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Interventions and Management

1. *Am J Occup Ther.* 2015 Nov-Dec;69(6):6906180010p1-6906180010p9.

Multiple Treatments of Pediatric Constraint-Induced Movement Therapy (pCIMT): A Clinical Cohort Study.

DeLuca SC, Ramey SL, Trucks MR, Wallace DA.

Pediatric constraint-induced movement therapy (pCIMT) is one of the most efficacious treatments for children with cerebral palsy (CP). Distinctive components of pCIMT include constraint of the less impaired upper extremity (UE), high-intensity therapy for the more impaired UE (≥ 3 hr/day, many days per week, for multiple weeks), use of shaping techniques combined with repetitive task practice, and bimanual transfer. A critical issue is whether multiple treatments of pCIMT produce additional benefit. In a clinical cohort (mean age = 31 mo) of 28 children with asymmetrical CP whose parents sought multiple pCIMT treatments, the children gained a mean of 13.2 (standard deviation [SD] = 4.2) new functional skills after Treatment 1; Treatment 2 produced a mean of 7.3 (SD = 4.7) new skills; and Treatment 3, 6.5 (SD = 4.2). These findings support the conclusion that multiple pCIMT treatments can produce clinically important functional gains for children with hemiparetic CP.

[PMID: 26565094](#)

2. *Neurorehabil Neural Repair.* 2015 Nov 11. pii: 1545968315613446. [Epub ahead of print]

Imaging Predictors of Improvement From a Motor Learning-Based Intervention for Children With Unilateral Cerebral Palsy.

Schertz M, Shiran SI, Myers V, Weinstein M, Fattal-Valevski A, Artzi M, Ben Bashat D, Gordon AM, Green D.

BACKGROUND: Motor-learning interventions may improve hand function in children with unilateral cerebral palsy (UCP) but with inconsistent outcomes across participants. **OBJECTIVE:** To examine if pre-intervention brain imaging predicts benefit from bimanual intervention. **METHOD:** Twenty children with UCP with Manual Ability Classification System levels I to III, aged 7-16 years, participated in an intensive bimanual intervention. Assessments included the Assisting Hand Assessment (AHA), Jebsen Taylor Test of Hand Function (JTTHF) and Children's Hand Experience Questionnaire (CHEQ) at baseline (T1), completion (T2) and 8-10 weeks post-intervention (T3). Imaging at baseline included conventional structural (radiological score), functional (fMRI) and diffusion tensor imaging (DTI). **RESULTS:**

Improvements were seen across assessments; AHA ($P = 0.04$), JTTHF ($P < .001$) and CHEQ ($P < 0.001$). Radiological score significantly correlated with improvement at T2; AHA ($r = .475$) and CHEQ ($r = .632$), but

negatively with improvement on unimanual measures at T3 (JTTFH $r = -.514$). fMRI showed negative correlations between contralesional brain activation when moving the affected hand and AHA improvements (T2: $r = -.562$, T3: $r = -.479$). Fractional Anisotropy in the affected posterior limb of the internal capsule correlated negatively with increased bimanual use on CHEQ at T2 ($r = -.547$) and AHA at T3 ($r = -.656$). CONCLUSIONS: Children with greater structural, functional and connective brain damage showed enhanced responses to bimanual intervention. Baseline imaging may identify parameters predicting response to intervention in children with UCP.

[PMID: 26564999](#)

3. *Pediatr Radiol.* 2015 Nov 10. [Epub ahead of print]

Optimization of MRI-based scoring scales of brain injury severity in children with unilateral cerebral palsy.

Pagnozzi AM, Fiori S, Boyd RN, Guzzetta A, Doecke J, Gal Y, Rose S, Dowson N.

