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## Interventions and Management

### 1. Intensive upper- and lower-extremity training for children with bilateral cerebral palsy: a quasi-randomized trial.

Bleyenheuft Y, Ebner-Karestinos D, Surana B, Paradis J, Sidiropoulos A, Renders A, Friel KM, Brandao M, Rameckers E, Gordon AM.

Dev Med Child Neurol. 2017 Jan 30. doi: 10.1111/dmcn.13379. [Epub ahead of print]

**AIM:** An approach that simultaneously engages both the upper and lower extremities, hand-arm bimanual intensive therapy including lower extremity (HABIT-ILE), has recently demonstrated improvements in upper and lower extremities in children with unilateral cerebral palsy (CP). It is not known whether children with bilateral CP would benefit from this approach. The aim of this study was to examine the efficacy of HABIT-ILE in children with bilateral CP. **METHOD:** A quasi-randomized trial design was used, whereby 20 participants (age 6-15y, Gross Motor Function Classification System levels II-IV, Manual Ability Classification System levels I-III) were assigned to a treatment (HABIT-ILE) or a comparison group in the order in which they were enrolled. Children in the HABIT-ILE group were assessed before and after 84 hours of intervention over 13 days, as well as at 3 months' follow-up. Children in the comparison group were assessed at the same time points. Children in both groups were assessed using the Gross Motor Function Measure (GMFM-66) and ABILHAND-Kids (primary measures), and six secondary measures. **RESULTS:** A group×test session interaction indicated significant improvements in the HABIT-ILE group as assessed by the GMFM-66, lower-extremity performance (6-Minute Walk Test; Pediatric Balance Scale), functional upper-extremity abilities (ABILHAND-Kids/Pediatric Evaluation of Disability Inventory), and the dexterity of the less affected upper extremity. **CONCLUSION:** HABIT-ILE is efficacious for improving both upper- and lower-extremity function in children with bilateral CP.

[PMID: 28133725](#)

### 2. Telerehabilitation approach for patients with hand impairment.

Staszuk A, Wiatrak B, Tadeusiewicz R, Karuga-Kuźniewska E, Rybak Z.

Acta Bioeng Biomech. 2016;18(4):55-62.

**PURPOSE:** Telerehabilitation is one of the newest branches of telemedicine which has been developed because patients need regular trainings outside the medical institution but still under specialist supervision. It helps maintain regularity of exercises and reduces costs. The professional and advanced systems for telerehabilitation are presented in papers, however, there is still lack of development of minor systems which provide therapeutic values and are more accessible to people. Therefore we focus on a solution for hand telerehabilitation of poststroke patients, based solely on a personal computer and camera. **METHODS:** We focused on the manipulative hand (fingers, metacarpus, wrist) movements trainings for patients with cerebral palsy. The contact between patient and physiotherapist is provided by using web cameras and web service. Additionally, the camera can be used to monitor the effectiveness of performed exercises. Computer vision system keeps track of the patient's hand movement. The digital image processing is used to detect if the patient performs exercises correctly. **RESULTS:** We

created web service and software application TeleReh that provides therapeutic values for the hand impaired people. The system created was evaluated by three physiotherapists, one doctor and a cerebral palsy patient. **CONCLUSIONS:** Our solution applies to all patients who have undergone basic rehabilitation in hospital and need to continue hand rehabilitation at home. The main advantages are: easy adaptation to the individual needs and abilities, monitoring the progress by using automatically generated reports after each training session. It is worth noticing that discussion between IT specialists, rehabilitants and patients was necessary to achieve good results.

[PMID: 28133379](#)

### **3. Implicit Learning of a Finger Motor Sequence by Patients with Cerebral Palsy After Neurofeedback.**

Alves-Pinto A, Turova V, Blumenstein T, Hantuschke C, Lampe R.

Appl Psychophysiol Biofeedback. 2017 Feb 7. doi: 10.1007/s10484-017-9349-1. [Epub ahead of print]

Facilitation of implicit learning of a hand motor sequence after a single session of neurofeedback training of alpha power recorded from the motor cortex has been shown in healthy individuals (Ros et al., *Biological Psychology* 95:54-58, 2014). This facilitation effect could be potentially applied to improve the outcome of rehabilitation in patients with impaired hand motor function. In the current study a group of ten patients diagnosed with cerebral palsy trained reduction of alpha power derived from brain activity recorded from right and left motor areas. Training was distributed in three periods of 8 min each. In between, participants performed a serial reaction time task with their non-dominant hand, to a total of five runs. A similar procedure was repeated a week or more later but this time training was based on simulated brain activity. Reaction times pooled across participants decreased on each successive run faster after neurofeedback training than after the simulation training. Also recorded were two 3-min baseline conditions, once with the eyes open, another with the eyes closed, at the beginning and end of the experimental session. No significant changes in alpha power with neurofeedback or with simulation training were obtained and no correlation with the reductions in reaction time could be established. Contributions for this are discussed.

[PMID: 28176012](#)

### **4. Improvement of upper trunk posture during walking in hemiplegic patients after injections of botulinum toxin into the arm.**

Hefter H, Rosenthal D.

Clin Biomech (Bristol, Avon). 2017 Jan 26;43:15-22. doi: 10.1016/j.clinbiomech.2017.01.018. [Epub ahead of print]

**BACKGROUND:** It has been hypothesized that altered trunk movements during gait in post-stroke patients or children with cerebral palsy are compensatory to lower limb impairment. Improvement of trunk movements and posture after injections of botulinum toxin into the affected arm would be at variance with this hypothesis and hint towards a multifactorial trunk control deficit. **PATIENTS AND METHODS:** Clinical gait analysis was performed in 11 consecutively recruited hemiplegic patients immediately before and 4 weeks after a botulinum toxin type A-injection into the affected arm. Kinematic data were collected using an 8 camera optical motion-capturing system and reflective skin-markers were attached according to a standard plug-in-gait model. Deviation of the trunk in lateral and forward direction and the trajectory of the C7-marker in a sacrum-fixed horizontal plane were analyzed in addition to classical gait parameters. The Wilcoxon-signed-rank test was used for pre/post-botulinum toxin comparisons. **FINDINGS:** After botulinum toxin injections a significant improvement of forearm flexion scores from 2.57 to 2.0 ( $p < 0.014$ ), and a reduced lateral deviation of the upper trunk from 3.5 degrees to 2.5 degrees ( $p < 0.014$ ) were observed. Free-walkers tended to walk faster ( $p < 0.046$ , 1-sided), with reduced pre-swing duration of both legs and an increased step length of the non-affected leg. The C7-marker trajectory was shifted towards the midline. **INTERPRETATION:** Injections of botulinum toxin into the affected arm of hemiplegic patients improve abnormal trunk lateral flexion. This shift of the center of mass of the upper body towards the midline improves various gait parameters including gait speed.

[PMID: 28187305](#)

### 5. Comparison of the psychometric properties of two balance scales in children with cerebral palsy.

Jeon YJ, Kim GM.

J Phys Ther Sci. 2016 Dec;28(12):3432-3434. doi: 10.1589/jpts.28.3432. Epub 2016 Dec 27.

[Purpose] The purpose of this study was to compare the item difficulty degree between the Pediatric Balance Scale and Fullerton Advanced Balance scale for children with cerebral palsy. [Subjects and Methods] Forty children with cerebral palsy (male=17, female=23) voluntarily participated in the study. Item difficulty was expressed in the Rasch analysis using a logit value, with a higher value indicative of increasing item difficulty. [Results] Among the 24 items of the combined Pediatric Balance Scale and Fullerton Advanced Balance scale, the most difficult item was "Walk with head turns", whereas, the easiest item was "Sitting with back unsupported and feet supported on the floor". Among the 14 items of the Pediatric Balance Scale, 9 items (item 1, 2, 3, 4, 5, 6, 7, 11, and 12) had negative logit values, whereas for the Fullerton Advanced Balance scale, only 1 item (item 1) had a negative logit value. [Conclusion] The Fullerton Advanced Balance scale is a more appropriate tool to assess balance ability than the Pediatric Balance Scale in a group of higher functioning children with cerebral palsy.

[PMID: 28174467](#)

### 6. Influence of Hippotherapy on Body Balance in the Sitting Position Among Children with Cerebral Palsy.

Matusiak-Wieczorek E, Małachowska-Sobieska M, Synder M.

Ortop Traumatol Rehabil. 2016 Mar 23;18(2):165-175. doi: 10.5604/15093492.1205024.

