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## Interventions and Management

### **1. Hand-Use-at-Home Questionnaire: validity and reliability in children with neonatal brachial plexus palsy or unilateral cerebral palsy.**

van der Holst M, Geerdink Y, Aarts P, Steenbeek D, Pondaag W, Nelissen RG, Geurts AC, Vliet Vlieland TP.

Clin Rehabil. 2018 May 1:269215518775156. doi: 10.1177/0269215518775156. [Epub ahead of print]

**OBJECTIVE:** To investigate construct validity and test-retest reliability of the parent-rated Hand-Use-at-Home questionnaire (HUH) in children with neonatal brachial plexus palsy or unilateral cerebral palsy. **DESIGN AND SUBJECTS:** For this cross-sectional study, children with neonatal brachial plexus palsy or unilateral cerebral palsy, aged 3-10 years, were eligible. **MAIN MEASURES:** The HUH, Pediatric Outcome Data Collection Instrument Upper Extremity Scale (neonatal brachial plexus palsy only), and Children's Hand-Use Experience Questionnaire (unilateral cerebral palsy only) were completed. The HUH was completed twice in subgroups of both diagnoses. Lesion-extent (indication of involved nerve rootlets in neonatal brachial plexus palsy as confirmed during clinical observation and/or nerve surgery) and Manual Ability Classification System levels (unilateral cerebral palsy) were obtained from the medical records. Spearman correlation coefficients between the HUH and all clinical variables, agreement, standard error of measurement, smallest detectable change and intra-class correlation were calculated. **RESULTS:** A total of 260 patients participated (neonatal brachial plexus palsy: 181), of which 56 completed the second HUH (neonatal brachial plexus palsy: 16). Median age was 6.9 years for children with neonatal brachial plexus palsy, 116 had C5-C6 lesions. Median age for children with unilateral cerebral palsy was 6.4 years, 33 had Manual Ability Classification System Level II. The HUH correlated moderately with lesion-extent (  $r_s = -0.5$ ), Pediatric Outcome Data Collection Instrument Upper Extremity Scale (  $r_s = 0.6$ ) and Children's Hand-Use Experience Questionnaire (  $r_s = 0.5$ ) but weakly with Manual Ability Classification System levels (  $r_s = -0.4$ ). Test-retest reliability was excellent (intra-class correlation<sub>2,1</sub> = 0.89, standard error of measurement = 0.599 and smallest detectable change = 1.66 logits) and agreement was good (mean difference HUH1 - HUH2 = 0.06 logits). **CONCLUSION:** The HUH showed good construct validity and test-retest reliability in children with neonatal brachial plexus palsy or unilateral cerebral palsy.

PMID: [29756465](#)

### **2. Tele-UPCAT: study protocol of a randomised controlled trial of a home-based Tele-monitored UPper limb Children Action observation Training for participants with unilateral cerebral palsy.**

Sgandurra G, Cecchi F, Beani E, Mannari I, Maselli M, Falotico FP, Inguaggiato E, Perazza S, Sicola E, Feys H, Klingels K, Ferrari A, Dario P, Boyd RN, Cioni G.

BMJ Open. 2018 May 14;8(5):e017819. doi: 10.1136/bmjopen-2017-017819.

**INTRODUCTION:** A new rehabilitative approach, called UPper Limb Children Action Observation Training (UPCAT), based on the principles of action observation training (AOT), has provided promising results for upper limb rehabilitation in children with unilateral cerebral palsy (UCP). This study will investigate if a new information and communication technology platform, named Tele-UPCAT, is able to deliver AOT in a home setting and will

test its efficacy on children and young people with UCP. **METHODS AND ANALYSIS:** A randomised, allocation concealed (waitlist control) and evaluator-blinded clinical trial with two investigative arms will be carried out. The experimental group will perform AOT at home for 3 weeks using a customised Tele-UPCAT system where they will watch video sequences of goal-directed actions and then complete the motor training of the same actions. The control group will receive usual care for 3 weeks, which may include upper limb training. They will be offered AOT at home after 3 weeks. Twenty-four children with UCP will be recruited for 12 participants per group. The primary outcome will be measured using Assisting Hand Assessment. The Melbourne Assessment 2, ABILHAND, Participation and Environment Measure-Children and Youth and Cerebral Palsy Quality of Life Questionnaire will be included as secondary measures. Quantitative measures from sensorised objects and participants worn Actigraphs GXT3+ will be analysed. The assessment points will be the week before (T0) and after (T1) the period of AOT/standard care. Further assessments will be at T1 plus, the week after the AOT period for the waitlist group and at 8 weeks (T2) and 24 weeks (T3) after AOT training. **ETHICS AND DISSEMINATION:** The trial has been approved by the Tuscany Paediatric Ethics Committee (169/2016). Publication of all outcomes will be in peer-reviewed journals and conference presentations.

PMID: [29764869](#)

### **3. Botulinum Toxin Type A Injection for Cervical Dystonia in Adults with Dyskinetic Cerebral Palsy.**

Yi YG, Kim K, Yi Y, Choi YA, Leigh JH, Bang MS.

Toxins (Basel). 2018 May 16;10(5). pii: E203. doi: 10.3390/toxins10050203.

We aimed to evaluate the efficacy and safety of injecting botulinum toxin A (BoNT-A) into the neck muscles to treat cervical dystonia (CD) in patients with dyskinetic cerebral palsy (CP). This was a randomized, double-blinded, placebo-controlled trial with cross-over design. We prospectively enrolled adults with dyskinetic CP who were over 20 years old and had been clinically diagnosed with CD for more than one year. The primary outcome measure was the change in Toronto Western Spasmodic Torticollis Rating Scale (TWSTRS) at four weeks from the baseline TWSTRS. Seventeen patients were initially enrolled, but one patient was excluded after the final evaluation because of a violation of the study protocol. At four weeks, the BoNT-A injections showed significant improvement in TWSTRS total scores compared to the saline injections ( $p = 0.0286$  for ANCOVA). At 12 weeks, the BoNT-A injections resulted in greater improvements in TWSTRS total scores than the saline injections without statistical significance ( $p = 0.0783$  for ANCOVA). Dysphagia occurred in three out of 16 patients: two after BoNT-A and one after saline. The dysphagia was transient and improved naturally within two weeks without any special treatment. BoNT-A injection for CD in adults with dyskinetic CP is relatively safe and improves pain and disability.

