRO alone, and 24 had undergone VDRO and open reduction and/or pelvic osteotomy (with the decision to proceed with open hip reduction and/or pelvic osteotomy made intraoperatively based on fluoroscopy and arthrogram). Clinical variables, functional level, radiographic variables, and complications/revisions were compared between groups. **RESULTS:** Patients requiring combined surgery (VDRO+) had higher baseline migration percentages (MP) ($84\% \pm 18$ VDRO+, $51\% \pm 21$ VDRO), higher acetabular indices (34 ± 10 VDRO+, 28 ± 7 VDRO), more negative center-edge angles (-36 ± 28 VDRO+, -0.3 ± 18 VDRO), and higher neck-shaft angles (162 ± 12 VDRO+, 157 ± 10 VDRO) (all $P < 0.02$). Postoperative radiographic variables were similar between groups. The percentage of patients with MP $> 30\%$ at final follow-up was similar between groups (38% VDRO+, 33% VDRO). There were no differences in complications or revision rates between groups. Of the hips with MP $> 50\%$ preoperatively and treated with VDRO alone, 41% developed postoperative MP of $\geq 30\%$ and 21% developed a MP of $\geq 40\%$. **CONCLUSIONS:** The study results confirm that combined procedures should be considered in patients with high MP. However, this study supports a sequential approach to surgical management of subluxated/dislocated hips in patients with CP as many hips with MP $> 50\%$ were successfully managed with VDRO alone. We recommend performing VDRO and soft tissue release first, assessing reduction using fluoroscopy and arthrogram and proceeding with open reduction and/or pelvic osteotomy if reduction and/or femoral head coverage are inadequate.

LEVEL OF EVIDENCE: Level III, retrospective comparative study.

[PMID: 22101664](#) [PubMed - in process]

3. Clin Orthop Relat Res. 2011 Nov 19. [Epub ahead of print]

Surgical Technique: Medial Column Arthrodesis in Rigid Spastic Planovalgus Feet.

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BACKGROUND: Treatment of spastic planovalgus feet is challenging, especially in patients with severe and rigid deformities. The available techniques do provide some correction but not at the site of the deformity and sometimes the correction is lost over time. We describe a new surgical approach at the site of the deformity. **TECHNIQUE:** Indications for the surgery included adolescents or young adults with severe and rigid planovalgus deformities of the feet resulting from cerebral palsy. Through a medial approach, arthrodesis of the talonavicular, navicular-medial cuneiform, and medial cuneiform first metatarsal joints was internally fixed using a single-molded plate over the plantar surface of the foot, recreating the longitudinal arch. **METHODS:** We retrospectively reviewed 21 patients (35 feet) with spastic cerebral palsy in whom the new technique was indicated for severe and rigid deformity, gait dysfunction, and pain (mean age, 190 months; range, 96-345 months). The mean age of the patients was 16 years (range, 8-29 years). We analyzed the patients clinically and radiographically. The minimum followup was 2.5 years (mean, 58 months; range, 2.5-7.5 years). **RESULTS:** At last followup, 34 of the 35 feet (97%) had radiographic

improvement of the deformity with no difficulties wearing shoes; one patient had persistent pain despite bone union. Union was achieved initially in eight patients (17 feet) and in another eight (10 feet) after revision surgery, of 27 of the 35 feet. The radiographic calcaneal inclination angle improved an average of 13°. The lateral talocalcaneal angle decreased from a mean of 43° to 26° after surgery. Four patients (five feet) had revision surgery for pseudoarthrosis, and another four patients (five feet) had revision surgery for other problems. **CONCLUSIONS:** Based on our preliminary observations, we believe stabilization of the medial column is a reasonable option for treating selected patients with severe and rigid planovalgus feet by providing a stable and pain-free foot, recreating the anatomy, and allowing the use of braces or regular shoes. Further studies with longer followup periods will be required to confirm these initial results and to verify if these findings persist over time.

LEVEL OF EVIDENCE: Level IV, case series.

