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## Interventions and Management

### 1. Interventions to improve upper limb function for children with bilateral cerebral palsy: a systematic review.

Plasschaert VFP, Vriezেকolk JE, Aarts PBM, Geurts ACH, Van den Ende CHM.

Dev Med Child Neurol. 2019 Jan 10. doi: 10.1111/dmcn.14141. [Epub ahead of print]

**AIM:** To systematically review the efficacy of interventions on upper limb function in children 0 to 19 years of age with bilateral cerebral palsy on the basis of outcome measures of upper limb function and measures of activities and/or participation according to the International Classification of Functioning, Disability and Health. **METHOD:** Cochrane, PubMed, Embase, CINAHL, and Web of Science were searched from inception to September 2017. Methodological quality and strength of evidence were analysed by two independent raters using Sackett's level of evidence and the American Academy for Cerebral Palsy and Developmental Medicine (AAPDM) guidelines. **RESULTS:** Fifteen studies with a large variety of interventions and heterogeneity in outcome measures met the inclusion criteria. Twelve studies provided level IV evidence according to AAPDM guidelines. For three small randomized controlled trials the level of evidence was II. Only one of these trials showed strong methodological quality: a study on hand-arm bimanual intensive therapy including lower extremities. **INTERPRETATION:** We identified a large variety of interventions, heterogeneity in outcome measures, and generally weak to moderate methodological quality for most studies. We recommend further research specifically aimed at bimanual-intensive, goal-directed, and task-specific training programmes for the upper limb in children with bilateral cerebral palsy, using either high-quality (multicentre) trials or well-designed single-case trials.

PMID: [30632139](#)

### 2. Stability of the Manual Ability Classification System in young children with cerebral palsy.

Burgess A, Boyd R, Ziviani J, Chatfield MD, Ware RS, Sakzewski L.

Dev Med Child Neurol. 2019 Jan 10. doi: 10.1111/dmcn.14143. [Epub ahead of print]

**AIM:** To examine the stability over time of the Manual Ability Classification System (MACS) levels in children with cerebral palsy (CP) aged 18 to 60 months. **METHOD:** This was a prospective longitudinal population-based study of 252 Australian children (160 males [63%] 92 females [37%]; mean age [SD] 41.7mo [14], range 17.2mo-69.2mo) with CP. Children were classified at 18 months (n=70), 24 months (n=131), 30 months (n=173), 36 months (n=209), 48 months (n=226), and 60 months (n=221) of age. Stability of the MACS was examined using the proportion of specific positive agreement and transition proportions, which are measures of agreement. **RESULTS:** There were 1030 unique observations, with each of the 252 participants seen between two and six occasions (median=4). Average specific positive agreement over the study period was 76% for MACS level I, 67% for level II, 50% for level III, 51% for level IV, and 83% for level V. MACS levels I and V have the highest degree of stability, while levels III and IV have the lowest. We show how this may be explained by the proportion of children in each MACS level. **INTERPRETATION:** Using measures of agreement rather than measures of

reliability provides accurate information when measuring stability over time of an ordinal classification system. The relative stability of MACS levels can be explained by the proportion of children in each level.

PMID: [30632141](#)

### **3. Reliability of maximum isometric arm, grip and pinch strength measurements in children (7-12 years) with unilateral spastic cerebral palsy.**

Dekkers K, Janssen-Potten Y, Gordon AM, Speth L, Smeets R, Rameckers E.

Disabil Rehabil. 2019 Jan 9;1-6. doi: 10.1080/09638288.2018.1524522. [Epub ahead of print]

**PURPOSE:** To investigate test-retest and inter-rater reliability of maximum isometric arm muscle strength measurements using the hand-held dynamometer (HDD) and maximum isometric grip and pinch strength measurements using the Biometrics E-Link Evaluation System in children aged 7-12 years with unilateral spastic cerebral palsy. **MATERIALS AND METHODS:** All data were obtained using a test-retest study design. The study met the conditions of the COSMIN criteria to achieve good methodological quality. **RESULTS:** For arm strength measurements, all test-retest reliability intraclass correlation coefficient (ICC) values and all but one inter-rater reliability ICC value indicated excellent reliability. For grip- and pinch strength measurements, all test-retest reliability and inter-rater reliability ICC values showed excellent reliability. The standard error of measurement values ranged from 4.97 to 11.36 N (HDD) and 0.37 to 1.81 kg (E-link). Smallest detectable change values ranged from 13.79 to 31.49 N (HDD) and 1.03 to 5.02 kg (E-link). **CONCLUSIONS:** The HDD and E-link system are usable measurement instruments for cross-sectional muscle strength measurements in children with unilateral spastic cerebral palsy. It is not clear if both instruments are usable to measure changes in muscle strength within an individual, especially if a child with unilateral spastic cerebral palsy has low muscle strength. Caution in the interpretation of changes in muscle strength is therefore necessary. **Implications for Rehabilitation** The hand-held dynamometer and E-Link Evaluation System are reliable measurement instruments to measure muscle strength of the arm and hand in children with unilateral spastic cerebral palsy, aged 7-12 years. Cross-sectional measurements; it is possible to measure upper extremity muscle strength in children with unilateral spastic cerebral palsy with the hand-held dynamometer and E-link system. Longitudinal measurements; changes in upper extremity muscle strength within one person should be interpreted with care, especially if a child with unilateral spastic cerebral palsy has low muscle strength.