PMID: [29772695](#)

### **4. PROGame: A process framework for serious game development for motor rehabilitation therapy.**

Amengual Alcover E, Jaume-I-Capó A, Moyà-Alcover B.

PLoSOne. 2018 May 16;13(5):e0197383. doi: 10.1371/journal.pone.0197383. eCollection 2018.

Serious game development for rehabilitation therapy is becoming increasingly popular because of the motivational advantages that these types of applications provide. Consequently, the need for a common process framework for this category of software development has become increasingly evident. The goal is to guarantee that products are developed and validated by following a coherent and systematic method that leads to high-quality serious games. This paper introduces a new process framework for the development of serious games for motor rehabilitation therapy. We introduce the new model and demonstrate its application for the development of a serious game for the improvement of the balance and postural control of adults with cerebral palsy. The development of this application has been facilitated by two technological transfer contracts and is being exploited by two different organizations. According to clinical measurements, patients using the application improved from high fall risk to moderate fall risk. We believe that our development strategy can be useful not only for motor rehabilitation therapy, but also for the development of serious games in many other rehabilitation areas.

PMID: [29768472](#)

### **5. Determinants of Hip and Femoral Deformities in Children With Spastic Cerebral Palsy.**

Cho Y, Park ES, Park HK, Park JE, Rha DW.

Ann Rehabil Med. 2018 Apr;42(2):277-285. doi: 10.5535/arm.2018.42.2.277. Epub 2018 Apr 30.

**OBJECTIVE:** To find factors affecting hip and femoral deformities in children with spastic cerebral palsy (CP) by comparing various clinical findings with imaging studies including plain radiography and computed tomography (CT) imaging. **METHODS:** Medical records of 709 children with spastic CP who underwent thorough baseline physical examination and functional assessment between 2 to 6 years old were retrospectively reviewed. Fifty-seven children (31 boys and 26 girls) who had both plain radiography of the hip and three-dimensional CT of the lower extremities at least 5 years after baseline examination were included in this study. **RESULTS:** The mean age at physical examination was 3.6 years (SD=1.6; range, 2-5.2 years) and the duration of follow-up imaging after baseline examination was 68.4 months (SD=22.0; range, 60-124 months). The migration percentage correlated with motor impairment and the severity of hip adductor spasticity (R1 angle of hip abduction with knee flexion). The femoral neck and shaft angle correlated with the ambulation ability and severity of hip adductor spasticity (R1 and R2 angles of hip abduction with both knee flexion and extension). **CONCLUSION:** Hip subluxation and coxa valga deformity correlated with both dynamic spasticity and shortening of hip adductor muscles. However, we found no correlation between femoral deformities such as femoral anteversion, coxa valga, and hip subluxation.

PMID: [29765881](https://pubmed.ncbi.nlm.nih.gov/29765881/)

## 6. The increase of anterior pelvic tilt after crouch gait treatment in patients with cerebral palsy.

de Moraes Filho MC, Blumetti FC, Kawamura CM, Leite JBR, Lopes JAF, Fujino MH, Neves DL.

Gait Posture. 2018 May 5;63:165-170. doi: 10.1016/j.gaitpost.2018.05.002. [Epub ahead of print]

**BACKGROUND:** The increase of anterior pelvic tilt (APT) has been described after the treatment of crouch gait in cerebral palsy (CP). The ideal treatment option for flexed knee gait in CP should provide knee extension improvement in the stance phase without generating the increase of APT. **RESEARCH QUESTION:** The purpose of this study was to compare three different approaches used for the treatment of crouch gait in CP [distal femur extension osteotomy (DFEO), patellar tendon shortening (PTS) and the combination of DFEO +PTS] regarding the increase of APT after the interventions. **METHODS:** The inclusion criteria were: (1) diagnosis of spastic diplegic CP, (2) GMFCS levels I-III, (3) patients who underwent DFEO and/or PTS and (4) with complete documentation in the gait laboratory before and after the intervention. The included patients were divided into 3 groups, according to the procedures performed for crouch gait treatment: PTS (19 patients), DFEO (54 patients) and PTS + DFEO (22 patients). **RESULTS:** During stance phase, knee flexion decreased from 41.60 to 13.60 in the PTS group ( $p < 0.001$ ), from 46.00 to 30.70 in the DFEO group ( $p < 0.001$ ) and from 52.30 to 29.50 in the PTS + DFEO group ( $p < 0.001$ ). APT increased 140 ( $p < 0.001$ ) in the PTS group,  $7.1^\circ$  ( $p < 0.001$ ) in the DFEO group and  $6.60$  ( $p < 0.001$ ) in the PTS + DFEO group after surgical intervention. The PTS group presented a more significant deterioration of pelvic tilt than the DFEO ( $p = 0.002$ ) and PTS + DFEO ( $p = 0.001$ ) groups. The increase of APT was higher when HSL was also performed in the PTS + DFEO group ( $p = 0.016$ ). **SIGNIFICANCE:** The increase of APT was observed in all studied groups, but it was more significant for those who underwent a PTS. The inclusion of HSL in the surgical plan was related a higher increase of APT in the PTS + DFEO group.

PMID: [29753172](https://pubmed.ncbi.nlm.nih.gov/29753172/)

## 7. Minimally invasive plate osteosynthesis for tibial derotation osteotomies in children with cerebral palsy.

Sarikaya IA, Seker A, Erdal OA, Talmac MA, Inan M.

Acta Orthop Traumatol Turc. 2018 May 11. pii: S1017-995X(17)30122-0. doi: 10.1016/j.aott.2018.02.003. [Epub ahead of print]

**OBJECTIVE:** Tibial derotation osteotomy can be used in the treatment of rotational deformities in case of ineffective conservative management. Our aim was to evaluate the results of the patients who underwent minimal invasive plate osteosynthesis for tibial derotation osteotomies. **METHODS:** Total of 16 patients (17 procedures) were included in this study. Mean age was 11.5 (3-25) years. We clinically assessed the tibial torsion by measuring the thigh-foot angle (TFA). No immobilization was used postoperatively and range of motion exercises were begun immediately. The patient was allowed weight-bearing activity, as tolerated, when callus formation was seen on the radiographs, at approximately three to four weeks after surgery. **RESULTS:** The mean follow-up time was 27.5 months. Mean preoperative and follow up TFA were  $27^\circ$  of internal rotation and  $3.74^\circ$  of external rotation, respectively. A mean of  $22.3^\circ$  improvement was achieved postoperatively. There was only one wound detachment, which was accepted as a complication and healed with local wound care. **CONCLUSIONS:** The recurrence risk and

correction loss can be decreased with plate-screw fixation. Minimal invasive surgery would also decrease the risk of wound complications. LEVEL OF EVIDENCE: Level IV, Therapeutic study.