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4. *Dev Med Child Neurol.* 2011 Nov 24. doi: 10.1111/j.1469-8749.2011.04091.x. [Epub ahead of print]

Informing evidence-based clinical practice guidelines for children with cerebral palsy at risk of osteoporosis: a systematic review.

Fehlings D, Switzer L, Agarwal P, Wong C, Sochetti E, Stevenson R, Sonnenberg L, Smile S, Young E, Huber J, Milo-Manson G, Kuwaik GA, Gaebler D.

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Aim: The aim of this systematic review was to inform evidence-based clinical practice guidelines for children with cerebral palsy (CP) and low bone mineral density (BMD). **Method:** A computer-assisted literature search was focused on low BMD in children with CP, and was limited to the following interventions: weight-bearing activities, bisphosphonate use, and vitamin D or calcium supplementation. Articles were classified according to American Academy of Neurology guidelines and recommendation classifications were given based on the evidence for the intervention increasing BMD and decreasing fragility fractures. Studies were included if they were English-language full-text studies, focused on children with CP, and included at least 10 participants receiving the studied interventions. **Results:** Twenty-one articles underwent full-text review and data abstraction, including seven studies of weight-bearing activities, five studies of vitamin D or calcium supplementation, and nine studies of bisphosphonates administration. Overall, the evidence that bisphosphonates administration increases BMD was assessed as level B (probable) while the evidence that vitamin D or calcium supplementation does so was assessed as level C (possible); there was insufficient evidence to suggest that weight-bearing activities are an effective intervention to improve BMD. The evidence that bisphosphonates help to prevent fragility fractures was assessed as level C (possible); there was inadequate evidence to support the use of weight-bearing activities or vitamin D or calcium supplementation to decrease fragility fractures. **Interpretation:** Evidence-based clinical practice guidelines were created outlining the suggested role of weight-bearing activities, vitamin D and calcium supplementation, and bisphosphonate use for children with CP with low BMD at risk of fragility fractures.

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5. Phys Occup Ther Pediatr. 2011 Nov 24. [Epub ahead of print]**Relationships Between Lower Limb Muscle Strength and Locomotor Capacity in Children and Adolescents with Cerebral Palsy Who Walk Independently.**

Ferland C, Lepage C, Moffet H, Maltais DB.

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This study aimed to quantify relationships between lower limb muscle strength and locomotor capacity for children and adolescents with cerebral palsy (CP) to identify key muscle groups for strength training. Fifty 6- to 16-year-olds with CP (Gross Motor Function Classification System level I or II) participated. Isometric muscle strength of hip flexor and abductor, knee flexor and extensor, and ankle dorsiflexor muscles was measured using hand-held dynamometry. Ankle plantar flexor concentric muscle strength was assessed as the maximal number of unilateral heel rises. Locomotor capacity was evaluated by the 6-min walk test (6MWT), 10-meter Shuttle Run Test (10mSRT), and Timed Up and Down Stairs Test (TUDS). With control for age, sex, and height, hip flexor and ankle plantar flexor strength explained 47.8% of the variance in the 6MWT and 32.9% of variance in the TUDS and hip abductor isometric strength explained 43.5% of the variance in the 10mSRT. Avenues for future research include randomized controlled trials that specifically target hip flexor muscles, as this has not previously been done, and determining factors other than strength that are likely related to locomotor capacity of children and adolescents with CP.

[PMID: 22114847](#) [PubMed - as supplied by publisher]

6. J Child Neurol. 2011 Nov 23. [Epub ahead of print]**Spread of Botulinum Neurotoxin Type A at Standard Doses Is Inherent to the Successful Treatment of Spastic Equinus Foot in Cerebral Palsy: Short-Term Neurophysiological and Clinical Study.**

Frasson E, Dall'ora E, Bordignon M, Brigo F, Tocco P, Primon D, Didonè G, Vicentini S, Fiaschi A, Bertolasi L.