BACKGROUND: Cerebrally palsied children demonstrated limited independence while performing various activities of daily living, which is due to disorders of postural control. The best solution to improve postural control is the use of therapies that simultaneously focus on the sense of balance and motor skills. Such possibilities for patients with cerebral palsy are offered, for example, by hippotherapy. OBJECTIVE: To assess the influence of hippotherapy on body balance in the sitting position among children with cerebral palsy. MATERIAL AND METHODS: The study enrolled thirty-nine children aged 6-12 years with GMFCS level 1 or 2 spastic diplegia or spastic hemiplegia. The participants were divided into an intervention group (n=19) and a control group (n=20). Children from the intervention group attended 30 minutes of hippotherapy once weekly for 12 consecutive weeks. The Sitting Assessment Scale (SAS) was used to assess the patients' posture and balance. RESULTS: Some children improved their posture and balance during the study. Generally, control of trunk and head position and function of arms were getting better, while footwork was the weakest. CONCLUSION: Hippotherapy has positive effects on the position and function of individual parts of the body, thus making it possible for cerebrally palsied children to improve posture and the ability to maintain balance in the sitting position.

[PMID: 28155825](#)

### 7. Robotic-assisted gait training improves walking abilities in diplegic children with cerebral palsy.

Wallard L, Dietrich G, Kerlirzin Y, Bredin J.

Eur J Paediatr Neurol. 2017 Feb 2. pii: S1090-3798(17)30072-7. doi: 10.1016/j.ejpn.2017.01.012. [Epub ahead of print]

The robotic-assisted gait training therapy (RAGT), based on intensity and repetition of movement, presents beneficial effects on recovery and improvement of postural and locomotor functions of the patient. This study sought to highlight the effect of this RAGT on the dynamic equilibrium control during walking in children with Cerebral Palsy (CP) by analyzing the different postural strategies of the fullbody (upper/lower body) before and after this RAGT in order to generate forward motion while maintaining balance. Data were collected by a motion analysis system (Vicon® - Oxford Metrics). Thirty children with bilateral spastic CP were evaluated using a full-body marker set which allows assessing both the lower and upper limb kinematics. The children were divided into two groups in such a way as to obtain a randomized controlled population: i) a group of fourteen children (Treated Group) underwent 20 sessions of RAGT using the driven gait orthosis Lokomat®Pediatric (Hocoma) compared to ii) a group of sixteen children without sessions of Lokomat®Pediatric (Control Group) receiving only daily physiotherapy. Significant improvements are observed between the TG pre- and post-test values of i) the kinematic data of the full-body in the sagittal and frontal planes and ii) the Gross Motor Function Measure test (D and E). This study shows the usefulness of this RAGT mainly in the balance control in gait. Indeed, the Treated Group use new dynamic strategies of gait that are especially characterized by a more appropriate control of the upper body associated with an improvement of the lower limbs kinematics.

[PMID: 28188024](#)

### 8. Reliability and validity of the Japanese version of the selective control assessment of the lower extremity tool among patients with spastic cerebral palsy.

Kusumoto Y, Hanao M, Takaki K, Matsuda T, Nitta O.

J Phys Ther Sci. 2016 Dec;28(12):3316-3319. doi: 10.1589/jpts.28.3316. Epub 2016 Dec 27.

[Purpose] The aim of this study was to translate the Selective Control Assessment of the Lower Extremity (SCALE) tool from English to Japanese and to assess the reliability and validity of the Japanese version of the SCALE (SCALE-J) tool in Japanese patients with spastic cerebral palsy. [Subjects and Methods] The SCALE tool was translated into Japanese in accordance with the published guidelines. In total, 55 patients with spastic cerebral palsy were enrolled in the present study. Reliability by internal consistency (Cronbach's  $\alpha$ ), intrarater reliability, inter-rater reliability, and convergent validity by comparing Gross Motor Function Classification System (GMFCS) scores were examined. [Results] The Cronbach's  $\alpha$  value of the SCALE-J tool was 0.97-0.98, whereas that of the intrarater and inter-rater reliability ranged from 0.93 to 0.96. The Spearman correlation coefficient revealed a good relationship between the SCALE tool and the GMFCS. [Conclusion] The SCALE-J tool was found to be reliable and valid; therefore, the SCALE tool may be useful for evaluation in clinical practice.

[PMID: 28174443](#)

### 9. Undercorrection of planovalgus deformity after calcaneal lengthening in patients with cerebral palsy.

Cho BC, Lee IH, Chung CY, Sung KH, Lee KM, Kwon SS, Moon SJ, Kim J, Lim H, Park MS.

J Pediatr Orthop B. 2017 Feb 1. doi: 10.1097/BPB.0000000000000436. [Epub ahead of print]

Calcaneal lengthening (CL) is one of the treatment options for planovalgus deformity in patients with cerebral palsy (CP). However, its indication still needs to be clarified according to the functional status of CP. The aim of this study was to investigate the radiographic outcome after CL in patients with CP and to evaluate the risk factors causing undercorrection of planovalgus deformities. We included consecutive patients with CP who underwent CL for planovalgus deformity, were followed for more than 2 years, and had preoperative and postoperative weight-bearing anteroposterior (AP) and lateral foot radiographs. Six radiographic indices were used to assess the radiographic outcome. The patient age, sex, and Gross Motor Function Classification System (GMFCS) level were evaluated as possible risk factors, and we controlled for the interaction of potentially confounding variables using multivariate analysis. A total of 44 (77 feet) patients were included in this study. The mean age of the patients at the time of surgery was 10.5 $\pm$ 4.0 years and the mean follow-up was 5.1 $\pm$ 2.2 years. Patients with GMFCS III/IV achieved less correction than those with GMFCS I/II in the AP talus-first metatarsal angle ( $P=0.001$ ), lateral talocalcaneal angle ( $P=0.028$ ), and the lateral talus-first metatarsal angle ( $P<0.001$ ). The rate of undercorrection in the GMFCS III/IV group was 1.6 times higher than that in the GMFCS I/II group in the AP talus-first metatarsal angle (odds ratios: 1.6; 95% confidence interval: 1.2-2.0;  $P<0.001$ ) and 1.6 times higher in the lateral talus-first metatarsal angle (odds ratios: 1.6; 95% confidence interval: 1.3-1.9;  $P<0.001$ ). In GMFCS I/II patients with CP, we found CL to be an effective procedure for the correction of planovalgus foot deformities. However, in GMFCS III/IV patients with planovalgus deformities, CL appears to be insufficient on the basis of the high rate of undercorrection in these patients. For patients with GMFCS level III/IV, additional or alternative procedures should be considered to correct the deformity and maintain the correction achieved.

[PMID: 28151778](#)

### 10. Correlation between visual gait analysis and functional aspects in cerebral palsy.

Folle MR, Tedesco AP, Nicolini-Panisson RD.

Acta Ortop Bras. 2016 Sep-Oct;24(5):259-261. doi: 10.1590/1413-785220162405162986.

OBJECTIVE: To verify the correlation between visual gait analysis (VGA) by the Edinburgh visual gait score (EVGS) and functional aspects using the Timed Up and Go Test (TUG) and Gross Motor Function Classification System (GMFCS) in individuals with cerebral palsy (CP). METHODS: Retrospective cross sectional study of 35 patients with CP. The mean age 12.61 years old, 94.3% were spastic; 34.4% hemiplegic, 54.3% diplegic, 11.4% triplegic; 45.7% were level II GMFCS, 42.9% level I, 5.7% level III and 5.7% level IV. VGA was analyzed by the Edinburgh visual gait score (EVGS), functional mobility was assessed by TUG and functionality through GMFCS. The Spearman correlation was used for statistical analysis. RESULTS: The mean EVGS score was 18.97. The mean TUG was 13.71sec. EVGS showed moderate correlation with TUG

( $r=0.46$ ,  $p=0.03$ ) and GMFCS ( $r=0.45$ ,  $p=0.00$ ). CONCLUSION: Worse VGA scores correlate to worse functionality and mobility performance. Due to the observed correlation, it is possible to assert that VGA is a useful tool on evaluation of CP patients. Level of Evidence III, Retrospective Comparative Study.

[PMID: 28149192](#)

### 11. A new classification of hemiplegia gait patterns based on bicluster analysis of joint moments.

Pauk J, Minta-Bielecka K.

Acta Bioeng Biomech. 2016;18(4):33-40.