PMID: [29759883](#)

### **8. Casting Protocols Following BoNT-A Injections to Treat Spastic Hypertonia of the Triceps Surae in Children with Cerebral Palsy and Equinus Gait: A Randomized Controlled Trial.**

Kelly B, MacKay-Lyons M, Berryman S, Hyndman J, Wood E.

Phys Occup Ther Pediatr. 2018 May 17:1-17. doi: 10.1080/01942638.2018.1471015. [Epub ahead of print]

AIM: To study the effects of single versus serial casting post-Botulinum toxin A (BoNT-A) injections on hypoextensibility of triceps surae in children, 2-7 years old, with cerebral palsy and equinus gait. METHODS: A randomized, stratified, parallel, two-group trial was conducted at a pediatric health center with assessments at baseline, precast, postcast and, 1-, 2-, and 6-month follow-ups. One week following BoNT-A injections into triceps surae muscle, a single below-knee cast (n = 10) or 3 serial casts (n = 10) were applied for 3 weeks. Primary outcome measure was the Modified Tardieu Scale (MTS), secondary outcome measures were Modified Ashworth Scale (MAS), GAITRite™, Gross Motor Function Measure-66 (GMFM-66), and Pediatric Evaluation of Disability Inventory (PEDI). RESULTS: Significant effects of time, but not group-by-time, were found for MTS R1 (P < 0.001), MTS R2 (P < 0.001), MAS (P = 0.001), GMFM-66 (P = 0.002), and PEDI (P < 0.001-0.009). One participant who received a single cast did not complete the 6-month assessment. CONCLUSIONS: Magnitudes of improvements were similar using single or serial casting. If these findings are corroborated in a larger scale study, the recommendation of a single cast may be appropriate due to its greater convenience for families and clinicians.

PMID: [29771161](#)

### **9. Gait pathology subtypes are not associated with self-reported fall frequency in children with cerebral palsy.**

Boyer ER, Patterson A.

Gait Posture. 2018 May 5;63:189-194. doi: 10.1016/j.gaitpost.2018.05.004. [Epub ahead of print]

BACKGROUND: Trips and falls are common concerns reported by parents of children with cerebral palsy. Specific gait pathologies (excessive internal hip rotation, intoeing, and stiff knee gait) are anecdotally associated with higher rates of falls. RESEARCH QUESTION: Is fall frequency higher for the aforementioned gait pathologies? METHODS: Parent-reported fall frequency from 1063 children with cerebral palsy who also had a three-dimensional gait analysis was retrospectively reviewed. Frequency of 10 common gait pathologies was determined and fall frequency for the gait pathologies of interest were compared to matched control groups. Possible effects of Gross Motor Functional Classification System (GMFCS) level and age on fall frequency were also assessed and matched in the control group, as appropriate. RESULTS: In general, parent-reported fall frequency increased from GMFCS level I to II and then decreased until level IV. Moreover, younger children tended to report greater fall frequency, though children who reported never falling were of similar age as those who reported weekly falls, resulting in an inverted-U shaped relationship. Children with cerebral palsy who walked with excessive internal hip rotation, excessive intoeing, or stiff knee gait did not report increased fall frequencies compared to other children with cerebral palsy matched on GMFCS level and age that did not walk with those gait patterns. Approximately 35% of children reported never falling, 35% reported falling daily, and 30% reported falling monthly or weekly for each gait pattern. Therefore, elevated fall frequency appears to be a generic problem for most children with CP rather than a function of a specific gait pattern. SIGNIFICANCE: Clinicians should be aware of these relationships, or lack thereof, when trying to decipher the cause of a child's falling and when determining appropriate interventions. Future studies may seek to more objectively quantify fall frequency, as self-report is the main limitation of this study.

PMID: [29763815](#)

### **10. A biomechanical comparison of initial sprint acceleration performance and technique in an elite athlete with cerebral palsy and able-bodied sprinters.**

Bezodis IN, Cowburn J, Brazil A, Richardson R, Wilson C, Exell TA, Irwin G.

Sports Biomech. 2018 May 16:1-12. doi: 10.1080/14763141.2018.1459819. [Epub ahead of print]

Cerebral palsy is known to generally limit range of motion and force producing capability during movement. It also limits sprint performance, but the exact mechanisms underpinning this are not well known. One elite male T36 multiple-Paralympic sprint medallist (T36) and 16 well-trained able-bodied (AB) sprinters each performed 5-6 maximal sprints from starting blocks. Whole-body kinematics (250 Hz) in the block phase and first two steps, and synchronised external forces (1,000 Hz) in the first stance phase after block exit were combined to quantify lower limb joint kinetics. Sprint performance (normalised average horizontal external power in the first stance after block exit) was lower in T36 compared to AB. T36 had lower extensor range of motion and peak extensor angular velocity at all lower limb joints in the first stance after block exit. Positive work produced at the knee and hip joints in the first stance was lower in T36 than AB, and the ratio of positive:negative ankle work produced was lower in T36 than AB. These novel results directly demonstrate the manner in which cerebral palsy limits performance in a competition-specific sprint acceleration movement, thereby improving understanding of the factors that may limit performance in elite sprinters with cerebral palsy.

PMID: [29763815](#)

### **11. Balance and mobility training at home using Wii Fit in children with cerebral palsy: a feasibility study.**

Chiu HC, Ada L, Lee SD.

BMJ Open. 2018 May 15;8(5):e019624. doi: 10.1136/bmjopen-2017-019624.