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To evaluate whether botulinum toxin type A at standard doses spreads to antagonist leg muscles in dynamic equinus foot, we studied 18 ambulatory children with hemiplegic cerebral palsy. The gastrocnemius muscle on the affected side was injected with botulinum toxin type A (Dysport) (mean \pm standard deviation, 14.3 \pm 0.9 U/kg). Compound muscle action potential areas were assessed in the lateral gastrocnemius and tibialis anterior muscles on the treated and untreated sides before botulinum toxin type A injections and on days 10 and 30 after injections. In all patients, compound muscle action potential areas recorded from both the muscles on the treated side decreased from preinjection values at day 10 ($P < .05$) and 30 ($P < .002$). After injection, ankle spasticity had diminished ($P < .05$), equinus foot excursion increased ($P < .05$), and functional gait improved ($P < .05$). This study shows that botulinum toxin type A spreads from foot flexors to antagonist extensors and suggests that spread may be partly responsible for improving gait in children with cerebral palsy.

[PMID: 22114218](#) [PubMed - as supplied by publisher]

7. Optom Vis Sci. 2011 Dec;88(12):1520-3.**Ocular findings in cerebral palsy patients undergoing orthopedic surgery.**

Woo SJ, Ahn J, Park MS, Lee KM, Gwon DK, Hwang JM, Chung CY.

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PURPOSE: To investigate the prevalence and clinical features of ocular abnormalities in patients with cerebral palsy (CP) and the association with gross motor function. **METHODS:** A complete ophthalmologic examination was

performed in 88 consecutive patients with CP before and during orthopedic surgery in a tertiary hospital from July 2008 to March 2010. The prevalence and clinical features of ocular abnormalities and the association with gross motor function state were investigated. RESULTS: Seventy-eight patients (89%) had ocular abnormalities. Refractive errors were found in 53 patients (60%). Strabismus including exotropia (50%), esotropia (9%), and hypertropia (9.1%) was found in 52 patients (59%). Posterior segment abnormalities were found in 19 patients (22%), cornea and lens abnormalities in 8 patients (9%), and epiblepharon in 5 patients (6%). Among 57 patients whose visual acuity could be measured, best-corrected visual acuity of the better eye was $\leq 20/40$ in 18 patients (32%) and $\leq 20/200$ in 3 patients (5%). Objective vision-impairing ocular abnormalities and vertical strabismus were significantly associated with poor gross motor function before orthopedic surgery. CONCLUSIONS: Ocular abnormalities were present in the majority of CP patients and patients with poor gross motor function were more likely to be afflicted with vision-impairing ocular abnormalities. Ophthalmologic evaluation is deemed necessary in CP patients, especially in those with poor motor function.

[PMID: 22113330](#) [PubMed - in process]

8. Disabil Rehabil. 2011 Nov 22. [Epub ahead of print]

International classification of functioning, disability and health in children with cerebral palsy.

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Purpose: We intended to describe how concepts from recent models of disability have been studied for evaluation of children with cerebral palsy (CP) and their clinical implications. Method: We revised studies that focused on the components of the International Classification of Functioning, Disability and Health (ICF) in children with CP. Results: Researchers have reported that children with CP exhibit impairments in various body functions/structures, limitations in functional activities performance and experience poorer participation outcomes than their typical peers. Moreover, it has been showed that participation of children with CP was affected by environmental factors. Conclusion: Therefore, evaluation and rehabilitation processes should be focused on the quality of life improvement by emphasizing what a child can and wants to execute within the environment. Also, environmental factors should be recognized so that barriers could be minimized and adaptations to the environment achieved. However, few studies have verified the interrelationship between contextual factors and the functioning and disability domains in children with CP. This would allow us to know about approaches specifically designed for these children's needs. [Box: see text].

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9. Disabil Rehabil Assist Technol. 2011 Nov 23. [Epub ahead of print]

Evaluation of methods for teaching electronic visual scanning to children with cerebral palsy: two series of case studies.