**PURPOSE:** Hemiplegia is a paralysis on one side of the body resulting from disease or injury to the motor centers of the brain that may lead to difficulty in walking and problems in balance. A new methodology for hemiplegia gait patterns classification based on bicluster analysis, which aims to identify a group of patients with similar gait patterns, and verify if spatial-temporal gait parameters are correlated with the Barthel Index, has been proposed. **METHODS:** Eighteen hemiplegia patients were recruited. Measurements included spatial-temporal gait parameters and joint moments. Gait data were measured using a motion tracking system and two force platforms. Bicluster analysis was used to classify the subjects' gait patterns. The relation between Barthel Index and spatial-temporal gait parameters was determined based on the Spearman correlation. **RESULTS:** A high correlation between spatial-temporal gait parameters and Barthel Index ( $r>0.5$ ,  $p<0.05$ ) was observed. Well-separated biclusters presenting similarity among the lower limb joints during the gait cycles were obtained from the data. **CONCLUSIONS:** Bicluster analysis can be useful for identifying patients with similar gait patterns. The relation between the gait patterns and the underlying impairments would allow clinicians to target rehabilitation strategies at the patient's individual needs.

[PMID: 28133375](#)

### 12. The WE-Study: does botulinum toxin A make walking easier in children with cerebral palsy?: Study protocol for a randomized controlled trial.

Brændvik SM, Roeleveld K, Andersen GL, Raftemo AE, Ramstad K, Majkic-Tajsic J, Lamvik T, Lund B, Follestad T, Vik T.

Trials. 2017 Feb 6;18(1):58. doi: 10.1186/s13063-016-1772-8.

**BACKGROUND:** Intramuscular injections of botulinum toxin A (BoNT-A) have been a cornerstone in the treatment of spasticity for the last 20 years. In Norway, the treatment is now offered to two out of three children with spastic cerebral palsy (CP). However, despite its common use, the evidence for its functional effects is limited and inconclusive. The objective of this study is to determine whether BoNT-A makes walking easier in children with CP. We hypothesize that injections with BoNT-A in the calf muscles will reduce energy cost during walking, improve walking capacity, increase habitual physical activity, reduce pain and improve self-perceived performance and satisfaction. **METHODS/DESIGN:** This randomized, double-blinded, placebo-controlled, multicenter trial is conducted in a clinical setting involving three health regions in Norway. Ninety-six children with spastic CP, referred for single-level injections with BoNT-A in the calf muscles, will be invited to participate. Those who are enrolled will be randomized to receive either injections with BoNT-A (Botox®) or 0.9% saline in the calf muscles. Stratification according to age and study center will be made. The allocation ratio will be 1:1. Main inclusion criteria are (1) age 4 - 17.5 years, (2) Gross Motor Function Classification System levels I and II, (3) no BoNT-A injections in the lower limbs during the past 6 months and (4) no orthopedic surgery to the lower limbs during the past 2 years. The outcome measures will be made at baseline and 4, 12 (primary endpoint) and 24 weeks after injections. Primary outcome is change in energy cost during walking. Secondary outcomes are change in walking capacity, change in activity, perceived change in performance and satisfaction in mobility tasks, and pain. The primary analysis will use a linear mixed model to test for difference in change in the outcome measures between the groups. The study is approved by the Regional Ethical Committee and The Norwegian Medicines Agency. Recruitment started in September 2015. **DISCUSSION:** The evaluation of effect is comprehensive and includes objective standardized tests and measures on both impairment and activity level. Results are to be expected by spring 2019.

[PMID: 28166806](#)

### 13. Safety, Tolerability, and Sensorimotor Effects of Extended-Release Dalfampridine in Adults With Cerebral Palsy: A Pilot Study.

Bethoux F, Fatemi A, Fowler E, Marciniak C, Mayadev A, Waksman J, Zackowski K, Suarez G, Blight AR, Rabinowicz AL, Carrazana E.

Clin Ther. 2017 Jan 25. pii: S0149-2918(17)30001-2. doi: 10.1016/j.clinthera.2016.12.015. [Epub ahead of print]

**PURPOSE:** The goal of this study was to evaluate the safety and tolerability of dalfampridine extended release (D-ER) in a pilot study of adults with cerebral palsy (CP) and limited ambulatory ability, and to explore drug effects on sensorimotor function. **METHODS:** An initial double-blind, single-dose crossover study was performed in 11 individuals randomized 1:1 to receive D-ER (10 mg) or placebo, followed by a 2-day washout period and the opposite treatment, with evaluation for safety and tolerability. A twice daily dosing, double-blind, placebo-controlled, crossover study was then performed. Participants were randomized in a 1:1 ratio to 1 of 2 sequences: 1 week of D-ER (10 mg BID) or placebo, followed by a 1-week washout and 1 week of the opposite treatment. Key inclusion criteria were age 18 to 70 years, body mass index 18.0 to 30.0 kg/m<sup>2</sup>, diagnosis of CP, and ability to perform all study procedures. Key exclusion criteria were severe CP, moderate or severe renal impairment, history of nonfebrile seizures, and prior dalfampridine use. Primary outcomes were safety profile and tolerability. Exploratory functional outcomes comprised changes in upper and lower extremity sensorimotor function (grip and pinch strength tests), manual dexterity (Box and Block Tests), and walking speed (Timed 25-Foot Walk). The most pronounced measured functional deficit in each individual was defined as the exploratory primary functional end point. Full crossover data were analyzed by using a mixed effects model. **FINDINGS:** Among the 24 total participants who were randomized to treatment and completed the twice daily dosing phase study, their mean age was 38.6 years (range, 20-62 years), 54% were women, and 83% had spastic CP. Adverse events were consistent with previous D-ER trials, most commonly headache (13% D-ER, 4% placebo), fatigue (13% D-ER, 0% placebo), insomnia (8% D-ER, 4% placebo), diarrhea (4% D-ER, 4% placebo), and nausea (4% D-ER, 4% placebo). The mixed model analysis of full crossover data identified no significant difference between D-ER and placebo in the primary functional analysis (the most pronounced deficit;  $P = 0.70$ ) or in the secondary analyses (hand strength [ $P = 0.48$ ], manual dexterity [ $P = 0.13$ ], or walking speed [ $P = 0.42$ ]). **IMPLICATIONS:** In this preliminary study of adults with CP, a BID dose of 10-mg D-ER was generally safe and well tolerated. The exploratory functional assessments for upper and lower sensorimotor deficits did not establish that the study population was markedly responsive to D-ER relative to placebo. These findings do not provide the proof-of-concept that would support further evaluation of D-ER as a potential intervention to improve function in adults with CP. ClinicalTrials.gov identifier: NCT01468350. (Clin Ther. 2017;39:XXX-XXX) © 2017 Elsevier HS Journals, Inc.

[PMID: 28131322](#)

### 14. Botulinum toxin and safety issues in cerebral palsy.

Yiannakopoulou E.

Dev Med Child Neurol. 2017 Mar;59(3):245. doi: 10.1111/dmcn.13326. Epub 2016 Nov 7.

[This commentary is on the original article by Montastruc et al.]

[PMID: 28145586](#)

### 15. Training effects of wheelchair dance on aerobic fitness in bedridden individuals with severe athetospastic cerebral palsy rated to GMFCS level V.

Terada K, Satonaka A, Terada Y, Suzuki N.

Eur J Phys Rehabil Med. 2017 Feb 8. doi: 10.23736/S1973-9087.17.04486-0. [Epub ahead of print]

**BACKGROUND:** There were few studies about training effects of wheelchair dance on aerobic fitness in the bedridden individuals with severe cerebral palsy for whom the traditional maximal or submaximal exercise tests were not applicable. As the oxygen pulse (O2P), the oxygen uptake divided by the heart rate, is regarded to be a relative measure of stroke volume and the O2P correlates to peak oxygen uptake, we would be able to assess the training effects of wheelchair dance on aerobic fitness in those individuals measuring O2P. **AIM:** To study training effects of wheelchair dance on aerobic fitness in bedridden individuals with severe athetospastic cerebral palsy. **DESIGN:** Pre-post study design. **SETTING:** A laboratory and a

community care center. **POPULATION:** Bedridden individuals with athetospastic cerebral palsy rated to Gross Motor Function Classification System (GMFCS) level V (N. = 6). **METHODS:** The O2P was compared between during the rest, the waltz, and the jive at the baseline, the 3rd, the 6th, and the 12th month of the intervention of wheelchair dance 6 to 15 minutes at a time, 2 days a week or more. **RESULTS:** Paired student t test showed that O2P during the waltz and the jive was significantly increased compared with that during the rest at the 6th and the 12th month, and O2P during the jive was also significantly increased compared with that during the rest at the 3rd, the 6th, and the 12th month of the intervention period. **CONCLUSION AND CLINICAL REHABILITATION IMPACT:** This is the first study that shows wheelchair dance may possibly increase aerobic fitness in bedridden individuals with severe athetospastic cerebral palsty rated GMFCS level V. Future studies with a larger sample will be warranted to prove the claim.