PMID: [30623690](#)

### **4. Transcranial Direct Current Stimulation (tDCS) Paired with Occupation-Centered Bimanual Training in Children with Unilateral Cerebral Palsy: A Preliminary Study.**

Rich TL, Nemanich S, Chen M, Friel K, Feyma T, Krach L, Nawshin T, Meekins G, Gillick BT.

Neural Plast. 2018 Nov 5;2018:9610812. doi: 10.1155/2018/9610812. eCollection 2018.

**OBJECTIVE:** We investigated the preliminary efficacy of cathodal transcranial direct current stimulation (tDCS) combined with bimanual training in children and young adults with unilateral cerebral palsy based on the principle of exaggerated interhemispheric inhibition (IHI). **METHODS:** Eight participants with corticospinal tract (CST) connectivity from the lesioned hemisphere participated in an open-label study of 10 sessions of cathodal tDCS to the nonlesioned hemisphere (20 minutes) concurrently with bimanual, goal-directed training (120 minutes). We measured the frequency of adverse events and intervention efficacy with performance (bimanual-Assisting Hand Assessment (AHA)-and unimanual-Box and Blocks), self-report (Canadian Occupational Performance Measure (COPM), ABILHAND), and neurophysiologic (motor-evoked potential amplitude, cortical silent period (CSP) duration, and motor mapping) assessments. **RESULTS:** All participants completed the study with no serious adverse events. Three of 8 participants showed gains on the AHA, and 4 of 8 participants showed gains in Box and Blocks (more affected hand). Nonlesioned CSP duration decreased in 6 of 6 participants with analyzable data. Cortical representation of the first dorsal interosseous expanded in the nonlesioned hemisphere in 4 of 6 participants and decreased in the lesioned hemisphere in 3 of 4 participants with analyzable data. **CONCLUSIONS:** While goal achievement was observed, objective measures of hand function showed inconsistent gains. Neurophysiologic data suggests nonlinear responses to cathodal stimulation of the nonlesioned hemisphere. Future studies examining the contributions of activity-dependent competition and cortical excitability imbalances are indicated.

PMID: [30627151](#)

### 5. Effect of Treadmill Training With Eyes Open and Closed on Knee Proprioception, Functional Balance and Mobility in Children With Spastic Diplegia.

El Shemy SA.

Ann Rehabil Med. 2018 Dec;42(6):854-862. doi: 10.5535/arm.2018.42.6.854. Epub 2018 Dec 28.

**OBJECTIVE:** To investigate the effect of treadmill training with eyes open (TEO) and closed (TEC) on the knee joint position sense (JPS), functional balance and mobility in children with spastic diplegia. **METHODS:** Forty-five children with spastic diplegia aged 11-13 years participated in this study. They were randomly assigned to three groups of equal number. The control group (CON) underwent designed physical therapy program whereas, the study groups (TEO and TEC) underwent the same program, in addition to treadmill gait training with eyes open and closed, respectively. Outcome measures were the degree of knee joint position error, functional balance and mobility. Measurements were taken before and after 12 weeks of intervention. **RESULTS:** After training, the three groups showed statistically significant improvement in all measured outcomes, compared to the baseline with non-significant change in the knee JPS in the CON group. When comparing posttreatment results, the TEC group showed greater significant improvement in all measured outcomes, than the TEO and CON groups. **CONCLUSION:** Treadmill training with eyes open and closed is effective in rehabilitation of children with diplegia, but blocked vision treadmill training has more beneficial effect.

PMID: [30613079](#)

### 6. The added value of orthotic management in the context of multi-level surgery in children with cerebral palsy.

Schwarze M, Block J, Kunz T, Alimusaj M, Heitzmann DWW, Putz C, Dreher T, Wolf SI.

Gait Posture. 2019 Jan 6;68:525-530. doi: 10.1016/j.gaitpost.2019.01.006. [Epub ahead of print]

**BACKGROUND:** Treatment of cerebral palsy includes an interdisciplinary concept and in more severe cases the well-established multi-level surgery (MLS). Different kinds of orthoses are typically part of postoperative treatment but there is a lack of knowledge about their additional benefit. **RESEARCH QUESTION:** Do ankle foot orthoses lead to an additional, measurable improvement of gait after MLS? **METHODS:** 20 children with bilateral spastic cerebral palsy (9 retrospective, 11 in a postoperative clinical routine) were included. All had a preoperative gait analysis before MLS. Postoperatively, they were fitted with different ankle foot orthoses (AFO), depending on their individual needs. Dynamic ankle foot orthoses (DAFO), combined DAFO with additional dynamic, elastic shank adaptation (DESA) and ground reaction force AFOs (GRAFO) were used. Patients underwent a second gait analysis 1.5 ( $\pm$  0.6) years postoperatively barefoot and with orthoses. Data analysis included testing for normal distribution (Shapiro-Wilk-Test) and further nonparametric statistical testing on basis of a Wilcoxon Single-Rank Test. **RESULTS:** The operation produced changes in the hip, knee and ankle joint, and the pelvis. Spatiotemporal parameters showed significant changes due to additional use of the orthoses. Further, additional kinematic changes occurred at the hip, knee and ankle joint as well as the foot. The Gillette Gait Index (GGI) improved significantly by supplementary orthoses, but not by surgery alone. The Gait Profile Score (GPS) and Gait Deviation Index (GDI) rather showed changes due to the surgery. **SIGNIFICANCE:** MLS significantly improves GPS and GDI more than a year after surgery, which can be interpreted as an improvement in gait pattern. In contrast, the GGI is improved by additional postoperative orthotic treatment, which implies that walking ability itself has improved, rather than the gait pattern. Orthoses show a positive additional effect on surgical results at different anatomical levels. Spatiotemporal parameters are positively influenced solely by additional orthotic support.