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Purpose: To evaluate the effectiveness of two instructional techniques in teaching electronic row-column scanning to children with cerebral palsy. Method: Two case series involving four participants each. Eight children, four boys and four girls (ages 3-13 years), were assigned to one of two intervention groups and completed three baseline and five intervention sessions. One intervention (n = 4) consisted of computer-based activities alone, while the other intervention (n = 4) consisted of a sequential approach starting with paper-based activities and then shifting to computer-based activities. Results: Participants within both groups demonstrated varying degrees of skill mastery (80% accuracy or better) of linear and, for some, electronic row-column scanning within the training phases of the intervention sessions. However, there was no clinically important change in test scores between baseline and outcome measures for either group. Conclusions: Significant challenges exist when studying the effectiveness of instructional techniques for teaching electronic row-column scanning to children with cerebral palsy. These case

series provide information regarding the importance of selecting the most appropriate scanning technique to ensure reliable switch activation, carefully structuring the teaching environment to optimize learning, and being cognizant of the impact of fatigue and motivation on performance.

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10. *Int J Pediatr Otorhinolaryngol.* 2011 Nov 17. [Epub ahead of print]

Cochlear implant outcomes in children with motor developmental delay.

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INTRODUCTION: Multiple handicapped children and children with syndromes and conditions resulting additional disabilities such as cerebral palsy, global developmental delay and autistic spectrum disorder, are now not routinely precluded from receiving a cochlear implant. The primary focus of this study was to determine the effect of cochlear implants on the speech perception and intelligibility of deaf children with and without motor developmental delay. **METHOD:** In a cohort study, we compared cochlear implant outcomes in two groups of deaf children with or without motor developmental delay (MDD). Among 262 children with pre-lingual profound hearing loss, 28 (10%) had a motor delay based on Gross Motor Function Classification (GMFC). Children with severe motor delays (classification scale levels 4 and 5) and cognitive delays were excluded. All children completed the Categories of Auditory Perception Scales (CAP) and Speech Intelligibility Rating (SIR) prior to surgery and 24 months after the device was activated. **RESULT:** The mean age for the study population was 4.09 ± 1.86 years. In all 262 patients the mean CAP score after surgery (5.38 ± 0.043) had a marked difference in comparison with the mean score before surgery (0.482 ± 0.018) ($P=0.001$). The mean CAP score after surgery for MDD children was 5.03, and was 5.77 for normal motor development children (NMD). The mean SIR score after surgery for MDD children was 2.53, and was 2.66 for NMD children. The final results of CAP and SIR did not have significant difference between NMD children versus MDD children ($P>0.05$). **CONCLUSION:** Regarding to the result, we concluded that children with hearing loss and concomitant MDD as an additional disabilities can benefit from cochlear implantation similar to those of NMD.

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Prevention and Cure

11. *Dev Med Child Neurol.* 2011 Nov 18. doi: 10.1111/j.1469-8749.2011.04135.x. [Epub ahead of print]

Atypical timing and presentation of periventricular haemorrhagic infarction in preterm infants: the role of thrombophilia.

Harteman JC, Groenendaal F, VAN Haastert IC, Liem KD, Stroink H, Bierings MB, Huisman A, DE Vries LS.

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Aim: Periventricular haemorrhagic infarction (PVHI) is a complication of preterm birth associated with cardiorespiratory instability. To date, the role of thrombophilia as a possible additional risk factor in infants with atypical timing and presentation of PVHI has not been investigated. **Method:** This was a retrospective cohort study of preterm infants who developed PVHI with an atypical timing and presentation either of antenatal onset or late in