[PMID: 28178772](#)

## 16. Motor impairment and skeletal mineralization in children with cerebral palsy.

Akhter N, Khan AA, Ayyub A.

J Pak Med Assoc. 2017 Feb;67(2):200-203.

**OBJECTIVE:** To evaluate the bone mineral density and the effect of motor impairment on bone mineral density in children with cerebral palsy. **METHODS:** The cross-sectional study was conducted at the Armed Forces Institute of Rehabilitation Medicine, Rawalpindi, Pakistan, from January 2013 to January 2015. Children diagnosed with cerebral palsy were sampled by non-probability purposive sampling from the Cerebral Palsy clinic. On the basis of Gross Motor Function Classification level of motor impairment, the children were divided into mild Cerebral Palsy (level 1 & 2) and moderate to severe Cerebral Palsy (level 3-5) groups. Bone mineral density z-score was measured at lumbar spine with Dual Energy X-Ray Absorptiometry at L1-L4 lumbar vertebra. Data was analysed using SPSS 20. **RESULTS:** Of the total 108 children selected, 18(16.6%) had to be excluded due to poor nutrition status or deranged serum chemistry, while in 4(3.7%) children Dual Energy X-ray Absorptiometry scan was not done on technical grounds. Of the remaining 86(79.6%) children, 39(45.3%) were males and 47 (54.7%) were females. The overall mean age was  $6.08 \pm 2.89$  years and mean bone mineral density z-score was  $-2.16 \pm 0.62$ . Statistically significant difference was found in bone mineral density z-scores of moderate to severe compared to mild Cerebral Palsy group ( $p < 0.05$ ). Significant difference in bone mineral density z-scores was also found among different levels of Gross Motor Function Classification system of motor impairment ( $p < 0.05$ ). **CONCLUSIONS:** Cerebral Palsy children had low bone mineral density z-score, especially those who were non-ambulatory.

[PMID: 28138171](#)

## 17. Effect of impaired ambulation and anti-epileptic drug intake on vitamin D status of children with cerebral palsy.

Seth A, Aneja S, Singh R, Majumdar R, Sharma N, Gopinath M.

Paediatr Int Child Health. 2017 Feb 1:1-6. doi: 10.1080/20469047.2016.1266116. [Epub ahead of print]

**BACKGROUND:** Children with cerebral palsy (CP) are vulnerable to developing vitamin D deficiency. There is little information on the prevalence and severity of vitamin D deficiency in these patients. **OBJECTIVE:** To study vitamin D status in children with CP with special reference to their intake of anti-epileptic drugs (AED) and ambulatory status. **METHODS:** The relative effects of AED use and ambulatory status on the vitamin D status of 120 children with CP aged 2-10 years were examined in this observational study. The patients were classified into four groups (30 in each) on the basis of AED use and ambulatory status: ambulatory (CPA), ambulatory receiving AED (CPAD), non-ambulatory (CPNA) and non-ambulatory receiving AED (CPNAD). A control group of 30 age-matched healthy children was also included. Parameters assessed included dietary calcium intake, sun exposure, serum total and ionised calcium (tCa, iCa), inorganic phosphate (iP), alkaline phosphatase (ALP), parathormone (PTH), 25 hydroxy vitamin D [25(OH)D] levels and a wrist radiograph to detect rickets. Vitamin D status was defined on the basis of serum 25(OH)D levels as normal ( $>50$  nmol/L), mild deficiency (25-50 nmol/L), moderate deficiency (12.5-25 nmol/L), severe deficiency ( $<12.5$  nmol/L). **RESULTS:** Median (IQR) serum 25 (OH)D levels in patients with CP were 35.6 (26.75-64) nmol/L compared with 60 (37-69.25) nmol/L in controls ( $p = 0.04$ ). Sixty per cent of children with CP and 36.7% of controls were vitamin D-deficient [25(OH)D  $< 50$  nmol/L]. Children with CP had a significantly lower dietary calcium intake and sun exposure than controls ( $p < 0.0001$  each). Serum tCa and iCa levels were significantly lower ( $p = 0.01$  and  $p < 0.001$ , respectively) and PTH and ALP levels significantly higher ( $p = 0.04$  and  $p = 0.001$ , respectively) in children with CP than in controls. Patients in the CPNAD group were the worst affected, 83.3% of them being

vitamin D-deficient with median (IQR) 25(OH)D levels of 33.5 (12.5-45.25) nmol/L. Also, 53.3% of them had raised ALP and 17.2% raised PTH levels. CONCLUSION: Children with CP are highly vulnerable to vitamin D deficiency. In these patients, AED use and lack of sun exposure contribute towards poor vitamin D status, the effect being more pronounced when they co-exist.

[PMID: 28145154](#)

### **18. An algorithmic approach to the management of unrecognized hydrocephalus in pediatric candidates for intrathecal baclofen pump implantation.**

Hanak BW, Tomycz L, Oxford RG, Hooper E, Apkon SD, Browd SR.

Surg Neurol Int. 2016 Dec 20;7:105. doi: 10.4103/2152-7806.196236. eCollection 2016.

**BACKGROUND:** Complications of intrathecal baclofen (ITB) pump implantation for treatment of pediatric patients with spasticity and dystonia associated with cerebral palsy remain unacceptably high. To address the concern that some patients may have underlying arrested hydrocephalus, which is difficult to detect clinically because of a low baseline level of neurological function, and may contribute to the high rates of postoperative cerebrospinal fluid leak, wound breakdown, and infection associated with ITB pump implantation, the authors implemented a standardized protocol including mandatory cranial imaging and assessment of intracranial pressure (ICP) by lumbar puncture prior to ITB pump implantation. **METHODS:** A retrospective case series of patients considered for ITB pump implantation between September 2012 and October 2014 at Seattle Children's Hospital is presented. All patients underwent lumbar puncture under general anesthesia prior to ITB pump implantation and, if the opening pressure was greater than 21 cmH<sub>2</sub>O, ITB pump implantation was aborted and alternative management options were presented to the patient's family. **RESULTS:** Eighteen patients were treated during the study time period. Eight patients (44.4%) who had ICPs in excess of 21 cmH<sub>2</sub>O on initial LP were identified. Eleven patients (61.1%) ultimately underwent ITB pump implantation (9/10 in the "normal ICP" group and 2/8 in the "elevated ICP" group following ventriculoperitoneal shunt placement), without any postoperative complications. **CONCLUSIONS:** Given the potentially high rate of elevated ICP and arrested hydrocephalus, the authors advocate pre-implantation assessment of ICP under controlled conditions and a thoughtful consideration of the neurosurgical management options for patients with elevated ICP.

[PMID: 28168091](#)

### **19. Impairments, activity limitations, and participation restrictions of the international classification of functioning, disability, and health model in children with ambulatory cerebral palsy.**

Mutlu A, Būğüşan S, Kara ÖK.

Saudi Med J. 2017 Feb;38(2):176-185. doi: 10.15537/smj.2017.2.16079.

**OBJECTIVES:** To examine the impairments, activity limitations, and participation restrictions in children with spastic unilateral and bilateral cerebral palsy (CP). We investigated the relationship between these factors according to the international classification of functioning, disability, and health (ICF) model. **Methods:** This prospective cross sectional study included 60 children aged between 4-18 years with spastic CP (30 unilateral, 30 bilateral involvement) classified as Levels I and II on the gross motor function classification system. Children had been referred to the Pediatric Rehabilitation Unit in the Department of Physiotherapy and Rehabilitation, Hacettepe University, Ankara, Turkey between March 2014 and March 2015. The Physician Rating scale was used to assess body functions and structures. The Gillette Functional Assessment Questionnaire 22-item skill set, Pediatric Functional Independence Measure, and Pediatric Outcomes Data Collection Instrument were used to assess activity and participation levels. **Results:** There was a significant positive correlation between impairments and activity limitations ( $r=0.558$ ;  $p=0.000$ ), as well as between activity limitations and participation restrictions ( $r=0.354$ ,  $p=0.005$ ). **Conclusion:** These results show that activity limitations in children with unilateral and bilateral ambulatory CP may be related to their impairments and participation restrictions, although the sample size of our study is not large enough for generalizations. Overall, our study highlights the need for up-to-date, practical evaluation methods according to the ICF model.