PMID: [30623847](#)

### 7. Double calcaneal osteotomy in treatment of flexible planovalgus foot deformity in ambulatory cerebral palsy. A case series study.

Aly AS, Abdel Rahman AF, Mahmoud S.

Foot Ankle Surg. 2018 Aug 24. pii: S1268-7731(18)30292-3. doi: 10.1016/j.fas.2018.07.003. [Epub ahead of print]

**BACKGROUND:** The aim of this prospective non randomized case series study was to assess the intermediate-term outcomes of double calcaneal osteotomy (lateral column lengthening and medial slide calcaneal osteotomy) use in ambulatory cerebral palsy with flexible planovalgus feet. **METHODS:** 16 cases with planovalgus feet were surgically treated by double calcaneal osteotomy and observed over an average of 33.5 months. The mean age at the time of surgery was 10.74 years. The functional outcomes were assessed clinically and radiologically. **RESULTS:** There were a statistical improvement of clinical heel valgus

and all radiological parameters as regard talar head uncoverage, calcaneal pitch, talo-calcaneal angle, and talus 1st metatarsal angle at the end of follow up period. **CONCLUSION:** Double calcaneal osteotomy is a good option in the treatment of flexible planovalgus feet in ambulatory cerebral palsy patients.

PMID: [30612816](#)

### **8. Combining muscle morphology and neuromotor symptoms to explain abnormal gait at the ankle joint level in cerebral palsy.**

Schless SH, Cenni F, Bar-On L, Hanssen B, Goudriaan M, Papageorgiou E, Aertbeliën E, Molenaers G, Desloovere K.

Gait Posture. 2018 Dec 4;68:531-537. doi: 10.1016/j.gaitpost.2018.12.002. [Epub ahead of print]

**BACKGROUND:** Individuals with spastic cerebral palsy (CP) have neuromotor symptoms contributing towards their gait patterns. However, the role of altered muscle morphology alongside these symptoms is yet to be fully investigated. **RESEARCH QUESTION:** To what extent can medial gastrocnemius and tibialis anterior volume and echo-intensity, plantar/dorsiflexion strength and selective motor control, plantarflexion spasticity and passive ankle dorsiflexion explain abnormal ankle gait. **METHOD:** In thirty children and adolescents with spastic CP ( $8.6 \pm 3.4$  y/mo) and ten typically developing peers ( $9.9 \pm 2.4$  y/mo), normalised muscle volume and echo-intensity were estimated. Both cohorts also underwent three-dimensional gait analysis, whilst for participants with spastic CP, plantar/dorsi-flexion strength and selective motor control, plantarflexion spasticity and maximum ankle dorsiflexion were also measured. The combined contribution of these parameters towards five clinically meaningful features of gait were evaluated, using backwards multiple regression analyses. **RESULTS:** With respect to the typically developing cohort, the participants with spastic CP had deficits in normalised medial gastrocnemius and tibialis anterior volume of 40% and 33%, and increased echo-intensity values of 19% and 16%, respectively. The backwards multiple regression analyses revealed that the combination of reduced ankle dorsiflexion, muscle volume, plantarflexion strength and dorsiflexion selective motor control could account for 12-62% of the variance in the chosen features of gait. **SIGNIFICANCE:** The combination of altered muscle morphology and neuromotor symptoms partly explained abnormal gait at the ankle in children with spastic CP. Both should be considered as important measures for informed treatment decision-making, but further work is required to better unravel the complex pathophysiology.

PMID: [30623848](#)

### **9. Presence and severity of dystonia and choreoathetosis overflow movements in participants with dyskinetic cerebral palsy and their relation with functional classification scales.**

Vanmechelen I, Bekteshi S, Bossier K, Feys H, Deklerck J, Monbaliu E.

Disabil Rehabil. 2019 Jan 8;1-8. doi: 10.1080/09638288.2018.1528637. [Epub ahead of print]

**BACKGROUND:** This cross-sectional study aims to investigate the presence and severity of overflow movements of dystonia and choreoathetosis in dyskinetic cerebral palsy (CP) and to assess the relationship of overflow movements with functional classification scales. **METHODS:** Fifty-two subjects with dyskinetic CP were included. Presence and severity of dystonia and choreoathetosis overflow movements were assessed with the Dyskinesia Impairment Scale. Functional abilities were classified with the Gross Motor Function Classification System, Manual Ability Classification System, Viking Speech Scale, Communication Function Classification System, and Eating and Drinking Ability Classification System. **RESULTS:** Dystonia and choreoathetosis overflow movements were simultaneously present. Median scores of dystonia overflow movements were significantly higher than choreoathetosis overflow movements. Dystonia and choreoathetosis overflow movements were significantly higher in extremities than in the central body. Correlations between dystonia and choreoathetosis overflow movements were fair. Moderate to good correlations were found between dystonia overflow score and Gross Motor Function Classification System, Manual Ability Classification System, and Eating and Drinking Ability Classification System. **CONCLUSIONS:** This is the first study to assess overflow movements in dyskinetic CP. All participants presented with dystonia and choreoathetosis overflow movements, with higher values for dystonia overflow movements. Dystonia overflow movements seem to have a larger impact on functional abilities. Implications for rehabilitation Dystonia and choreoathetosis overflow movements are both present in children with dyskinetic cerebral palsy, with dystonia overflow movements being more severe than choreoathetosis overflow movements. Overflow movements impact heavily on daily functional ability and the execution of voluntary activities. Dystonia overflow movements show good correlations with functional classification scales. The measurable characteristics of overflow movements can be used as a guideline for targeted treatment with, e.g., botulinum-toxin-A injections.