**OBJECTIVES:** To investigate whether balance and mobility training at home using Wii Fit is feasible and can provide clinical benefits. **DESIGN:** Single-group, pre-post intervention study. **SETTING:** Participants' home. **PARTICIPANTS:** 20 children with cerebral palsy (6-12 years). **INTERVENTION:** Participants undertook 8 weeks of home-based Wii Fit training in addition to usual care. **MAIN MEASURES:** Feasibility was determined by adherence, performance, acceptability and safety. Clinical outcomes were strength, balance, mobility and participation measured at baseline (preintervention) and 8 weeks (postintervention). **RESULTS:** The training was feasible with 99% of training completed; performance on all games improved; parents understood the training (4/5), it did not interfere in life (3.8/5), was challenging (3.9/5) and would recommend it (3.9/5); and there were no injurious falls. Strength increased in dorsiflexors (Mean Difference (MD) 2.2 N m, 95% CI 1.1 to 3.2,  $p<0.001$ ), plantarflexors (MD 2.2 N m, 95% CI 1.3 to 3.1,  $p<0.001$ ) and quadriceps (MD 7.8 N m, 95% CI 5.2 to 10.5,  $p<0.001$ ). Preferred walking speed increased (MD 0.25 m/s, 95% CI 0.09 to 0.41,  $p<0.01$ ), fast speed increased (MD 0.24 m/s, 95% CI 0.13 to 0.35,  $p<0.001$ ) and distance over 6 min increased (MD 28 m, 95% CI 10 to 45,  $p<0.01$ ). Independence in participation increased (MD 1.4 out of 40, 95% CI 0.0 to 2.8,  $p=0.04$ ). **CONCLUSIONS:** Balance and mobility training at home using Wii Fit was feasible and safe and has the potential to improve strength and mobility, suggesting that a randomised trial is warranted.

PMID: [29763815](#)

### **12. Relationship Between Functional Level and Muscle Thickness in Young Children With Cerebral Palsy.**

Choe YR, Kim JS, Kim KH, Yi TI.

Ann Rehabil Med. 2018 Apr;42(2):286-295. doi: 10.5535/arm.2018.42.2.286. Epub 2018 Apr 30.

**OBJECTIVE:** To investigate the relationship between functional level and muscle thickness (MT) of the rectus femoris (RF) and the gastrocnemius (GCM) in young children with cerebral palsy (CP). **METHODS:** The study participants were comprised of 26 children (50 legs) with spastic CP, aged 3-6 years, and 25 age-matched children with typical development (TD, 50 legs). The MT of the RF, medial GCM, and lateral GCM was measured with ultrasound imaging. The functional level was evaluated using the Gross Motor Function Measurement-88 (GMFM-88), Gross Motor Function Classification System (GMFCS), and based on the mobility area of the Korean version of the Modified Barthel Index (K-MBI). The measurement of spasticity was evaluated with the Modified Ashworth Scale (MAS). **RESULTS:** We note that the height, weight, body mass index, and MT of the RF, and the medial and lateral GCM were significantly higher in the TD group ( $p<0.05$ ). There was a direct relationship between MT of the RF and medial GCM and the GMFM-88, GMFCS, and mobility scores of the K-MBI in individuals with early CP. In addition, we have noted that there was a direct relationship between MT of the lateral GCM and the GMFM-88 and GMFCS. Although there was a tendency toward lower MT with increasing MAS ratings in the knee and ankle, the correlation was not statistically significant. **CONCLUSION:** In young children with CP, MT of the RF and GCM was lower than in age-matched children with TD. Furthermore, it is noted with confidence that a significant positive correlation existed between MT and functional level as evaluated using the GMFM-88, GMFCS, and mobility area

of K-MBI.

PMID: [29765882](#)

### **13. Effect of the frequency of therapy on the performance of activities of daily living in children with cerebral palsy.**

Park EY, Kim EJ.

J Phys Ther Sci. 2018 May;30(5):707-710. doi: 10.1589/jpts.30.707. Epub 2018 May 8.

[Purpose] This study investigated the frequency effect of physical and occupational therapy on activities of daily living performance in children with cerebral palsy. [Subjects and Methods] A total of 162 children with cerebral palsy who attended a convalescent or rehabilitation center for disabled individuals or a special school for physical disabilities in South Korea participated in this study. The Pediatric Evaluation Disability Inventory was used to collect data on activities of daily living performance according to physical therapy frequency based on neurodevelopmental therapy for 1 year. [Results] The relationships between physical therapy frequency and activities of daily living performance (mobility, social function, and total functional skill) and between occupational therapy frequency and activities of daily living performance (social function and total functional skill) were significant. There was no significant difference in activities of daily living performance according to physical therapy frequency. The difference in the activities of daily living performance according to occupational therapy frequency was significant for social function. [Conclusion] Intensive occupational therapy was more effective in improving activities of daily living performance in children with cerebral palsy. In particular, their social function further improved with intensive physical therapy.

PMID: [29765186](#)

### **14. A systematic review to explore the feasibility of a behavioural sleep intervention for insomnia in children with neurodevelopmental disorders: A transdiagnostic approach.**

Rigney G, Ali NS, Corkum PV, Brown CA, Constantin E, Godbout R, Hanlon-Dearman A, Ipsiroglu O, Reid GJ, Shea S, Smith IM, Van der Loos HFM, Weiss SK.

Sleep Med Rev. 2018 Mar 31. pii: S1087-0792(18)30001-7. doi: 10.1016/j.smr.2018.03.008. [Epub ahead of print] Review.

Children with neurodevelopmental disorders (NDD) are at high risk for sleep problems, especially insomnia. It is currently not known whether behavioural sleep interventions developed for typically developing (TD) children are effective for children with NDD, and if interventions need to be modified for each diagnostic group. The aim of this systematic review was to identify and evaluate commonalities, trends in outcomes, and the methodological quality of parent-delivered behavioural sleep interventions for children with NDD, specifically Attention-Deficit/Hyperactivity Disorder (ADHD), Autism Spectrum Disorder (ASD), Cerebral Palsy, and Fetal Alcohol Spectrum Disorder. Nine databases were searched. A total of 40 studies met eligibility criteria. The majority of studies were conducted with ASD and ADHD populations. Common sleep problems were evident across the NDD populations. The most frequently reported included bedtime resistance, night-waking, early morning awakening, and co-sleeping. The most common interventions used were implementation of healthy sleep practices, reinforcement, graduated extinction, and faded bedtime. All studies reported at least one behavioural treatment component as effective. Commonalities across NDD populations, as well as the TD population, for both sleep problems reported and behavioural interventions implemented, suggest the feasibility of developing a transdiagnostic behavioural sleep intervention suitable for children with a range of NDD.