[PMID: 28133691](#)

## 20. Editorial commentary on 'Toolbox of multi-item measures aligning with ICF core sets for children and youth with cerebral palsy'.

Fairhurst C.

Eur J Paediatr Neurol. 2017 Mar;21(2):250-251. doi: 10.1016/j.ejpn.2017.01.008.

[No abstract available]

[PMID: 28187822](#)

## 21. What do the relationships between functional classification systems of children with cerebral palsy tell us?

Mutlu A, Pistav-Akmese P, Yardımcı BN, Ogretmen T.

J Phys Ther Sci. 2016 Dec;28(12):3493-3498. doi: 10.1589/jpts.28.3493. Epub 2016 Dec 27.

[Purpose] To examine the distribution of and relationship between the Gross Motor Function, Manual Ability, and Communication Function Classification Systems in different limbs of children with spastic cerebral palsy. We also investigated whether the four predicting variables of gender, age, manual ability, and gross motor classifications could significantly predict effective and non-effective communicator groups in communication function. [Subjects and Methods] This retrospective cross-sectional study included 327 children with a mean age of  $10.13 \pm 4.09$  years. Classifications were performed by an experienced pediatric physiotherapist. [Results] Gross motor function levels showed a strong correlation with manual ability levels ( $r_s=0.78$ ). Manual ability level was strongly correlated with communication function levels ( $r_s=0.73$ ), particularly in quadriplegic children ( $r_s=0.78$ ). Gross motor function levels were moderately correlated with communication function levels ( $r_s=0.71$ ). Effective communicators in communication function showed more functional levels of manual ability and were determined by Gross Motor Function classifications. The variables were better at predicting ineffective communicators (91% correct) compared with effective communicators (85% correct). [Conclusion] Further studies are needed to relate these functional performance systems to the activity and participation levels as well as the quality of life, desires, and participation of the subjects.

[PMID: 28174481](#)

## 22. Orofacial functions in experimental models of cerebral palsy: A systematic review.

Lacerda DC, Ferraz-Pereira KN, Terácio A, de Santana BJ, Quevedo OG, Manhães-de-Castro R, Toscano AE.

J Oral Rehabil. 2017 Feb 4. doi: 10.1111/joor.12489. [Epub ahead of print]

**BACKGROUND:** Children who suffer from cerebral palsy (CP) often present comorbidities in the form of orofacial dysfunctions. Studies in animals have contributed to elaborate potential therapies aimed at minimizing the chronic disability of the syndrome. **OBJECTIVE:** To systematically review the scientific literature regarding the possible effects that experimental models of CP can have on orofacial functions. **METHODS:** Two independent authors conducted a systematic review in the electronic databases Medline, Scopus, CINAHL, Web of Science and Lilacs, using Mesh and Decs terms in animal models. The motor and sensory parameters of sucking, chewing and swallowing were considered as primary outcomes; reactivity odor, controlled salivation, postural control, head mobility during feeding, and the animal's ability to acquire food were secondary outcomes. **RESULTS:** Ten studies were included in the present review. Most studies used rabbits as experimental models of CP, which was induced by either hypoxia-ischemia, inflammation or intraventricular hemorrhage. Orofacial functions were altered in all experimental models of CP. However, we found more modifications in hypoxia-ischemia models overall. On the other hand, the model of inflammation was more effective to reproduce higher damage for coordinating sucking and swallowing. **CONCLUSION:** All of the CP experimental models that were assessed modified the oral functions in different animal species. However, further studies should be conducted in order to clarify the mechanisms underlying orofacial damage in order to optimize treatment strategies for children who suffer from CP. This article is protected by copyright. All rights reserved.

[PMID: 28160523](#)

### **23. Perinatal undernutrition associated to experimental model of cerebral palsy increases adverse effects on chewing in young rats.**

Lacerda DC, Ferraz-Pereira KN, Visco DB, Pontes PB, Chaves WF, Guzman-Quevedo O, Manhães-de-Castro R, Toscano AE. *Physiol Behav.* 2017 Jan 30;173:69-78. doi: 10.1016/j.physbeh.2017.01.043. [Epub ahead of print]

The aim of the present study was to investigate the effect of perinatal undernutrition on the sensorimotor pattern of chewing in rats submitted to cerebral palsy experimental model. A total of 60 male Wistar rats were randomly distributed into four groups: Nourished/Control (NC, n=15), Nourished/Cerebral Palsy (NCP, n=15); Undernourished/Control (UC, n=15) and Undernourished/Cerebral Palsy (UCP, n=15). Animals of cerebral palsy (CP) group were subjected to an experimental model based on the combination of perinatal anoxia associated with sensorimotor restriction of the hindlimb. In the rats were evaluated body weight gain, intake of breast milk, feed post-weaning consumption, parameters of the chewing, intra-oral sensitivity and muscle properties (muscle weight and distribution of types of fibers) of the masseter and digastric. Animals from undernourished CP group showed greater reduction in most data evaluated including body weight ( $P<0.05$ ), food intake post-weaning ( $P<0.05$ ), frequency of chewing cycles ( $P<0.05$ ), duration of the reactions of "taste" ( $P<0.05$ ), muscle weight and decrease of the proportion of type IIB fibers in the masseter muscle ( $P<0.05$ ). These results demonstrated in rats submitted a cerebral palsy that perinatal undernutrition intensifies the damage in morphological and functional parameters of chewing.

[PMID: 28153456](#)

### **24. Effects of assisted aquatic movement and horseback riding therapies on emotion and brain activation in patients with cerebral palsy.**

Ryu K, Ali A, Kwon M, Lee C, Kim Y, Lee G, Kim J.

*J Phys Ther Sci.* 2016 Dec;28(12):3283-3287. doi: 10.1589/jpts.28.3283. Epub 2016 Dec 27.

[Purpose] The purpose of this study was to determine the effects of assisted aquatic movement and horseback riding therapies on emotion and brain activation in patients with cerebral palsy. [Subjects and Methods] Thirty-two right-handed patients with cerebral palsy (18 male, 14 female) whose ages ranged from 8 to 48 years participated in this experiment. Their cerebral palsy levels ranged from 1 to 3. The participants were assigned to one of three groups according to the experimental conditions: an assisted aquatic movement therapy group, a horseback riding therapy group, or a control group. Electroencephalograms, the Feeling Scale and the Felt Arousal Scale were examined as dependent variables. [Results] Analysis of self-reported data demonstrated a significant positive improvement in the emotions of participants in the assisted aquatic movement therapy group in comparison with the control group. With regard to the electroencephalogram analysis, the results of this study showed increased alpha power in the assisted aquatic movement therapy group compared with the horseback riding and control groups. [Conclusion] The results of this study suggest that professionals can consider assisted aquatic movement therapy as an effective therapeutic intervention for the improvement of mental health and brain activation.

[PMID: 28174435](#)

### **25. A qualitative evaluation of an aerobic exercise program for young people with cerebral palsy in specialist schools.**

Cleary SL, Taylor NF, Dodd KJ, Shields N.

*Dev Neurorehabil.* 2017 Feb 2:1-8. doi: 10.1080/17518423.2016.1277798. [Epub ahead of print]

**PURPOSE:** To explore the perceived effects of an aerobic exercise program delivered in specialist schools for young people with cerebral palsy with high support needs. **METHODS:** In-depth interviews were completed with 8 students with cerebral palsy, 10 parents, 8 teachers and 7 physiotherapists. Interviews were audio-recorded, transcribed verbatim and independently coded by two researchers. Data were analyzed using thematic analysis. **RESULTS:** Two themes emerged: one about program impact and the second about influential design features. Exercise was perceived as important, and participants indicated that the program had resulted in positive physical (e.g., improved ease of mobility, fitness and stamina) and psychosocial (e.g., happiness, social experience, challenge) impacts. The school setting, program staff and student attitudes were key features of the program. **CONCLUSIONS:** These data converge with those from a randomized controlled trial and attribute physical and

psychosocial benefits to a specialist school-based exercise program for young people with cerebral palsy.