PMID: [30620229](#)

### **10. Longitudinal trajectories of physical activity and walking performance by gross motor function classification system level for children with cerebral palsy.**

Bjornson K, Fiss A, Avery L, Wentz E, Kerfeld C, Cicirello N, Hanna SE.

Disabil Rehabil. 2019 Jan 7;1-9. doi: 10.1080/09638288.2018.1534995. [Epub ahead of print]

**PURPOSE:** This study aims to present developmental trajectories for physical activity (PA) and walking performance for children with cerebral palsy (CP). **MATERIALS AND METHODS:** Seventy-nine children with CP, 39 (49%) female, Gross Motor Functional Classification System levels I-V, and mean age 91.3 months (+/-27.7 SD) participated. Participants in levels I-V wore the Actigraph to capture PA and children in levels I-II also wore a StepWatch (SW) (n = 43) to measure walking performance. Trajectories for average PA counts/minute and number of minutes of moderate to vigorous PA were generated for levels I, II, and III/IV/V (aggregate). Single leg strides/day and average strides faster than 30 strides/min trajectories were generated for levels I-II. **RESULTS:** Participants did not display plateaus in PA or walking performance based on functional level. Children in all levels showed a decrease in amount and intensity of PA from 3.0 to 12 years old, with participants in level I demonstrating the steepest decline. Children in level I decreased slightly, and level II increased slightly in both walking performance measures from 3.0 to 12 years old. **CONCLUSIONS:** Longitudinal curves demonstrate variations in PA and walking performance by functional level and provide prognostic information as to what changes may be anticipated for children with CP. Implications for rehabilitation Longitudinal developmental trajectories for physical activity and walking performance for children with cerebral palsy across functional levels are documented. Trajectories have potential to support collaborative intervention planning between therapists and families relative to physical activity and walking performance.

PMID: [30616403](#)

### **11. Dysphagia-Related Quality of Life in Adults with Cerebral Palsy on Full Oral Diet Without Enteral Nutrition.**

Yi YG, Oh BM, Seo HG, Shin HI, Bang MS.

Dysphagia. 2019 Jan 5. doi: 10.1007/s00455-018-09972-7. [Epub ahead of print]

There have been no quantitative studies on dysphagia and its impact on quality of life (QOL) of adults with cerebral palsy (CP). In this cross-sectional study, we aimed to investigate the characteristics of dysphagia symptoms and their impact on QOL in adults with CP on a full oral diet compared with healthy adults. Additionally, we aimed to determine the factors affecting dysphagia-related QOL in this population. We enrolled adults with CP on full oral diet (N = 117) and healthy individuals (N = 117) and interviewed them using the swallowing-quality of life (SWAL-QOL) questionnaire which includes 14 items regarding dysphagia symptoms and 30 items regarding swallowing-related QOL. The functional status of each participant with CP was evaluated using the gross motor function classification system, the manual ability classification system (MACS), and the Functional Oral Intake Scale (FOIS). Among pharyngeal symptoms, choking on food was reported most frequently (sometimes or more 76.9%), followed by coughing and choking on liquid. Among oral symptoms, chewing problems were reported most frequently (sometimes or more 59.8%), followed by food dribbling from the mouth (sometimes or more 53.8%). Compared to healthy adults, those with CP reported worse QOL across all SWAL-QOL items, with the lowest scores obtained for meal duration, followed by communication, burden, fatigue, sleep, and eating desire. On multiple linear regression analysis, higher MACS level, lower FOIS level, and older age were predictors of worse SWAL-QOL score. Among adults with CP, it is necessary to evaluate swallowing function and establish an active intervention plan even if a full oral diet is established.

PMID: [30612235](#)

### **12. Norms for a Pictographic System: The Aragonese Portal of Augmentative/Alternative Communication (ARASAAC) System.**

Paolieri D, Marful A.

Front Psychol. 2018 Dec 14;9:2538. doi: 10.3389/fpsyg.2018.02538. eCollection 2018.

Different systems are used to facilitate communication for people with speech problems. Among these, pictographic systems offer an extraordinary solution for many people with severe communication disorders; for example, people with autism spectrum disorders, aphasia, cognitive impairment, cerebral palsy, etc. The pictographic system called Aragonese Portal of Augmentative and Alternative Communication (ARASAAC <http://arasaac.org>), freely distributed under the Creative Commons License (BY-NC-SA), is an important reference in many countries. Although these images are widely used, there are no previous studies on their reliability and validity. In order to obtain a useful tool in the clinical context, scores of name



agreement, H index, tip-of-the-tongue responses, conceptual familiarity, image agreement, visual complexity, and response times were collected for the 295 most frequent images in the ARASAAC dataset. The psychometric analyses showed adequate validity and reliability values. The regression analysis indicated that naming times were explained by picture-name agreement, age of acquisition, and conceptual familiarity, while the tip-of-the-tongue states were mainly predicted by picture-name agreement and name agreement. In conclusion, these norms from the ARASAAC dataset offer a valuable tool for clinical intervention as well as for psycholinguistic research.