BACKGROUND: Several scoring systems for measuring brain injury severity have been developed to standardize the classification of MRI results, which allows for the prediction of functional outcomes to help plan effective interventions for children with cerebral palsy. **OBJECTIVE:** The aim of this study is to use statistical techniques to optimize the clinical utility of a recently proposed template-based scoring method by weighting individual anatomical scores of injury, while maintaining its simplicity by retaining only a subset of scored anatomical regions. **MATERIALS AND METHODS:** Seventy-six children with unilateral cerebral palsy were evaluated in terms of upper limb motor function using the Assisting Hand Assessment measure and injuries visible on MRI using a semiquantitative approach. This cohort included 52 children with periventricular white matter injury and 24 with cortical and deep gray matter injuries. A subset of the template-derived cerebral regions was selected using a data-driven region selection algorithm. Linear regression was performed using this subset, with interaction effects excluded. **RESULTS:** Linear regression improved multiple correlations between MRI-based and Assisting Hand Assessment scores for both periventricular white matter (R squared increased to 0.45 from 0, $P < 0.0001$) and cortical and deep gray matter (0.84 from 0.44, $P < 0.0001$) cohorts. In both cohorts, the data-driven approach retained fewer than 8 of the 40 template-derived anatomical regions. **CONCLUSION:** The equal or better prediction of the clinically meaningful Assisting Hand Assessment measure using fewer anatomical regions highlights the potential of these developments to enable enhanced quantification of injury and prediction of patient motor outcome, while maintaining the clinical expediency of the scoring approach.

[PMID: 26554854](#)

4. *Phys Occup Ther Pediatr.* 2015 Nov 13:1-15. [Epub ahead of print]

Does Context Matter? Mastery Motivation and Therapy Engagement of Children with Cerebral Palsy.

Miller L, Ziviani J, Ware RS, Boyd RN.

AIMS: To determine if mastery motivation at baseline predicts engagement in two goal-directed upper limb (UL) interventions for children with unilateral cerebral palsy (UCP). **METHODS:** Participants were 44 children with UCP, mean age 7 years 10 months, Manual Ability Classification System level I (N = 23) or II (N = 21). Twenty-six children received intensive novel group-based intervention (Hybrid Constraint Induced Movement Therapy, hCIMT) and 18 received distributed individual occupational therapy (OT). Caregivers completed the Dimensions of Mastery Questionnaire (DMQ) parent-proxy report at baseline. Children's engagement was independently rated using the Pediatric Volitional Questionnaire (PVQ). Associations between children's mastery motivation and engagement were examined using linear regression. **RESULTS:** Children who received hCIMT had lower DMQ persistence at baseline ($p = .05$) yet higher PVQ volitional ($p = .04$) and exploration ($p = .001$) scores. Among children who received hCIMT, greater object-oriented persistence was associated with task-directedness ($\beta = 0.25$, $p = .05$), seeking challenges ($\beta = 0.51$, $p = .02$), exploration ($\beta = 0.10$, $p = .03$), and volitional scores ($\beta = 0.23$, $p = .01$). **CONCLUSION:** Despite having lower levels of persistence prior to engaging in UL interventions, children who received hCIMT demonstrated greater engagement in goal-directed tasks than children who received individual OT.

Within hCIMT, children's motivational predisposition to persist with tasks manifested in their exploration and engagement in therapy.

[PMID: 26565438](#)

5. Clin Biomech (Bristol, Avon). 2015 Nov 5. pii: S0268-0033(15)00287-9. doi: 10.1016/j.clinbiomech.2015.10.010. [Epub ahead of print]

The use of turning tasks in clinical gait analysis for children with cerebral palsy.

Dixon PC, Stebbins J, Theologis T, Zavatsky AB.

BACKGROUND: Turning while walking is a crucial component of locomotion that is performed using an outside (step) or inside (spin) limb strategy. The aims of this paper were to determine how children with cerebral palsy perform turning maneuvers and if specific kinematic and kinetic adaptations occur compared to their typically developing peers. **METHODS:** Motion capture data from twenty-two children with cerebral palsy and fifty-four typically developing children were collected during straight and 90° turning gait trials. Experimental data were used to compute spatio-temporal parameters, margin of stability, ground reaction force impulse, as well as joint kinematics and kinetics. **FINDINGS:** Both child groups preferred turning using the spin strategy. The group of children with cerebral palsy exhibited the following adaptations during turning gait compared to the typically developing group: stride length was decreased across all phases of the turn with largest effect size for the depart phase (2.02), stride width was reduced during the turn phase, but with a smaller effect size (0.71), and the average margin of stability during the approach phase of turning was reduced (effect size of 0.98). Few overall group differences were found for joint kinematic and kinetic measures; however, in many cases, the intra-subject differences between straight walking and turning gait were larger for the majority of children with cerebral palsy than for the typically developing children. **INTERPRETATION:** In children with cerebral palsy, turning gait may be a better discriminant of pathology than straight walking and could be used to improve the management of gait abnormalities.