[PMID: 28152322](#)

## **26. Association Between Moderate and Late Preterm Birth and Neurodevelopment and Social-Emotional Development at Age 2 Years.**

Cheong JL, Doyle LW, Burnett AC, Lee KJ, Walsh JM, Potter CR, Treyvaud K, Thompson DK, Olsen JE, Anderson PJ, Spittle AJ.

JAMA Pediatr. 2017 Feb 6:e164805. doi: 10.1001/jamapediatrics.2016.4805. [Epub ahead of print]

**IMPORTANCE:** Moderate and late preterm (MLPT) births comprise most preterm infants. Therefore, long-term developmental concerns in this population potentially have a large public health influence. While there are increasing reports of developmental problems in MLPT children, detail is lacking on the precise domains that are affected. **OBJECTIVE:** To compare neurodevelopment and social-emotional development between MLPT infants and term-born control infants at age 2 years. **DESIGN, SETTING, AND PARTICIPANTS:** This investigation was a prospective longitudinal cohort study at a single tertiary hospital. Participants were MLPT infants (32-36 weeks' completed gestation) and healthy full-term controls ( $\geq 37$  weeks' gestation) recruited at birth. During a 3-year period between December 7, 2009, and November 7, 2012, MLPT infants were recruited at birth from the neonatal unit and postnatal wards of the Royal Women's Hospital, Melbourne, Australia. The term control recruitment extended to March 26, 2014. The dates of the data developmental assessments were February 23, 2012, to April 8, 2016. **EXPOSURE:** Moderate and late preterm birth. **MAIN OUTCOMES AND MEASURES:** Cerebral palsy, blindness, and deafness assessed by a pediatrician; cognitive, language, and motor development assessed using the Bayley Scales of Infant Development-Third Edition (developmental delay was defined as less than -1 SD relative to the mean in controls in any domain of the scales); and social-emotional and behavioral problems assessed by a parent questionnaire (Infant Toddler Social Emotional Assessment). Outcomes were compared between birth groups using linear and logistic regression, adjusted for social risk. **RESULTS:** In total, 198 MLPT infants (98.5% of 201 recruited) and 183 term-born controls (91.0% of 201 recruited) were assessed at 2 years' corrected age. Compared with controls, MLPT children had worse cognitive, language, and motor development at age 2 years, with adjusted composite score mean differences of -5.3 (95% CI, -8.2 to -2.4) for cognitive development, -11.4 (95% CI, -15.3 to -7.5) for language development, and -7.3 (95% CI, -10.6 to -3.9) for motor development. The odds of developmental delay were higher in the MLPT group compared with controls, with adjusted odds ratios of 1.8 (95% CI, 1.1-3.0) for cognitive delay, 3.1 (95% CI, 1.8-5.2) for language delay, and 2.4 (95% CI, 1.3-4.5) for motor delay. Overall social-emotional competence was worse in MLPT children compared with controls (t statistic mean difference, -3.6 (95% CI, -5.8 to -1.4), but other behavioral domains were similar. The odds of being at risk for social-emotional competence were 3.9 (95% CI, 1.4-10.9) for MLPT children compared with controls. **CONCLUSIONS AND RELEVANCE:** Moderate and late preterm children exhibited developmental delay compared with their term-born peers, most marked in the language domain. This knowledge of developmental needs in MLPT infants will assist in targeting surveillance and intervention.

[PMID: 28152144](#)

## **27. Parents' experiences of participation in physical activities for children with cerebral palsy - protecting and pushing towards independence.**

Lauruschkus K, Nordmark E, Hallström I.

Disabil Rehabil. 2017 Apr;39(8):771-778. doi: 10.3109/09638288.2016.1161841. Epub 2016 Mar 26.

**PURPOSE:** To explore how parents of children with cerebral palsy (CP) experience their child's participation in physical activities and to identify facilitators and barriers for being physically active and reducing sedentary behaviour. **METHODS:** Twenty-five parents of sixteen children, aged 8-11 years old with CP, with varying gross motor, cognitive and communicative functions and with different cultural backgrounds, participated in focus group or individual interviews. Content analysis was used for analysis. **RESULTS:** Five subcategories addressing children's participation in physical activity were found: "Belonging and taking space in the family", "Important persons facilitating and hindering", "Friends important but hard to get", "Good for the body but challenging" and "Availability and opting out possibilities". The subcategories built the main category "Protecting and pushing towards independence", expressing the challenges parents experienced when their child wanted to be

physically active. **CONCLUSIONS:** Parents desire competent persons to be available for support in participation in physical activities. They want support in finding friends for their child to be physically active with. Family culture and attitudes affect their child's motivation for being physically active and should be taken into account when designing interventions for increased participation in physical activities and for reduced sedentary behaviour in children with disabilities. Implications for Rehabilitation Friends and competent adults facilitate participation in physical activities and reduce sedentary behaviour. Information on accessible and tailored physical activities is an important facilitator for participation in physical activities. Service planning and design of interventions may be facilitated by taking the individual family culture into account.

[PMID: 28187693](#)

## **28. Development of user-friendly and interactive data collection system for cerebral palsy.**

Raharjo I, Burns TG, Venugopalan J, Wang MD.

IEEE EMBS Int Conf Biomed Health Inform. 2016 Feb;2016:406-409. doi: 10.1109/BHI.2016.7455920.

Cerebral palsy (CP) is a permanent motor disorder that appears in early age and it requires multiple tests to assess the physical and mental capabilities of the patients. Current medical record data collection systems, e.g., EPIC, employed for CP are very general, difficult to navigate, and prone to errors. The data cannot easily be extracted which limits data analysis on this rich source of information. To overcome these limitations, we designed and prototyped a database with a graphical user interface geared towards clinical research specifically in CP. The platform with MySQL and Java framework is reliable, secure, and can be easily integrated with other programming languages for data analysis such as MATLAB. This database with GUI design is a promising tool for data collection and can be applied in many different fields aside from CP to infer useful information out of the vast amount of data being collected.

[PMID: 28133638](#)

# Prevention and Cure

## **29. [Neuroprotection for preterm infants with antenatal magnesium sulphate].**

[Article in French]

Marret S, Ancel PY.

J Gynecol Obstet Biol Reprod (Paris). 2016 Dec;45(10):1418-1433. doi: 10.1016/j.jgyn.2016.09.028. Epub 2016 Oct 28.

**OBJECTIVE:** To evaluate in preterm born children the neuroprotective benefits and the risks, at short- and long-term outcome, of the antenatal administration of magnesium sulphate (MgSO<sub>4</sub>) in women at imminent risk of preterm delivery. **MATERIAL AND METHODS:** Computer databases Medline, the Cochrane Library and the recommendations of various international scientific societies. **RESULTS:** Given the demonstrated benefit of antenatal MgSO<sub>4</sub> intravenous administration on the reduction of cerebral palsy rates and the improvement of motor development in children born preterm, it is recommended for all women whose imminent delivery is expected or programmed before 32 weeks of gestation (WG) (grade A). The analysis of the literature finds no argument for greater benefit of antenatal MgSO<sub>4</sub> administration in sub-groups of gestational age, or depending on the type of pregnancy (single or multiple pregnancy) or with the cause of preterm birth (NP2). Its administration is recommended before 32 WG, if single or multiple pregnancy, whatever the cause of prematurity (grade B). It is recommended 4g loading dose (professional consensus). With a loading dose of 4g intravenous (IV) in 20min, the serum magnesium is lower than with intramuscular suggesting a preference for the IV route (professional consensus). It is proposed to use a maintenance dose of 1g/h until delivery with a maximum recommended duration of 12hours without exceeding a cumulative dose of 50g (professional consensus). These doses are without severe adverse maternal side effects or adverse effects in newborns at short- and medium-term outcome (NP1). **CONCLUSION:** It is recommended to administer magnesium sulfate to the women at high risk of imminent preterm birth before 32 WG, whether expected or planned (grade A), with a 4g IV loading dose followed by a maintenance dose of 1g/h for 12hours (professional consensus), the pregnancy is single or multiple, whatever the cause of prematurity (professional consensus).

[PMID: 28166926](#)

### 30. Cranial ultrasound findings in preterm infants predict the development of cerebral palsy.

Skovgaard AL, Zachariassen G.

Dan Med J. 2017 Feb;64(2). pii: A5330.