PMID: [30618959](#)

### **13. The Functional Communication Classification System: extended reliability and concurrent validity for children with cerebral palsy aged 5 to 18 years.**

Caynes K, Rose TA, Theodoros D, Burmester D, Ware RS, Johnston LM.

Dev Med Child Neurol. 2019 Jan 6. doi: 10.1111/dmcn.14135. [Epub ahead of print]

**AIM:** To examine psychometric properties and clinical utility of the Functional Communication Classification System (FCCS) for classifying observable communication function in children with cerebral palsy (CP) aged 5 to 18 years. **METHOD:** Eighty-two children (38 males, 44 females) with CP in six age groups (5y [n=15], 8y [n=14], 10y [n=14], 12y [n=14], 15y [n=11], and 17y [n=14]) were assessed by a speech-language pathologist (SLP) and parent for FCCS ratings. Data were compared with: (1) everyday communication function, assessed using the Clinical Evaluation of Language Fundamentals - Fourth Edition Pragmatics Profile (CELF-4 PP) for familiar and unfamiliar partners; (2) motor speech, gross and fine motor function; and (3) associated impairments, including epilepsy, intelligence, hearing, and vision. Interrater agreement was calculated for FCCS ratings using kappa ( $\kappa$ ) statistics. Relationships between FCCS ratings and other measures were examined using Spearman's correlation coefficient. **RESULTS:** Almost perfect interrater agreement was demonstrated between SLP and parent FCCS ratings ( $\kappa_w = 0.96$ ). Correlations were excellent between FCCS ratings with CELF-4 PP ratings, motor speech, and intellect; moderate with gross and fine motor function; and fair with other associated impairments (hearing, visual, and epilepsy). There was no correlation between age and FCCS. **INTERPRETATION:** The FCCS is a reliable and valid communication classification system for children with CP aged 5 to 18 years, and highly suitable for surveillance, research, and clinical purposes. **WHAT THIS PAPER ADDS:** The Functional Communication Classification System (FCCS) is valid and reliable for communication classification in children with cerebral palsy. Excellent agreement is present between speech language pathologists and parents. The FCCS shows excellent correlation with pragmatics, motor speech, and intelligence. The FCCS is moderately correlated with gross and fine motor function. The FCCS has fair correlation with epilepsy, hearing, and vision.

PMID: [30613944](#)

### **14. Promoting capacities for future adult roles and healthy living using a lifecourse health development approach.**

Palisano RJ, Di Rezze B, Stewart D, Freeman M, Rosenbaum PL, Hlyva O, Wolfe L, Gorter JW.

Disabil Rehabil. 2019 Jan 8:1-10. doi: 10.1080/09638288.2018.1544670. [Epub ahead of print]

**PURPOSES:** First, to describe how young adults with cerebral palsy (CP) experience lifecourse health development, and second, to create key messages for pediatric health service providers to promote children's capacities for future adult roles and healthy adult living. **METHODS:** Interpretive description qualitative design. Participants were a purposive sample of 23 young adults with CP, 25-33 years of age, who varied in functional abilities, education, living, and work situations. Three experienced interviewers conducted 50-60 min interviews. Transcripts were analyzed to identify themes. Subsequently, a one-day meeting was held with an advisory group to inform our interpretive description of key messages. **RESULTS:** Four themes emerged from the interviews: personal lifecourse, contexts for healthy living, health development through everyday experiences, and healthy living as an adaptive process. Key messages for service providers are: (a) address healthy living across the lifecourse, (b) focus on contexts of healthy living, (c) focus on everyday experiences and experiential learning, and (d) pay attention to the timing of opportunities and experiences. **CONCLUSION:** The findings provide first steps toward adoption of an approach to lifecourse health development for individuals with CP that emphasizes physical, mental, and emotional wellbeing and goals for desired social participation over the lifecourse. Implications for rehabilitation Young adults with cerebral palsy experience lifecourse health development as a personal ongoing and dynamic process occurring in many contexts. Individuals with cerebral palsy continually adjust to changing contexts (adaptive process). Everyday experiences and experiential learning enable individuals with cerebral palsy to develop capacities for current and future healthy living including social participation. "Timing" of opportunities and experiences is important for health development.

PMID: [30621464](#)

**15. Dance as art and therapy in cerebral palsy.**

Herman J.

Dev Med Child Neurol. 2019 Jan 10. doi: 10.1111/dmcn.14151. [Epub ahead of print]

PMID: [30632135](#)**16. Economic evaluations of physiotherapy interventions for neurological disorders: a systematic review.**

Winsler S, Lee SH, Law HS, Leung HY, Bello UM, Kannan P.