the postnatal course in the absence of a preceding sudden deterioration of their clinical condition. In infants with atypical PVHI mutation analysis of the factor V Leiden (G1691A), prothrombin (G20210A) gene, and C677T and A1298C polymorphisms in the MTHFR gene was performed, and plasma lipoprotein(a) and homocysteine levels were measured. Results: Sixty-two preterm infants who presented with a PVHI were studied. Seventeen had an atypical presentation (seven males, 10 females; median birthweight 1170g [range 580-1990g]; median gestational age 30.6wks [range 28.7-33.7wks]). The typical PVHI group comprised 28 males and 17 females (median birthweight 1200g [range 670-2210g]; median gestational age 29.6wks [range 25.3-33.6wks]). Among the 17 infants with atypical presentation, the factor V Leiden mutation was found in seven infants (41%) as well as in the mothers of six of these seven infants; in one infant this was concomitant with a prothrombin gene mutation. A polymorphism in the MTHFR gene was also present in these infants. In two infants with an atypical presentation who were tested for this, a mutation in the COL4A1 gene was found (reported previously). All but two of the infants with an atypical presentation developed spastic unilateral cerebral palsy. Interpretation: An atypical presentation of PVHI in preterm infants tends to occur more often in the presence of thrombophilia. Testing of thrombophilia, especially factor V Leiden and prothrombin gene mutation, is recommended in these infants.

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12. Dev Med Child Neurol. 2011 Nov 23. doi: 10.1111/j.1469-8749.2011.04157.x. [Epub ahead of print]

Advances and limitations in our knowledge of cortical reorganization in cerebral palsy.

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13. Eur J Paediatr Neurol. 2011 Nov 18. [Epub ahead of print]

The effects of multiple pre- and perinatal risk factors on the occurrence of cerebral palsy. A Norwegian register based study.

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AIMS: To examine the effects of multiple risk factors on cerebral palsy (CP). MATERIALS/METHODS: For 176,591 Norwegian infants born 1996-98 and surviving the early neonatal period, data on a number of potential pre- and perinatal risk factors (RFs) for CP were available in the Medical Birth Registry of Norway. For 241 children with CP detailed clinical data were available in the Norwegian CP registry. RESULTS: In children born at term, 31% had no RF, and none had five or more, while in children born preterm, 9% had no RF in addition to prematurity ($p < 0.001$ vs. term), and 5% had five or more ($p < 0.02$ vs. term). In both groups, few children shared the same combination of RFs. Interdependent sequences were more often observed among children born preterm than at term ($p < 0.001$ vs. term). The most detrimental effect was observed for the combination of maternal disease and low 5-min Apgar score, registered in 11.2% of children with CP. The combination of maternal disease and premature birth had an interaction contrast ratio of 9.25 (CI: 3.56; 14.94), which may be consistent with biological interaction. CONCLUSIONS: The majority of children with CP born at term most likely had an antenatal or single cause, suggesting individual susceptibility to an injury. The majority of children born preterm, had combinations or sequences of antenatal and perinatal risk factors as the most likely cause of CP.

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14. *J Neurol Neurophysiol*. 2011 Sep 20;2011. pii: S1- 004.

Vascular Protection Following Cerebral Ischemia and Reperfusion.

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Despite considerable research that has contributed to a better understanding of the pathophysiology of stroke, translation of this knowledge into effective therapies has largely failed. The only effective treatment for ischemic stroke is rapid recanalization of an occluded vessel by dissolving the clot with tissue plasminogen activator (tPA). However, stroke adversely affects vascular function as well that can cause secondary brain injury and limit treatment that depends on a patent vasculature. In middle cerebral arteries (MCA), ischemia/reperfusion (I/R) cause loss of myogenic tone, vascular paralysis, and endothelial dysfunction that can lead to loss of autoregulation. In contrast, brain parenchymal arterioles retain considerable tone during I/R that likely contributes to expansion of the infarct into the penumbra. Microvascular dysregulation also occurs during ischemic stroke that causes edema and hemorrhage, exacerbating the primary insult. Ischemic injury of vasculature is progressive with longer duration of I/R. Early postischemic reperfusion has beneficial effects on stroke outcome but can impair vascular function and exacerbate ischemic injury after longer durations of I/R. This review focuses on current knowledge on the effects of I/R on the structure and function of different vascular segments in the brain and highlight some of the more promising targets for vascular protection.

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