**INTRODUCTION:** Our aim was to evaluate any association between gestational age, birth weight and findings on cranial ultrasounds during hospitalisation in very preterm infants and mortality and neurological outcome in childhood. **METHOD:** This study was a retrospective cohort study based on a patient record review. The cohort consisted of very preterm born children (gestational age  $\leq 32 + 0$ ) born from 2004 to 2008. For each infant, we obtained results from all cranial ultrasounds performed during hospitalisation. In 2014, patient records were evaluated for cerebral palsy, Gross Motor Function Classification System, blindness and deafness. **RESULTS:** A total of 249 infants were included. The mortality rate was 9.2%. In all, 217 children were evaluated at 5-9 years of age. Four children were diagnosed with germinal matrix haemorrhage - intraventricular haemorrhage grade 3 (GMH-IVH3) and periventricular haemorrhagic infarction (PVHI), of whom two developed cerebral palsy. Nine children were diagnosed with periventricular leukomalacia (PVL), of whom six developed cerebral palsy. Cerebral palsy was detected in 14 children (6.4%), and one (0.5%) child was in need of a hearing assistive device. Severe brain injury (GMH-IVH3, PVHI or PVL) ( $p = 0.000$ ) and being of male gender ( $p = 0.03$ ) were associated with cerebral palsy in childhood. **CONCLUSION:** Severe brain injuries detected by neonatal cranial ultrasound in very preterm infants is associated with development of cerebral palsy in childhood.

[PMID: 28157062](#)

### 31. The association of neonatal morbidity with long-term neurological outcome in infants who were growth restricted and preterm at birth: secondary analyses from TRUFFLE (Trial of Randomized Umbilical and Fetal Flow in Europe).

Van Wassenaer-Leemhuis AG, Marlow N, Lees C, Wolf H; TRUFFLE investigators.

BJOG. 2017 Feb 3. doi: 10.1111/1471-0528.14511. [Epub ahead of print]

**OBJECTIVE:** To study the relationship between neonatal morbidity (NNM) and two-year neurodevelopmental impairment (NDI) in surviving children after early fetal growth restriction (FGR). **DESIGN:** Secondary analysis of a European randomised trial (TRUFFLE) of delivery for very preterm fetuses dependent on venous Doppler or cardiotocographic criteria. **SETTING:** Tertiary perinatal centres, participants in TRUFFLE. **POPULATION:** 402 surviving children after early FGR. **METHODS:** Prospective data were collection from the recognition of FGR until the corrected age of two years. We studied the association between NNM and NDI, retaining trial allocation in all statistical models. NNM included any of bronchopulmonary dysplasia, brain injury, sepsis or necrotising enterocolitis. NDI was a composite of Bayley cognitive score  $< 85$ , cerebral palsy or severe sensory impairment. **MAIN OUTCOME MEASURE:** NDI in relation to NNM. **RESULTS:** NNM occurred in 104 cases (26%) and was more frequent in 17 of 39 infants with NDI (44%) than in the 87 of 363 infants with normal outcome (24%) [odds ratio 2.5 (95% CI, 1.3-4.8);  $P = 0.01$ ]. In 22 of 39 NDI cases (56%) there was no preceding NNM. NNM was inversely related to gestational age, but NDI did not vary by gestational age. In multivariable analyses, cerebral ultrasound abnormalities were most strongly associated with NDI, together with trial group allocation, birthweight ratio, infant sex and Apgar score. **CONCLUSIONS:** With the exception of cerebral ultrasound abnormalities, commonly used NNMs are poor markers of later NDI and should not be used as surrogate outcomes for NDI.

[PMID: 28158932](#)

### 32. Sensory tractography and robot-quantified proprioception in hemiparetic children with perinatal stroke.

Kuczynski AM, Carlson HL, Lebel C, Hodge JA, Dukelow SP, Semrau JA, Kirton A.

Hum Brain Mapp. 2017 Feb 8. doi: 10.1002/hbm.23530. [Epub ahead of print]

Perinatal stroke causes most hemiparetic cerebral palsy, resulting in lifelong disability. We have demonstrated the ability of robots to quantify sensory dysfunction in hemiparetic children but the relationship between such deficits and sensory tract structural connectivity has not been explored. It was aimed to characterize the relationship between the dorsal column medial lemniscus (DCML) pathway connectivity and proprioceptive dysfunction in children with perinatal stroke. Twenty-nine participants (6-19 years old) with MRI-classified, unilateral perinatal ischemic stroke (14 arterial, 15 venous), and upper extremity deficits were recruited from a population-based cohort and compared with 21 healthy controls. Diffusion tensor

imaging (DTI) defined DCML tracts and five diffusion properties were quantified: fractional anisotropy (FA), mean, radial, and axial diffusivities (MD, RD, AD), and fiber count. A robotic exoskeleton (KINARM) tested upper limb proprioception in an augmented reality environment. Correlations between robotic measures and sensory tract diffusion parameters were evaluated. Lesioned hemisphere sensory tracts demonstrated lower FA and higher MD, RD, and AD compared with the non-dominant hemisphere of controls. Dominant (contralesional) hemisphere tracts were not different from controls. Both arterial and venous stroke groups demonstrated impairments in proprioception that correlated with lesioned hemisphere DCML tract diffusion properties. Sensory tract connectivity is altered in the lesioned hemisphere of hemiparetic children with perinatal stroke. A correlation between lesioned DCML tract diffusion properties and robotic proprioceptive measures suggests clinical relevance and a possible target for therapeutic intervention. *Hum Brain Mapp*, 2017. © 2017 Wiley Periodicals, Inc.

[PMID: 28176425](#)

### **33. Continuous cardiotocography (CTG) as a form of electronic fetal monitoring (EFM) for fetal assessment during labour.**

Alfirevic Z, Devane D, Gyte GM, Cuthbert A.

Cochrane Database Syst Rev. 2017 Feb 3;2:CD006066. doi: 10.1002/14651858.CD006066.pub3. [Epub ahead of print]

**BACKGROUND:** Cardiotocography (CTG) records changes in the fetal heart rate and their temporal relationship to uterine contractions. The aim is to identify babies who may be short of oxygen (hypoxic) to guide additional assessments of fetal wellbeing, or determine if the baby needs to be delivered by caesarean section or instrumental vaginal birth. This is an update of a review previously published in 2013, 2006 and 2001. **OBJECTIVES:** To evaluate the effectiveness and safety of continuous cardiotocography when used as a method to monitor fetal wellbeing during labour. **SEARCH METHODS:** We searched the Cochrane Pregnancy and Childbirth Group Trials Register (30 November 2016) and reference lists of retrieved studies. **SELECTION CRITERIA:** Randomised and quasi-randomised controlled trials involving a comparison of continuous cardiotocography (with and without fetal blood sampling) with no fetal monitoring, intermittent auscultation intermittent cardiotocography. **DATA COLLECTION AND ANALYSIS:** Two review authors independently assessed study eligibility, quality and extracted data from included studies. Data were checked for accuracy. **MAIN RESULTS:** We included 13 trials involving over 37,000 women. No new studies were included in this update. One trial (4044 women) compared continuous CTG with intermittent CTG, all other trials compared continuous CTG with intermittent auscultation. No data were found comparing no fetal monitoring with continuous CTG. Overall, methodological quality was mixed. All included studies were at high risk of performance bias, unclear or high risk of detection bias, and unclear risk of reporting bias. Only two trials were assessed at high methodological quality. Compared with intermittent auscultation, continuous cardiotocography showed no significant improvement in overall perinatal death rate (risk ratio (RR) 0.86, 95% confidence interval (CI) 0.59 to 1.23, N = 33,513, 11 trials, low quality evidence), but was associated with halving neonatal seizure rates (RR 0.50, 95% CI 0.31 to 0.80, N = 32,386, 9 trials, moderate quality evidence). There was no difference in cerebral palsy rates (RR 1.75, 95% CI 0.84 to 3.63, N = 13,252, 2 trials, low quality evidence). There was an increase in caesarean sections associated with continuous CTG (RR 1.63, 95% CI 1.29 to 2.07, N = 18,861, 11 trials, low quality evidence). Women were also more likely to have instrumental vaginal births (RR 1.15, 95% CI 1.01 to 1.33, N = 18,615, 10 trials, low quality evidence). There was no difference in the incidence of cord blood acidosis (RR 0.92, 95% CI 0.27 to 3.11, N = 2494, 2 trials, very low quality evidence) or use of any pharmacological analgesia (RR 0.98, 95% CI 0.88 to 1.09, N = 1677, 3 trials, low quality evidence). Compared with intermittent CTG, continuous CTG made no difference to caesarean section rates (RR 1.29, 95% CI 0.84 to 1.97, N = 4044, 1 trial) or instrumental births (RR 1.16, 95% CI 0.92 to 1.46, N = 4044, 1 trial). Less cord blood acidosis was observed in women who had intermittent CTG, however, this result could have been due to chance (RR 1.43, 95% CI 0.95 to 2.14, N = 4044, 1 trial). Data for low risk, high risk, preterm pregnancy and high-quality trials subgroups were consistent with overall results. Access to fetal blood sampling did not appear to influence differences in neonatal seizures or other outcomes. Evidence was assessed using GRADE. Most outcomes were graded as low quality evidence (rates of perinatal death, cerebral palsy, caesarean section, instrumental vaginal births, and any pharmacological analgesia), and downgraded for limitations in design, inconsistency and imprecision of results. The remaining outcomes were downgraded to moderate quality (neonatal seizures) and very low quality (cord blood acidosis) due to similar concerns over limitations in design, inconsistency and imprecision. **AUTHORS' CONCLUSIONS:** CTG during labour is associated with reduced rates of neonatal seizures, but no clear differences in cerebral palsy, infant mortality or other standard measures of neonatal wellbeing. However, continuous CTG was associated with an increase in caesarean sections and instrumental vaginal births. The challenge is how best to convey these results to women to enable them to make an informed decision without compromising the normality of labour. The question remains as to whether future randomised trials should measure efficacy (the intrinsic value of continuous CTG in trying to prevent adverse neonatal outcomes under optimal clinical conditions) or effectiveness (the effect of this technique in routine clinical practice). Along with the need for further investigations into long-term effects of operative births for women and babies, much remains to be learned about the causation and possible links between antenatal or intrapartum events, neonatal seizures