Disabil Rehabil. 2019 Jan 7:1-10. doi: 10.1080/09638288.2018.1510993. [Epub ahead of print]

**PURPOSE:** To identify the existing evidence evaluating the cost-effectiveness of physiotherapy treatments for people with neurological disorders. **METHODS:** Multiple databases were searched from database inception until July 2018. Studies estimating the cost-effectiveness as incremental cost-effectiveness ratios, cost per quality-adjusted life year, cost per disability-adjusted life year and cost per other measurable results were included. Physiotherapy Evidence Database scale, and Consensus on Health Economic Criteria list were used for rating the quality of the evidence. **RESULTS:** Ten studies involving 1462 participants were included. Aerobic training, progressive strength training, and a pragmatic physiotherapy program (combination of stretching, strength, and balance training) were reported as potentially cost-effective for older adults with vascular cognitive impairment, falls prevention in Parkinson's disease and multiple sclerosis respectively. Physiotherapy as an adjuvant for pain control was also reported as cost-effective for reflex sympathetic dystrophy. One study testing extra physiotherapy-by-physiotherapy assistant in cerebral palsy and two studies testing extra therapy using a robotic arm and Wii therapy for hand rehabilitation in stroke were reported as not cost-effective. **CONCLUSIONS:** There are limited studies that have evaluated the cost-effectiveness of physiotherapy treatments in neurological disorders. Three studies that combined extra physiotherapy-by-physiotherapy assistant and novel interventions with conventional physiotherapy were found not cost-effective. Implications for Rehabilitation Progressive muscle strengthening exercise over a period of 6-month is reported to be cost-effective for falls prevention in people with Parkinson's disease Aerobic training is reported as potentially cost-effective for older adults with vascular cognitive impairment Physiotherapy given as an adjuvant treatment is reported to be potentially cost-effective for reflex sympathetic dystrophy of less than 1-year duration One study reported physiotherapy involving static stretching, aerobic exercise, strengthening exercise, and balance training as cost-effective for people with multiple sclerosis Additional physiotherapy-by-physiotherapy assistant or family member for improving motor development in cerebral palsy and the use of novel physiotherapy techniques such as robotics or Wii plus conventional physiotherapy for improving arm function in stroke are found not cost-effective Group therapy for improving physical activity in mild Alzheimer's disease is found not cost-effective.

PMID: [30616401](#)**17. Special Considerations in Pediatric Assessment.**

Kim H, Shin MR.

Phys Med Rehabil Clin N Am. 2018 Aug;29(3):455-471. doi: 10.1016/j.pmr.2018.03.002. Epub 2018 May 28.

Pediatric spasticity management requires special consideration because of continuous growth and underlying medical complications due to upper motor neuron disease. Early intervention, regular follow-up, and management of spasticity are critical to improve function and prevent musculoskeletal complications, functional deterioration, and the development of pain. Thorough history taking along with comprehensive medical evaluation and physical examination by practitioners with knowledge about spasticity are important clues for spasticity management in addition to thorough history taking and review of current medications. This article reviews the rationale of early intervention and continuum of care, basic physical examination, and therapeutic options for spasticity management and spasticity's aggravating factors.

PMID: [30626508](#)**18. Central Effects of Botulinum Neurotoxin-Evidence from Human Studies.**

Weise D, Weise CM, Naumann M.

Toxins (Basel). 2019 Jan 6;11(1). pii: E21. doi: 10.3390/toxins11010021.

For more than three decades, Botulinum neurotoxin (BoNT) has been used to treat a variety of clinical conditions such as spastic or dystonic disorders by inducing a temporary paralysis of the injected muscle as the desired clinical effect. BoNT is known to primarily act at the neuromuscular junction resulting in a biochemical denervation of the treated muscle. However, recent evidence suggests that BoNT's pharmacological properties may not only be limited to local muscular denervation at the injection site but may also include additional central effects. In this review, we report and discuss the current evidence for BoNT's central effects based on clinical observations, neurophysiological investigations and neuroimaging studies in humans. Collectively, these data strongly point to indirect mechanisms via changes to sensory afferents that may be primarily responsible for the marked plastic effects of BoNT on the central nervous system. Importantly, BoNT-related central effects and consecutive modulation and/or reorganization of the brain may not solely be considered "side-effects" but rather an additional therapeutic impact responsible for a number of clinical observations that cannot be explained by merely peripheral actions.

PMID: [30621330](#)

### **19. Comparison of bispectral index (BIS) and entropy in patients with cerebral palsy during sevoflurane induction.**

Kim NY, Lee IO, Lim BG, Kim HZ, Kong MH, Lee MK, Lim SH, Kim NS.

Korean J Anesthesiol. 2009 Oct;57(4):422-427. doi: 10.4097/kjae.2009.57.4.422.

**BACKGROUND:** Demand of anesthesia for patients with cerebral palsy is more increasing. But there is still lacking in clinical research regarding how BIS and entropy reflect well on sedative and hypnotic state in patients with cerebral palsy. **METHODS:** Fifteen patients with cerebral palsy (Group CP) and fifteen patients without cerebral palsy (Group NL) scheduled for elective orthopedic surgery were included in the study. Induction of anesthesia was done by having the patient inhale 1 vol% sevoflurane and 100% oxygen using a total fresh gas flow of 8 L/min. Simultaneously BIS, state entropy (SE), response entropy (RE), end-tidal sevoflurane concentration were recorded every 15 seconds till there was no self respiration. When end-tidal sevoflurane concentration had not risen any more for 30 seconds, we increased inhaled sevoflurane concentration in 1 vol% increments. End point of recording was when self respiration was lost or the time sevoflurane concentration reached 8 vol%. **RESULTS:** No significant differences in RE, SE, BIS at baseline and end point were found between the two groups. No significant difference in the time reach end point was found between the two groups. BIS, SE and RE correlated with end-tidal sevoflurane concentration in the two groups. **CONCLUSIONS:** The authors found no significant difference in the entropy values between patients with CP and normal patients. Also, the entropy values could be interpreted like BIS in patients with CP. And BIS showed a stronger correlation with end tidal sevoflurane concentrations than entropy.