PMID: [29764710](#)

### **15. Robot-assisted training using Hybrid Assistive Limb® for cerebral palsy.**

Matsuda M, Iwasaki N, Mataka Y, Mutsuzaki H, Yoshikawa K, Takahashi K, Enomoto K, Sano K, Kubota A, Nakayama T, Nakayama J, Ohguro H, Mizukami M, Tomita K.

Brain Dev. 2018 May 14. pii: S0387-7604(18)30147-5. doi: 10.1016/j.braindev.2018.04.004. [Epub ahead of print]

**PURPOSE:** The Hybrid Assistive Limb® (HAL®, CYBERDYNE) is a wearable robot that provides assistance to a patient while they are walking, standing, and performing leg movements based on the wearer's intended movement. The effect of robot-assisted training using HAL® for cerebral palsy (CP) is unknown. Therefore, we assessed the effect of robot-assisted training using HAL® on patients with CP, and compared walking and gross motor abilities between pre-intervention and post-intervention. **METHODS:** Six subjects with CP were included (mean age: 16.8 years; range: 13-24 years; Gross Motor Function Classification System levels II-IV: n = 1, 4, 1). Robot-assisted training using HAL® were performed 2-4 sessions per week, 20 min per session, within a 4 weeks period, 12 times in total. Outcome measures included gait speed, step length, cadence, single-leg support per gait cycle, hip and knee joint angle in stance, and swing phase per gait cycle, 6-minute walking distance (6 MD), physiological cost index (PCI), knee-extension strength, and Gross Motor Function Measure (GMFM). **RESULTS:** There were significant increases in self-selected walking speed (SWS), cadence during SWS and maximum walking speed (MWS), single-leg support per gait cycle, hip joint angle in the swing phase, 6 MD, and GMFM. In contrast, gait speed during MWS, step length during SWS and MWS, hip and knee joint angle in the stance phase, knee joint angle in the swing phase, PCI, and knee-extension strength generally improved, but not significantly. **CONCLUSION:** Robot-assisted training using HAL® may improve walking and gross motor abilities of patients with CP.

PMID: [29773349](#)

## **16. Brain-Machine Interfaces: Powerful Tools for Clinical Treatment and Neuroscientific Investigations.**

Slutzky MW.

Neuroscientist. 2018 May 1:1073858418775355. doi: 10.1177/1073858418775355. [Epub ahead of print]

Brain-machine interfaces (BMIs) have exploded in popularity in the past decade. BMIs, also called brain-computer interfaces, provide a direct link between the brain and a computer, usually to control an external device. BMIs have a wide array of potential clinical applications, ranging from restoring communication to people unable to speak due to amyotrophic lateral sclerosis or a stroke, to restoring movement to people with paralysis from spinal cord injury or motor neuron disease, to restoring memory to people with cognitive impairment. Because BMIs are controlled directly by the activity of prespecified neurons or cortical areas, they also provide a powerful paradigm with which to investigate fundamental questions about brain physiology, including neuronal behavior, learning, and the role of oscillations. This article reviews the clinical and neuroscientific applications of BMIs, with a primary focus on motor BMIs.

PMID: [29772957](#)

## **17. The effects of literacy interventions on single-word reading for individuals who use aided AAC: a systematic review.**

Mandak K, Light J, Boyle S.

Augment Altern Commun. 2018 May 18:1-13. doi: 10.1080/07434618.2018.1470668. [Epub ahead of print]

The purpose of this systematic review was to investigate the effects of instruction on single-word reading of individuals who use aided augmentative and alternative communication (AAC). A systematic search identified nine single-case experimental design studies that involved 24 individuals who used aided AAC. Overall, the evidence indicated that instruction had positive effects on reading at the single-word level for individuals across ages and diagnostic categories (i.e., autism spectrum disorder (ASD), cerebral palsy (CP), Down syndrome, and intellectual disability). The studies revealed that these effects were consistent across a range of participant, intervention, and outcome measure characteristics. Phonological approaches, sight-word approaches, and a combination of these two approaches yielded very large effects. Despite the large effects, the findings must be viewed with caution due to limitations in the number of studies and participants and limitations in the reporting of detailed participant and intervention characteristics across the studies. In order to determine which interventions are most effective for which individuals, future research directions are discussed, including the need for greater specificity in describing participant and intervention characteristics, investigations into how to best measure intervention outcomes without requiring spoken responses, and investigations into longer-term interventions targeting a wider range of reading skills.

PMID: [29772935](#)

### 18. The Cognitive Orientation to daily Occupational Performance (CO-OP) Approach: Best responders in children with cerebral palsy and brain injury.

Jackman M, Novak I, Lannin NA, Galea C, Froude E.

Res Dev Disabil. 2018 May 8. pii: S0891-4222(18)30095-7. doi: 10.1016/j.ridd.2018.04.019. [Epub ahead of print]

**BACKGROUND:** Identifying the characteristics of individuals who are most likely to respond to a certain rehabilitation intervention is advantageous for the child, family, clinicians and the healthcare system. **AIM:** To investigate the individual characteristics of children with cerebral palsy or brain injury who responded best to the Cognitive Orientation to daily Occupational Performance (CO-OP) Approach. **METHODS:** Post hoc analyses were conducted on 30 participants who participated in CO-OP within a larger randomized controlled trial. **Inclusion:** cerebral palsy or brain injury; age 4-15 years; Manual Abilities Classification System (MACS) I-IV; goals related to hand function; sufficient cognitive, language and behavioral ability to undertake CO-OP. **Outcome measures** were the Canadian Occupational Performance Measure (COPM) and Goal Attainment Scale (GAS) collected immediately following the two week intervention period. **RESULTS:** Following CO-OP, 67% (n = 20) of participants showed a statistically significant response on the COPM, and 73%(n = 22) on the GAS. Nine participants were classified as best responders. When compared to non-responders, best responders were more likely to be female (p = .025) and to have received a higher dose of CO-OP (p = .028). Neither age nor MACS were predictors of response. **CONCLUSION:** To be successful in CO-OP, children should meet the prerequisites of CO-OP, particularly the language and cognitive ability to set goals and communicate effectively with the therapist. In this small sample, children with comorbidities were less likely to achieve goals, females were more likely to respond and dose of therapy was important to success.