[PMID: 26549659](#)

6. Dev Med Child Neurol. 2015 Nov 11. doi: 10.1111/dmcn.12955. [Epub ahead of print]

Neuromuscular electrical stimulation-assisted gait increases muscle strength and volume in children with unilateral spastic cerebral palsy.

Pool D, Elliott C, Bear N, Donnelly CJ, Davis C, Stannage K, Valentine J.

AIM: To determine if neuromuscular electrical stimulation (NMES) applied to the ankle dorsiflexors during gait improves muscle volume and strength in children with unilateral spastic cerebral palsy (CP). **METHOD:** Thirty-two children (15 females, 17 males; mean age 10y 8mo, age range 5y 5mo-18y 1mo) with unilateral spastic CP and a Gross Motor Function Classification System of level I or level II were randomly assigned to either the 8-week daily NMES treatment group or control group (usual or conventional treatments). Outcomes at week 8 (post-NMES) and week 14 (carryover) included magnetic resonance imaging for muscle volumes (tibialis anterior, anterior compartment, and gastrocnemius), strength (hand-held dynamometry for isometric dorsiflexion strength and heel raises for functional strength), and clinical measures for lower limb selective motor control. **RESULTS:** At week 8, the treatment group demonstrated significantly ($p < 0.05$) increased muscle volumes for tibialis anterior, anterior compartment, medial and lateral gastrocnemius, and dorsiflexion strength not only when compared to their baseline values but also when compared to the control group at week 8. At week 14, both tibialis anterior and lateral gastrocnemius volumes in the treatment group remained significantly increased when compared to their baseline values. However, only lateral gastrocnemius volumes had significantly greater values when compared to the control group at week 14. There were no between group differences in the clinical measures for lower limb selective motor control at week 8 and 14. **INTERPRETATION:** Eight weeks of daily NMES-assisted gait increases muscle volume and strength of the stimulated ankle dorsiflexors in children with unilateral spastic CP. These changes are use-

dependent and do not carry over after the 8-week treatment period. Gastrocnemius volume also increased post-treatment with carryover at week 14.

[PMID: 26555148](#)

7. Muscle Nerve. 2015 Nov 13. doi: 10.1002/mus.24972. [Epub ahead of print]

Heterogeneity of muscle sizes in the lower limbs of children with cerebral palsy.

Handsfield GG, Meyer CH, Abel MF, Blemker SS.

INTRODUCTION: Cerebral palsy (CP) is associated with reduced muscle volumes, but previous studies have reported deficits in only a small number of muscles. The extent of volume deficits across lower limb muscles is not known. This study presents an imaging-based assessment of muscle volume and length deficits in 35 lower limb muscles. **METHODS:** We imaged and segmented 35 muscles in 10 subjects with CP and 8 typically developing (TD) controls using MRI. Muscle volumes were normalized, and Z-scores were computed using TD data. Volume Z-scores and percent deficits in volume, length, and cross-sectional area are reported. **RESULTS:** Muscle volumes are 20% lower on average for subjects with CP. Volume deficits differ significantly between muscles (12%-43%) and display significant heterogeneity across subjects. Distal muscles, especially the soleus, are commonly and severely small.

DISCUSSION: Heterogeneity across muscles and across subjects reinforces the subject-specificity of CP and the need for individualized treatment planning. This article is protected by copyright. All rights reserved.

[PMID: 26565390](#)

8. Childs Nerv Syst. 2015 Nov 9. [Epub ahead of print]

Selective dorsal rhizotomy as an alternative to intrathecal baclofen pump replacement in GMFCS grades 4 and 5 children.

Ingale H, Ughratdar I, Muquit S, Moussa AA, Vloeberghs MH.