PMID: [30625900](#)

### **20. Resting-state network complexity and magnitude changes in neonates with severe hypoxic ischemic encephalopathy.**

Li HX, Yu M, Zheng AB, Zhang QF, Hua GW, Tu WJ, Zhang LC.

Neural Regen Res. 2019 Apr;14(4):642-648. doi: 10.4103/1673-5374.247468.

Resting-state functional magnetic resonance imaging has revealed disrupted brain network connectivity in adults and teenagers with cerebral palsy. However, the specific brain networks implicated in neonatal cases remain poorly understood. In this study, we recruited 14 term-born infants with mild hypoxic ischemic encephalopathy and 14 term-born infants with severe hypoxic ischemic encephalopathy from Changzhou Children's Hospital, China. Resting-state functional magnetic resonance imaging data showed efficient small-world organization in whole-brain networks in both the mild and severe hypoxic ischemic encephalopathy groups. However, compared with the mild hypoxic ischemic encephalopathy group, the severe hypoxic ischemic encephalopathy group exhibited decreased local efficiency and a low clustering coefficient. The distribution of hub regions in the functional networks had fewer nodes in the severe hypoxic ischemic encephalopathy group compared with the mild hypoxic ischemic encephalopathy group. Moreover, nodal efficiency was reduced in the left rolandic operculum, left supramarginal gyrus, bilateral superior temporal gyrus, and right middle temporal gyrus. These results suggest that the topological structure of the resting state functional network in children with severe hypoxic ischemic encephalopathy is clearly distinct from that in children with mild hypoxic ischemic encephalopathy, and may be associated with impaired language, motion, and cognition. These data indicate that it may be possible to make early predictions regarding brain development in children with severe hypoxic ischemic encephalopathy, enabling early interventions targeting brain function. This study was approved by the Regional Ethics Review Boards of the Changzhou Children's Hospital (approval No. 2013-001) on January 31, 2013. Informed consent was obtained from the family members of the children. The trial was registered with the Chinese Clinical Trial Registry (registration number: ChiCTR1800016409) and the protocol version is 1.0.

PMID: [30632504](#)



## 21. A Novel Scoring System for Term-Equivalent-Age Cranial Ultrasound in Extremely Preterm Infants.

Skiöld B, Hallberg B, Vollmer B, Ådén U, Blennow M, Horsch S.

Ultrasound Med Biol. 2019 Jan 2. pii: S0301-5629(18)30514-3. doi: 10.1016/j.ultrasmedbio.2018.11.005. [Epub ahead of print]

The role of term-equivalent-age (TEA) cranial ultrasound (cUS) in predicting outcome in preterm infants is increasingly being recognized. However, a detailed quantitative scoring system that allows comparison of groups and comparison with TEA magnetic resonance imaging (MRI) scoring systems is lacking. Eighty-four extremely preterm infants underwent cUS and MRI at TEA. Cranial US was evaluated using a novel detailed scoring system. Agreement between cUS and MRI scores was good (Spearman's  $\rho = 0.51$ ,  $p < 0.001$ ). Outcome at 30 mo corrected was assessed in 66 of 84 preterm and 85 term-born infants. Sensitivity was the same for cUS and MRI in prediction of cerebral palsy (75%) and severe cognitive delay (100%); the specificity was slightly higher for MRI (cerebral palsy: 97% vs. 90%, severe cognitive delay: 95% vs. 90%). The proposed novel cUS scoring system is a helpful tool in quantitative assessment of cUS at TEA and prediction of outcome at 30 mo.

PMID: [30611572](#)

## 22. Extensive cardiopulmonary resuscitation of preterm neonates at birth and mortality and developmental outcomes.

Fischer N, Soraisham A, Shah PS, Synnes A, Rabi Y, Singhal N, Ting JY, Creighton D, Dewey D, Ballantyne M, Lodha A; Canadian Neonatal Network™ (CNN).

Resuscitation. 2019 Jan 7. pii: S0300-9572(18)31008-6. doi: 10.1016/j.resuscitation.2019.01.003. [Epub ahead of print]

**OBJECTIVE:** To compare mortality and neurodevelopmental outcomes of extremely low gestational age neonates who received delivery room extensive cardiopulmonary resuscitation (DR-CPR) to those who did not require DR-CPR. **METHODS:** Preterm neonates born at <29 weeks' gestational age between January 2010 and September 2011 and assessed at Canadian Neonatal Follow-Up Network centers were studied. Neonates who received DR-CPR were compared to those who did not require DR-CPR using univariate and multivariable analyses. The primary outcome was a composite of mortality or any neurodevelopmental impairment at 18 to 24 months corrected age defined as the presence of any one or more of the following: cerebral palsy; Bayley-III cognitive, language, or motor composite scores <85 on any one of the components; sensorineural/mixed hearing loss or unilateral or bilateral visual impairment. Secondary outcomes were the individual components of the composite outcomes. **RESULTS:** Of the 2760 neonates born, 173 were excluded and remaining 2587 eligible neonates were included in our study. Of these 2068 had outcome data (80%) of whom 190 (9.2%) received DR-CPR. DR-CPR was independently associated with mortality or neurodevelopmental impairment (adjusted odds ratio [aOR] 1.76; 95% CI 1.21-2.55) and mortality alone (aOR 1.94; 95% CI 1.33-2.83). DR-CPR was also associated with increased odds of motor impairment (aOR 2.03; 95% CI 1.28-3.23). **CONCLUSION:** In extremely low gestational age neonates, DR-CPR was associated with higher odds of the composite outcome of mortality or neurodevelopmental impairment, mortality alone, and lower motor scores at 18 to 24 months' corrected age.