PMID: [29752028](https://pubmed.ncbi.nlm.nih.gov/29752028/)

### 19. Special Education.

Carugno P, Sharma S. 2018 Apr 30.

StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2018 Jan-. Available from <http://www.ncbi.nlm.nih.gov/books/NBK499857/PubMed>

Special education is the process by which students with special needs are educated by the process of addressing their differences while integrating them as much as possible in the typical environment where their peers are educated. Success, measured as self-sufficiency, academic achievement, and future contributions to the community may not be achieved if the student is not provided this additional help. In the United States and many other countries, children who have educational needs are entitled by law to the identification of these needs, to be evaluated, and to receive services and accommodations that will help them perform to the best of their abilities and reach their academic potential. Special needs can include learning disabilities, speech and language impairments, autism spectrum disorders, cognitive impairments, emotional and behavioral disorders, physical disabilities like cerebral palsy, muscular dystrophies, sensory impairments like vision or hearing, chronic medical illnesses, and any condition that affects optimal education. Whenever possible, the needs of these students should be met in the same environment where typically developing peers learn. Only when progress is lacking in this mainstream setting, then a different classroom placement can be selected for their education. This new setting may include fewer students in the classroom, more teachers, or an increased level of support. The process of moving a child from the typical classroom or educational setting to a more restrictive one is gradual. Emphasis should be placed on finding the balance where the students' educational needs are met in the least restrictive environment.

PMID: [29763032](https://pubmed.ncbi.nlm.nih.gov/29763032/)

### 20. Prevalence and antimicrobial sensitivity pattern of urinary tract infection among children with cerebral palsy.

Ryakitimbo A, Philemon R, Mazuguni F, Msuya L.

Pediatric Health Med Ther. 2018 May 8;9:59-65. doi: 10.2147/PHMT.S159766. eCollection 2018.

**BACKGROUND:** Urinary tract infection (UTI) in children with cerebral palsy (CP) is a challenging yet common clinical condition. Children with CP bare the greatest risk of contracting UTI because of their difficulties in neuromotor control which lead to delay of bladder control, causing incomplete bladder emptying and urine retention. **METHOD:** This was an analytical cross-sectional study that was conducted from September 2016 to March 2017 at Comprehensive Community Based Rehabilitation in Tanzania - Moshi and Kilimanjaro Christian Medical Centre

Neurological Pediatrics Outpatient Clinic. All children who met the inclusion criteria were studied. Urine samples were collected at one point by catheterization, and urine dipstick and urine culture were done. Data were analyzed using SPSS version 20. **RESULTS:** A total of 99 children were enrolled in the study. The median age was 4 years (3-8 years); 53.5% were aged between 2 and 4 years. More than half were male. UTI was detected in 13.1% (n=13) of the children. Five causative agents of UTI were isolated, namely *Escherichia coli*, *Proteus mirabilis*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, and *Enterococcus faecalis*. The two most common organisms, *E. coli* and *P. mirabilis*, both had low sensitivity to ampicillin and co-trimoxazole while they were sensitive to ciprofloxacin and ceftriaxone. **CONCLUSION:** UTI is a common finding among children with CP. *E. coli* and *P. mirabilis* are the commonest causative agents and are sensitive to ciprofloxacin and ceftriaxone but have low sensitivity to ampicillin and co-trimoxazole.

PMID: [29774893](#)

## **21. Biofeedback interventions for individuals with cerebral palsy: a systematic review.**

MacIntosh A, Lam E, Vigneron V, Vignais N, Biddiss E.

Disabil Rehabil. 2018 May 12:1-23. doi: 10.1080/09638288.2018.1468933. [Epub ahead of print]

**PURPOSE:** The purpose of this study is to evaluate the quality of evidence of biofeedback interventions aimed at improving motor activities in people with Cerebral Palsy (CP). Second, to describe the relationship between intervention outcomes and biofeedback characteristics. **METHODS:** Eight databases were searched for rehabilitation interventions that provided external feedback and addressed motor activities. Two reviewers independently assessed and extracted data. The Grading of Recommendations Assessment, Development, and Evaluation (GRADE) framework was used to evaluate quality of evidence for outcome measures related to two International Classification of Functioning, Disability and Health (ICF) chapters. **RESULTS:** Fifty-seven studies were included. There were 53 measures related Activities and Participation and 39 measures related to Body Functions. Strength of evidence was "Positive, Very-Low" due to the high proportion of non-controlled studies and heterogeneity of measures. Overall, 79% of studies and 63% of measures showed improvement post-intervention. Counter to motor learning theory recommendations, most studies provided feedback consistently and concurrently throughout the intervention regardless of the individual's desire or progress. **CONCLUSION:** Heterogeneous interventions and poor study design limit the strength of biofeedback evidence. A thoughtful biofeedback paradigm and standardized outcome toolbox can strengthen the confidence in the effect of biofeedback interventions for improving motor rehabilitation for people with CP. Implications for Rehabilitation Biofeedback can improve motor outcomes for people with Cerebral Palsy. If given too frequently, biofeedback may prevent the client from learning autonomously. Use consistent and concurrent feedback to improve simple/specific motor activities. Use terminal feedback and client-directed feedback to improve more complex/general motor activities.

PMID: [29756481](#)

## **22. Trihexyphenidyl for dystonia in cerebral palsy.**

Harvey AR, Baker LB, Reddihough DS, Scheinberg A, Williams K.

Cochrane Database Syst Rev. 2018 May 15;5:CD012430. doi: 10.1002/14651858.CD012430.pub2. [Epub ahead of print] Review.