BACKGROUND: Conventionally, selective dorsal rhizotomy (SDR) has been reserved for ambulant children and implantation of intrathecal baclofen (ITB) pump for non-ambulant children with cerebral palsy. Rather than replacing the ITB pump in selected Gross Motor Function Classification System (GMFCS) grades 4 and 5 children, we elected to undertake SDR instead. We discuss the rationale and outcomes. **OBJECTIVES:** To assess if children with severe spasticity treated with long-term ITB pump would benefit from SDR as alternative procedure to replacement of ITB pump. **METHOD:** This study is a prospective review of ten children with severe spasticity. Indications for ITB pump replacement in 3/10 children were previous ITB pump infection and the remaining seven were nearing depletion of drug delivery system. Pre- and post-SDR mean modified Ashworth scores, assessment of urological function and survey of parent/carer satisfaction were undertaken. **RESULT:** Mean Ashworth score reductions post-SDR in the lower limbs and upper limbs were 2.4 and 1.70, respectively. An improvement in urological function was also noticed in 27 % of patients. Overall, 90 % of parents/carers felt that functional outcome with SDR was improved compared with that of ITB. **CONCLUSION:** SDR in comparison to ITB in this subgroup is cheaper, less intrusive by avoiding refills/replacement and found to be more effective than ITB in reducing spasticity and providing ease for nursing care. We therefore suggest that consideration should be given to SDR as an alternative in patients previously implanted with ITB systems complicated by infection or nearing end of battery life.

[PMID: 26552383](#)

9. Cochrane Database Syst Rev. 2015 Nov 13;11:CD004552. [Epub ahead of print]

Intrathecal baclofen for treating spasticity in children with cerebral palsy.

Hasnat MJ, Rice JE.

BACKGROUND: Cerebral palsy is a disorder of movement and posture arising from a non-progressive lesion in the developing brain. Spasticity, a disorder of increased muscle tone, is the most common motor difficulty and is associated with activity limitation to varying degrees in mobility and self care. Oral baclofen, a gamma-aminobutyric acid (GABA) agonist, has been used in oral form to treat spasticity for some time, but it has a variable effect on spasticity and the dose is limited by the unwanted effect of excessive sedation. Intrathecal baclofen produces higher local concentrations in cerebrospinal fluid at a fraction of the equivalent oral dose and avoids this excessive sedation.

OBJECTIVES: To determine whether intrathecal baclofen is an effective treatment for spasticity in children with cerebral palsy. **SEARCH METHODS:** We searched the CENTRAL, MEDLINE, EMBASE and CINAHL databases, handsearched recent conference proceedings, and communicated with researchers in the field and pharmaceutical and drug delivery system companies. **SELECTION CRITERIA:** We included studies which compared the effect of intrathecal baclofen treatment on spasticity, gross motor function or other areas of function with controls. **DATA COLLECTION AND ANALYSIS:** Two authors selected studies, two authors extracted data and two authors assessed the methodological quality of included studies. **MAIN RESULTS:** Six studies met the inclusion criteria. The data obtained were unsuitable for the conduct of a meta-analysis; we have completed a qualitative summary. All studies were found to have high or unclear risk of bias in some aspects of their methodology. Five of the six studies reported data collected in the randomised controlled phase of the study. A sixth study did not report sufficient results to determine the effect of intrathecal baclofen versus placebo. Of these five studies, four were conducted using lumbar puncture or other short-term means of delivering intrathecal baclofen. One study assessed the effectiveness of implantable intrathecal baclofen pumps over six months. The four short-term studies demonstrated that intrathecal baclofen therapy reduces spasticity in children with cerebral palsy. However, two of these studies utilised inappropriate techniques for statistical analysis of results. The single longer-term study demonstrated minimal reduction in spasticity with the use of intrathecal baclofen therapy. One of the short-term studies and the longer term study showed improvement in comfort and ease of care. The longer term study found a small improvement in gross motor function and also in some domains of health-related quality of life. Some caution is required in interpreting the findings of the all the studies in the review due to methodological issues. In particular, there was a high risk of bias in the methodology of the longer term study due to the lack of placebo use in the control group and the absence of blinding to the intervention after randomisation for both participants and investigators. **AUTHORS' CONCLUSIONS:**