PMID: [30629993](#)

## 23. Clinically practical formula for preoperatively estimating the cutting rate of the spinal nerve root in a functional posterior rhizotomy.

Morota N.

Childs Nerv Syst. 2019 Jan 4. doi: 10.1007/s00381-018-04027-6. [Epub ahead of print]

**OBJECTIVE:** A functional posterior rhizotomy (FPR) ideally involves minimal cutting of the posterior root while providing maximal reduction of disabling spasticity. However, the ideal cutting rate has yet to be determined. It was hypothesized that the cutting rate of the posterior root would negatively correlate with preoperative motor function in children with spasticity. **METHODS:** Children who underwent an FPR between March 1996 and March 2017 and whose pre- and postoperative data were followed more than a year were enrolled. The preoperative Gross Motor Function Measure (GMFM) score and the overall cutting rate of the posterior root were plotted on a scatter plot, and a simple linear regression analysis was performed. The rationale for the cutting rate of the posterior root was tested by postoperative chronological changes in the GMFM score up to 5 years after the FPR. The Gross Motor Function Classification System (GMFCS) was used to group the children. The postoperative and preoperative GMFM were compared at each GMFCS level. **RESULTS:** One hundred thirty-seven children (aged 2 to 19 years old, mean 5.9 years old) met the selection criteria. The cutting rate of the posterior root ranged from 17 to

83%, (mean 48.3%). A scatter plot was then made using GMFM scores between 10 and 90. The formula for the simple linear regression analysis was  $y = -0.5539x + 73.896$  (x, GMFM score; y, overall cutting rate (%)). The formula was further approximated based on the scatter plot findings as  $y = 100 - x$ . The postoperative GMFM showed an improved average score for all GMFCS levels although statistically significant improvement at postoperative 5 years was confirmed in only the GMFCS level 1 group. CONCLUSIONS: The findings of this study supported the hypothesis of the negative correlation of the cutting rate of the posterior root with preoperative motor function in children with spasticity. The amount of posterior nerve root/rootlet cutting during FPR negatively correlated with the preoperative GMFM score. The approximated formula is simple, practical for clinical use, and helpful for preoperatively estimating the required overall cutting rate for the posterior root. The suggested cutting rate induced by the approximated formula should be used as a reference value and be modified according to preoperative motor function, severity and distribution of spasticity, the result of intraoperative neurophysiology, and other factors.

PMID: [30610480](#)

#### 24. Neurosurgical Approaches.

Madsen PJ, Isaac Chen HC, Lang SS.

Phys Med Rehabil Clin N Am. 2018 Aug;29(3):553-565. doi: 10.1016/j.pmr.2018.04.002. Epub 2018 May 29.

Neurosurgery has long had a role in the treatment of disorders of muscle hyperactivity. This article discusses the use of selective peripheral neurotomy for the treatment of focal and multifocal spasticity, selective dorsal rhizotomy for alleviation of more generalized spasticity most often in the setting of cerebral palsy, dorsal root entry zone lesioning for cases of severe spasticity in a nonfunctioning limb, and deep brain stimulation for the treatment of dystonia. For each procedure, relevant pathophysiology and basic surgical anatomy and technique are addressed. Additionally, relevant aspects of patient selection, efficacy data, and complications of these procedures are discussed.

PMID: [30626515](#)

## Prevention and Cure

#### 25. Causal role of group B Streptococcus-induced acute chorioamnionitis in intrauterine growth retardation and cerebral palsy-like impairments.

Allard MJ, Brochu ME, Bergeron JD, Segura M, Sébire G.

J Dev Orig Health Dis. 2019 Jan 10:1-8. doi: 10.1017/S2040174418001083. [Epub ahead of print]

Chorioamnionitis and intrauterine growth retardation (IUGR) are risk factors for cerebral palsy (CP). Common bacteria isolated in chorioamnionitis include group B Streptococcus (GBS) serotypes Ia and III. Little is known about the impact of placental inflammation induced by different bacteria, including different GBS strains. We aimed to test the impact of chorioamnionitis induced by two common GBS serotypes (GBSIa and GBSIII) on growth and neuromotor outcomes in the progeny. Dams were exposed at the end of gestation to either saline, inactivated GBSIa or GBSIII. Inactivated GBS bacteria invaded placentas and triggered a chorioamnionitis featured by massive polymorphonuclear cell infiltrations. Offspring exposed to GBSIII - but not to GBSIa - developed IUGR, persisting beyond adolescent age. Male rats in utero exposed to GBSIII traveled a lower distance in the Open Field test, which was correlating with their level of IUGR. GBSIII-exposed rats presented decreased startle responses to acoustic stimuli beyond adolescent age. GBS-exposed rats displayed a dysmyelinated white matter in the corpus callosum adjacent to thinner primary motor cortices. A decreased density of microglial cells was detected in the mature corpus callosum of GBSIII-exposed males - but not females - which was correlating positively with the primary motor cortex thickness. Altogether, our results demonstrate a causal link between pathogen-induced acute chorioamnionitis and (1) IUGR, (2) serotype - and sex-specific neuromotor impairments and (3) abnormal development of primary motor cortices, dysmyelinated white matter and decreased density of microglial cells.

PMID: [30626456](#)