**BACKGROUND:** Cerebral palsy occurs in up to 2.1 of every 1000 live births and encompasses a range of motor problems and movement disorders. One commonly occurring movement disorder amongst those with cerebral palsy is dystonia: sustained or intermittent involuntary muscle spasms and contractions that cause twisting, repetitive movements and abnormal postures. The involuntary contractions are often very painful and distressing and cause significant limitations to activity and participation. Oral medications are often the first line of medical treatment for dystonia. Trihexyphenidyl is one such medication that clinicians often use to treat dystonia in people with cerebral palsy. **OBJECTIVES:** To assess the effects of trihexyphenidyl in people with dystonic cerebral palsy, according to the World Health Organization's (WHO) International Classification of Functioning, Disability and Health (ICF) domains of impairment, activity and participation. We also assessed the type and incidence of adverse effects in people taking the drug. **SEARCH METHODS:** We searched CENTRAL, MEDLINE, Embase, eight other databases and two trials registers in May 2017, and we checked reference lists and citations to identify additional studies. **SELECTION CRITERIA:** We included randomised controlled trials comparing oral trihexyphenidyl versus placebo for dystonia in cerebral palsy. We included studies in children and adults of any age with dystonic cerebral palsy, either in isolation or with the associated movement disorders of spasticity, ataxia, chorea, athetosis and/or hypotonia. We included studies regardless of whether or not the study authors specified the method used to

diagnose dystonia in their study population. Primary outcomes were change in dystonia and adverse effects. Secondary outcomes were: activity, including mobility and upper limb function; participation in activities of daily living; pain; and quality of life. DATA COLLECTION AND ANALYSIS: We used standard methodological procedures expected by Cochrane. MAIN RESULTS: We identified one study, which was set in Australia, that met the inclusion criteria. This was a randomised, double-blind, placebo-controlled, cross-over trial in 16 children (10 boys and 6 girls) with predominant dystonic cerebral palsy and a mean age of 9 years (standard deviation 4.3 years, range 2 to 17 years). We considered the trial to be at low risk of selection, performance, detection, attrition, reporting and other sources of bias. We rated the GRADE quality of the evidence as low. We found no difference in mean follow-up scores for change in dystonia as measured by the Barry Albright Dystonia Scale (BADS), which assesses eight body regions for dystonia on a 5-point scale (0 = none to 4 = severe), resulting in a total score of 0 to 32. The BADS score was 2.67 points higher (95% confidence interval (CI) -2.55 to 7.90; low-quality evidence), that is, worse dystonia, in the treated group. Trihexyphenidyl may be associated with an increased risk of adverse effects (risk ratio 2.54, 95% CI 1.38 to 4.67; low-quality evidence). There was no difference in mean follow-up scores for upper limb function as measured by the Quality of Upper Extremity Skills Test, which has four domains that collectively assess 36 items (each scored 1 or 2) and produces a total score of 0 to 100. The score in the treated group was 4.62 points lower (95% CI -10.98 to 20.22; low-quality evidence), corresponding to worse function, than in the control group. We found low-quality evidence for improved participation (as represented by higher scores) in the treated group in activities of daily living, as measured by three tools: 18.86 points higher (95% CI 5.68 to 32.03) for the Goal Attainment Scale (up to five functional goals scored on 5-point scale (-2 = much less than expected to +2 = much more than expected)), 2.91 points higher (95% CI 1.01 to 4.82) for the satisfaction subscale of the Canadian Occupational Performance Measure (COPM; satisfaction with performance in up to five problem areas scored on a 10-point scale (1 = not satisfied at all to 10 = extremely satisfied)), and 2.24 points higher (95% CI 0.64 to 3.84) for performance subscale of the COPM (performance in up to five problem areas scored on a 10-point scale (1 = not able to do to; 10 = able to do extremely well)). The study did not report on pain or quality of life. AUTHORS' CONCLUSIONS: At present, there is insufficient evidence regarding the effectiveness of trihexyphenidyl for people with cerebral palsy for the outcomes of: change in dystonia, adverse effects, increased upper limb function and improved participation in activities of daily living. The study did not measure pain or quality of life. There is a need for larger randomised, controlled, multicentre trials that also examine the effect on pain and quality of life in order to determine the effectiveness of trihexyphenidyl for people with cerebral palsy.

PMID: [29763510](#)

### 23. Associations of Coexisting Conditions with Healthcare Spending for Children with Cerebral Palsy.

Berry JG, Glader L, Stevenson RD, Hasan F, Crofton C, Hussain K, Hall M.

J Pediatr. 2018 May 8. pii: S0022-3476(18)30522-5. doi: 10.1016/j.jpeds.2018.04.021. [Epub ahead of print]

OBJECTIVE: To determine which coexisting conditions have the strongest associations with healthcare use and spending among children with cerebral palsy (CP). STUDY DESIGN: Retrospective analysis of 16 695 children ages 0-18 years with CP - identified with International Classification of Diseases, Ninth Revision, Clinical Modification codes - using Medicaid from January 1, 2013 to December 31, 2013 from 10 states in the Truven MarketScan Medicaid Database. Using generalized linear models, we assessed which coexisting conditions (including medical technology) identified with Agency for Healthcare Research and Quality's Chronic Condition Indicators had the strongest associations with total healthcare spending across the healthcare continuum. RESULTS: Median per-patient annual Medicaid spending for children with CP was \$12 299 (IQR \$4826-\$35 582). Most spending went to specialty (33.1%) and hospital (26.7%) care. The children had a median 6 (IQR 4-10) coexisting conditions; epilepsy was the most common (38.1%). Children with epilepsy accounted for 59.6% (\$364 million) of all CP spending. In multivariable analysis, the coexisting conditions most strongly associated with increased spending were tracheostomy (median additional cost per patient = \$56 567 [95%CI \$51 386-61 748]) and enterostomy (median additional cost per patient = \$25 707 [95%CI \$23 753-27 660]). CONCLUSIONS: Highly prevalent in children with CP using Medicaid, coexisting conditions correlate strongly with healthcare spending. Tracheostomy and enterostomy, which indicate significant functional impairments in breathing and digestion, are associated with the highest spending. Families, providers, payers, and legislators may leverage these findings when designing policies positioned to enable the best health and care for children with cerebral palsy.

PMID: 29752173.

**24. The fetus at the tipping point: modifying the outcome of fetal asphyxia.**

Dhillon SK, Lear CA, Galinsky R, Wassink G, Davidson J, Juul S, Robertson NJ, Gunn AJ, Bennet L.