There is some limited short-term evidence that intrathecal baclofen is an effective therapy for reducing spasticity in children with cerebral palsy. The effect of intrathecal baclofen on long-term spasticity outcomes is less certain. The validity of the evidence for the effectiveness of intrathecal baclofen in treating spasticity in children with cerebral palsy from the studies in the review is constrained by the small sample sizes of the studies and methodological issues in some studies. Spasticity is an impairment in the domain of body structure and function. Consideration must also be given to the broader context in determining whether intrathecal baclofen therapy is effective. The aim of therapy may be, for example, to improve gross motor function, to increase participation at a social role level, to improve comfort, to improve the ease of care by others or to improve the overall quality of life of the individual. Intrathecal baclofen may improve gross motor function in children with cerebral palsy, but more reliable evidence is needed to determine this. There is some evidence that intrathecal baclofen improves ease of care and the comfort and quality of life of the individuals receiving it, but again small sample sizes and methodological issues in the studies mean that these results should be interpreted with caution. Further evidence of the effectiveness of intrathecal baclofen for treating spasticity, increasing gross motor function and improving comfort, ease of care and quality of life is needed from other investigators in order to validate these results. The short duration of the controlled studies included in this review did not allow for the exploration of questions regarding whether the subsequent need for orthopaedic surgery in children receiving intrathecal baclofen therapy is altered, or the safety and the economic implications of intrathecal baclofen treatment when long-term therapy is administered via an implanted device. Controlled studies are not the most appropriate study design to address these questions, cohort studies may be more appropriate.

[PMID: 26563961](#)

10. J Clin Diagn Res. 2015 Oct;9(10):YC01-4. doi: 10.7860/JCDR/2015/12882.6604. Epub 2015 Oct 1.

Validation of Gujarati Version of ABILOCO-Kids Questionnaire.

Diwan S, Diwan J, Patel P, Bansal AB.

BACKGROUND: ABILOCO-Kids is a measure of locomotion ability for children with cerebral palsy (CP) aged 6 to 15 years & is available in English & French. **AIM:** To validate the Gujarati version of ABILOCO-Kids questionnaire to be used in clinical research on Gujarati population. **MATERIALS AND METHODS:** ABILOCO-Kids questionnaire was translated into Gujarati from English using forward-backward-forward method. To ensure face & content validity of Gujarati version using group consensus method, each item was examined by group of experts having mean experience of 24.62 years in field of paediatric and paediatric physiotherapy. Each item was analysed for content, meaning, wording, format, ease of administration & scoring. Each item was scored by expert group as either accepted, rejected or accepted with modification. Procedure was continued until 80% of consensus for all items. Concurrent validity was examined on 55 children with Cerebral Palsy (6-15 years) of all Gross Motor Functional Classification System (GMFCS) level & all clinical types by correlating score of ABILOCO-Kids with Gross Motor Functional Measure & GMFCS. **RESULT:** In phase 1 of validation, 16 items were accepted as it is; 22 items accepted with modification & 3 items went for phase 2 validation. For concurrent validity, highly significant positive correlation was found between score of ABILOCO-Kids & total GMFM ($r=0.713$, $p<0.005$) & highly significant negative correlation with GMFCS ($r= -0.778$, $p<0.005$). **CONCLUSION:** Gujarati translated version of ABILOCO-Kids questionnaire has good face & content validity as well as concurrent validity which can be used to measure caregiver reported locomotion ability in children with CP.

[PMID: 26557603](#)

11. Phys Occup Ther Pediatr. 2015 Nov 13:1-15. [Epub ahead of print]

Playfulness in Children with Limited Motor Abilities When Using a Robot.

Rios-Rincon AM, Adams K, Magill-Evans J, Cook A.