and long-term neurodevelopmental outcomes, whilst considering changes in clinical practice over the intervening years (one-to-one-support during labour, caesarean section rates). The large number of babies randomised to the trials in this review have now reached adulthood and could potentially provide a unique opportunity to clarify if a reduction in neonatal seizures is something inconsequential that should not greatly influence women's and clinicians' choices, or if seizure reduction leads to long-term benefits for babies. Defining meaningful neurological and behavioural outcomes that could be measured in large cohorts of young adults poses huge challenges. However, it is important to collect data from these women and babies while medical records still exist, where possible describe women's mobility and positions during labour and birth, and clarify if these might impact on outcomes. Research should also address the possible contribution of the supine position to adverse outcomes for babies, and assess whether the use of mobility and positions can further reduce the low incidence of neonatal seizures and improve psychological outcomes for women.

[PMID: 28157275](#)

### **34. Prognostic Accuracy of Electroencephalograms in Preterm Infants: A Systematic Review.**

Fogtmann EP, Plomgaard AM, Greisen G, Gluud C.

*Pediatrics*. 2017 Feb;139(2). pii: e20161951. doi: 10.1542/peds.2016-1951.

**CONTEXT:** Brain injury is common in preterm infants, and predictors of neurodevelopmental outcome are relevant. **OBJECTIVE:** To assess the prognostic test accuracy of the background activity of the EEG recorded as amplitude-integrated EEG (aEEG) or conventional EEG early in life in preterm infants for predicting neurodevelopmental outcome. **DATA SOURCES:** The Cochrane Library, PubMed, Embase, and the Cumulative Index to Nursing and Allied Health Literature. **STUDY SELECTION:** We included observational studies that had obtained an aEEG or EEG within 7 days of life in preterm infants and reported neurodevelopmental outcomes 1 to 10 years later. **DATA EXTRACTION:** Two reviewers independently performed data extraction with regard to participants, prognostic testing, and outcomes. **RESULTS:** Thirteen observational studies with a total of 1181 infants were included. A meta-analysis was performed based on 3 studies (267 infants). Any aEEG background abnormality was a predictor of abnormal outcome. For prediction of a developmental quotient <70 points, cerebral palsy, or death, the pooled sensitivity was 0.83 (95% confidence interval, 0.69-0.92) and specificity 0.83 (95% confidence interval, 0.77-0.87). **LIMITATIONS:** All studies were at high risk of bias. Heterogeneity was evident among the studies with regard to the investigated aEEG and EEG variables, neurodevelopmental outcomes, and cutoff values. **CONCLUSIONS:** aEEG or EEG recorded within the first 7 days of life in preterm infants may have potential as a predictor for later neurodevelopmental outcome. We need high-quality studies to confirm these findings. Meanwhile, the prognostic value of aEEG and EEG should be used only as a scientific tool.

[PMID: 28143915](#)

### **35. Systemic activation of Toll-like receptor 2 suppresses mitochondrial respiration and exacerbates hypoxic-ischemic injury in the developing brain.**

Mottahedin A, Svedin P, Nair S, Mohn CJ, Wang X, Hagberg H, Ek J, Mallard C.

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Infection and inflammation are known risk factors for neonatal brain injury. Mycoplasma and Gram-positive bacteria, for which Toll-like receptor 2 (TLR2) plays a key role in recognition and inflammatory response, are among the most common pathogens in the perinatal period. Here, we report that systemic activation of TLR2 by Pam3CSK4 (P3C) increases neural tissue loss and demyelination induced by subsequent hypoxia-ischemia (HI) in neonatal mice. High-resolution respirometry of brain isolated mitochondria revealed that P3C suppresses ADP-induced oxidative phosphorylation, the main pathway of cellular energy production. The results suggest that infection and inflammation might contribute to HI-induced energy failure.

[PMID: 28139935](#)

**36. Role of Antioxidants in Neonatal Hypoxic-Ischemic Brain Injury: New Therapeutic Approaches.**

Arteaga O, Álvarez A, Revuelta M, Santaolalla F, Urtasun A, Hilario E.

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Hypoxic-ischemic brain damage is an alarming health and economic problem in spite of the advances in neonatal care. It can cause mortality or detrimental neurological disorders such as cerebral palsy, motor impairment and cognitive deficits in neonates. When hypoxia-ischemia occurs, a multi-faceted cascade of events starts out, which can eventually cause cell death. Lower levels of oxygen due to reduced blood supply increase the production of reactive oxygen species, which leads to oxidative stress, a higher concentration of free cytosolic calcium and impaired mitochondrial function, triggering the activation of apoptotic pathways, DNA fragmentation and cell death. The high incidence of this type of lesion in newborns can be partly attributed to the fact that the developing brain is particularly vulnerable to oxidative stress. Since antioxidants can safely interact with free radicals and terminate that chain reaction before vital molecules are damaged, exogenous antioxidant therapy may have the potential to diminish cellular damage caused by hypoxia-ischemia. In this review, we focus on the neuroprotective effects of antioxidant treatments against perinatal hypoxic-ischemic brain injury, in the light of the most recent advances.

[PMID: 28134843](#)

**37. Risk of cerebral palsy in Chinese children: A N:M matched case control study.**

Gao J, Zhao B, He L, Sun M, Yu X, Wang L.

J Paediatr Child Health. 2017 Jan 30. doi: 10.1111/jpc.13479. [Epub ahead of print]

AIM: To estimate epidemiological risk factors for cerebral palsy (CP) in children. METHODS: A N:M matched case control study was conducted in 114 persons with CP and 1286 controls. Relevant data were collected using a maternal self-design questionnaire. Univariate logistic regression and multivariate conditional logistic regression analyses were performed using SPSS. RESULTS: Univariate analysis has yielded 20 significant risk factors for CP. Advanced maternal age (30 years or older) at childbirth (adjusted odds ratio (OR) 1.63, 95% confidence interval (CI) 0.98-2.72), alcohol consumption during pregnancy (adjusted OR 4.17, 95% CI 1.23-14.08), living in the countryside (adjusted OR 1.71, 95% CI 1.18-2.48), father's occupational exposure to harmful substances (adjusted OR 3.34, 95% CI 1.61-6.93) and multiple births (adjusted OR 3.10, 95% CI 1.65-5.84) were found to be risk factors for CP by multivariate analysis. On the other side, high mother's education level (adjusted OR 0.60, 95% CI 0.46-0.76), folic acid supplements (adjusted OR 0.50, 95% CI 0.30-0.82), and high birth hospital level (adjusted OR 0.68, 95% CI 0.52-0.90) were found to be protective factors. CONCLUSION: Although the important risk factors of CP focus on gestation at birth and perinatal events, the incidence could probably be further lowered, if potential risk factors identified in this study are considered.

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