J Physiol. 2018 May 17. doi: 10.1113/JP274949. [Epub ahead of print]

Brain injury around birth is associated with nearly half of all cases of cerebral palsy. Although brain injury is multifactorial, particularly after preterm birth, acute hypoxia-ischaemia is a major contributor to injury. It is now well established that the severity of injury after HI is determined by a dynamic balance between injurious and protective processes. In addition, mothers who are at risk of premature delivery have high rates of diabetes and antepartum infection/inflammation and are almost universally given treatments such as antenatal glucocorticoids and magnesium sulphate to reduce the risk of death and complications after preterm birth. We review evidence that these common factors affect responses to fetal asphyxia, often in unexpected ways. For example, glucocorticoid exposure dramatically increases delayed cell loss after acute hypoxia-ischaemia, largely through secondary hyperglycaemia. This critical new information is important to understand the effects of clinical treatments of women whose fetuses are at risk of perinatal asphyxia. This article is protected by copyright. All rights reserved.

PMID: [29774532](#)**25. Correlation of the predisposition of Chinese children to cerebral palsy with nucleotide variation in pri-miR-124 that alters the non-canonical apoptosis pathway.**

Li H, Wang XL, Wu YQ, Liu XM, Li AM.

Acta Pharmacol Sin. 2018 May 17. doi: 10.1038/aps.2017.211. [Epub ahead of print]

Cerebral palsy is a group of non-progressive motor impairment syndromes caused by brain lesions during development. Herein, we investigated the relationship between nucleotide variations in a miRNA coding region and the predisposition of Chinese children to cerebral palsy. A total of 233 CP patients and 256 healthy participants were enrolled, and 60 children were selected from each group for plasma miRNA detection. We screened the coding regions of pri-miR-124-1, -2, and -3 using PCR and sequencing. The expression of miR-124 was determined by qRT-PCR. Luciferase assays and Western blots were used to confirm the regulation of target genes by miR-124. The function of miR-124 was further identified in SH-SY5Y cells by detecting cell viability and apoptosis. We revealed that the rare alleles T of rs3802169 and G of rs191727850 were found to be associated with an increased risk of cerebral palsy (OR=3.71, 95% CI 1.74-7.92 and OR=2.18, 95% CI 1.36-3.49, respectively). We further showed that the levels of mature miR-124 were down-regulated by the C-to-T variation in vitro. More importantly, the reduction of miR-124 resulting from the C-to-T change led to the less-efficient inhibition of the target genes ITGB1, LAMC1 and BECN1, which may play important roles during the development of the nervous system. Meanwhile, the reduction in the expression of miR-124 was also related to the increased nuclear translocation of apoptosis-inducing factor (AIF) under oxidative stress, thereby inducing more cell apoptosis. Our results suggest that one functional polymorphism in pri-miR-124-1 might contribute to the genetic predisposition of Chinese children to cerebral palsy by disrupting the production of miR-124, which consequently interfered in the expression and function of the target genes of miR-124.

PMID: [29772695](#)**26. [Research on brain white matter network in cerebral palsy infant].**

Li J, Yang C, Wang Y, Nie S.

Sheng Wu Yi Xue Gong Cheng Xue Za Zhi. 2017 Oct 1;34(5):688-694. doi: 10.7507/1001-5515.201612044. Chinese.

Present study used diffusion tensor image and tractography to construct brain white matter networks of 15 cerebral palsy infants and 30 healthy infants that matched for age and gender. After white matter network analysis, we found that both cerebral palsy and healthy infants had a small-world topology in white matter network, but cerebral palsy infants exhibited abnormal topological organization: increased shortest path length but decreased normalized clustering coefficient, global efficiency and local efficiency. Furthermore, we also found that white matter network hub regions were located in the left cuneus, precuneus, and left posterior cingulate gyrus. However, some abnormal nodes existed in the frontal, temporal, occipital and parietal lobes of cerebral palsy infants. These results indicated that the white matter networks for cerebral palsy infants were disrupted, which was consistent with previous studies about the abnormal brain white matter areas. This work could help us further study the pathogenesis of cerebral palsy infants.

PMID: [29772695](#)

### **27. Genomic analysis identifies masqueraders of full-term cerebral palsy.**

Takezawa Y, Kikuchi A, Haginoya K, Niihori T, Numata-Uematsu Y, Inui T, Yamamura-Suzuki S, Miyabayashi T, Anzai M, Suzuki-Muromoto S, Okubo Y, Endo W, Togashi N, Kobayashi Y, Onuma A, Funayama R, Shirota M, Nakayama K, Aoki Y, Kure S.

Ann Clin Transl Neurol. 2018 Mar 26;5(5):538-551. doi: 10.1002/acn3.551. eCollection 2018 May.

**OBJECTIVE:** Cerebral palsy is a common, heterogeneous neurodevelopmental disorder that causes movement and postural disabilities. Recent studies have suggested genetic diseases can be misdiagnosed as cerebral palsy. We hypothesized that two simple criteria, that is, full-term births and nonspecific brain MRI findings, are keys to extracting masqueraders among cerebral palsy cases due to the following: (1) preterm infants are susceptible to multiple environmental factors and therefore demonstrate an increased risk of cerebral palsy and (2) brain MRI assessment is essential for excluding environmental causes and other particular disorders. **METHODS:** A total of 107 patients—all full-term births—without specific findings on brain MRI were identified among 897 patients diagnosed with cerebral palsy who were followed at our center. DNA samples were available for 17 of the 107 cases for trio whole-exome sequencing and array comparative genomic hybridization. We prioritized variants in genes known to be relevant in neurodevelopmental diseases and evaluated their pathogenicity according to the American College of Medical Genetics guidelines. **RESULTS:** Pathogenic/likely pathogenic candidate variants were identified in 9 of 17 cases (52.9%) within eight genes: CTNNB1, CYP2U1, SPAST, GNAO1, CACNA1A, AMPD2, STXBP1, and SCN2A. Five identified variants had previously been reported. No pathogenic copy number variations were identified. The AMPD2 missense variant and the splice-site variants in CTNNB1 and AMPD2 were validated by in vitro functional experiments. **INTERPRETATION:** The high rate of detecting causative genetic variants (52.9%) suggests that patients diagnosed with cerebral palsy in full-term births without specific MRI findings may include genetic diseases masquerading as cerebral palsy.

PMID: [29763510](#)