AIMS: Children with limited gross motor and manual abilities have fewer opportunities to engage in free play. We investigated the effect of a robotic intervention on the playfulness of children with cerebral palsy (CP). **METHODS:** We used a partially nonconcurrent multiple baseline design with four children and their mothers. Children were classified in level IV or V on the Gross Motor Function and Manual Ability Classification Systems. The intervention was the availability of an adapted Lego robot during a 15-min free play session between the child and mother. There were two sessions per week for about 14 weeks. Playfulness was measured using the Test of Playfulness. **RESULTS:** Statistical comparisons using the 2 SD band and X-moving range chart methods revealed that all the children's levels of playfulness increased significantly while they played with the robot. Comparison of baseline and follow-up phase indicated that three children had retention of improved level of playfulness. **CONCLUSION:** Play with adapted Lego robots increased the level of playfulness in all four children during free play with their mothers. The findings have implications for providing children with limitations in motor abilities opportunities for free play with family and friends.

[PMID: 26566226](#)

12.Toxins (Basel). 2015 Nov 6;7(11):4645-4654.

Questionnaire about the Adverse Events and Side Effects Following Botulinum Toxin A Treatment in Patients with Cerebral Palsy.

Blaszczyk I, Foumani NP, Ljungberg C, Wiberg M.

Botulinum toxin A (BoNT-A) injections for treatment of spasticity in patients with cerebral palsy (CP) have been used for about two decades. The treatment is considered safe but a low frequency of adverse events (AE) has been reported. A good method to report AEs is necessary to verify the safety of the treatment. We decided to use

an active surveillance of treatment-induced harm using a questionnaire we created. We studied the incidence of reported AEs and side effects in patients with CP treated with BoNT-A. We investigated the relationship between the incidence of AEs or side effects and gender, age, weight, total dose, dose per body weight, Gross Motor Function Classification System (GMFCS) and number of treated body parts. Seventy-four patients with CP participated in our study. In 54 (51%) of 105 BoNT-A treatments performed in 45 (61%) patients, there were 95 AEs and side effects reported, out of which 50 were generalized and/or focal distant. Severe AEs occurred in three patients (4%), and their BoNT-A treatment was discontinued. Consecutive collection of the AE and side-effect incidence using our questionnaire can increase the safety of BoNT-A treatment in patients with CP.

[PMID: 26561833](#)

Prevention and Cure

13. *Dev Med Child Neurol.* 2015 Nov 11. doi: 10.1111/dmcn.12953. [Epub ahead of print]

Cerebral palsy after neonatal encephalopathy: do neonates with suspected asphyxia have worse outcomes?

Garfinkle J, Wintermark P, Shevell MI, Oskoui M; Canadian Cerebral Palsy Registry.

AIM: We sought to investigate how brain injury and severity, and neurological subtype of cerebral palsy (CP) differed in term-born children with CP after neonatal encephalopathy, between those with suspected birth asphyxia and those without. **METHOD:** Using the Canadian CP Registry, which included 1001 children, those with CP born at ≥ 36 wks after moderate or severe neonatal encephalopathy, were dichotomized according to the presence or absence of suspected birth asphyxia. Gross Motor Function Classification System (GMFCS) scores, neurological subtypes, comorbidities, and magnetic resonance imaging findings were compared. **RESULTS:** Of the 147 term-born children with CP (82 males, 65 females; median age 37 months, interquartile range [IQR] 26-52.5) who after moderate or severe neonatal encephalopathy had the required outcome data, 61 (41%) met criteria for suspected birth asphyxia. They had a higher frequency of non-ambulatory GMFCS status (odds ratio [OR] 3.4, 95% confidence interval [CI] 1.72-6.8), spastic quadriplegia (OR 2.8, 95% CI 1.4-5.6), non-verbal communication skills impairment (OR 4.2, 95% CI 2.0-8.6), isolated deep grey matter injury (OR 4.1, 95% CI 1.8-9.5), a lower frequency of spastic hemiplegia (OR 0.17, 95% CI 0.07-0.42), focal injury (OR 0.20; 95% CI 0.04-0.93), and more comorbidities ($p=0.017$) than those who did not meet criteria. **INTERPRETATION:** Term-born children who develop CP after neonatal encephalopathy with suspected birth asphyxia have a greater burden of disability than those without suspected birth asphyxia.

[PMID: 26555029](#)