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## Interventions and Management

1. *Dev Med Child Neurol.* 2015 May 6. doi: 10.1111/dmcn.12789. [Epub ahead of print]

**Cerebral palsy research funding from the National Institutes of Health, 2001 to 2013.**

Wu YW<sup>1</sup>, Mehravari AS, Numis AL, Gross P.

**AIM:** Cerebral palsy (CP) is a poorly understood disorder with no cure. We determined the landscape of National Institutes of Health (NIH) funding for CP-related research. **METHOD:** We searched NIH databases Research Portfolio Online Reporting Tools Expenditures and Results, and Research, Condition, and Disease Categorization for keywords 'cerebral palsy' among all NIH-funded studies, 2001 to 2013. We classified grants by type and area of study. **RESULTS:** NIH funding, averaging \$30 million per year, supported clinical (\$215 million), basic (\$187 million), and translational (\$26.3 million) CP-related research. Clinical intervention studies comprised 19% of funding, and focused on treatments (\$60.3 million), early parent intervention (\$2.7 million), and CP prevention (\$2.5 million). Among grants that specified gestational age, more funds were devoted to preterm (\$166 million) than term infants (\$15 million). CP in adulthood was the main focus of 4% of all funding. Annual NIH funding for CP increased steadily over the study period from \$3.6 to \$66.7 million. However, funding for clinical intervention studies peaked in 2008, and has since decreased. **INTERPRETATION:** Additional research funds are needed to improve the treatment and prevention of CP. Topics that have been relatively underfunded include clinical interventions, prevention, and term infants and adults with CP.

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2. *Dev Med Child Neurol.* 2015 Jun;57(6):530-538. doi: 10.1111/dmcn.12705. Epub 2015 Feb 27.

**Randomized controlled trial of web-based multimodal therapy for unilateral cerebral palsy to improve occupational performance.**

James S<sup>1</sup>, Ziviani J<sup>2,3</sup>, Ware RS<sup>4,5</sup>, Boyd RN<sup>1</sup>.

**AIM:** The study aimed to investigate the effectiveness of a web-based therapy programme, 'Move it to improve it' (Mitii™), in children with unilateral cerebral palsy (UCP) on occupational performance, upper limb function, and visual perception. **METHOD:** Participants (n=102) were matched in pairs and randomized to intervention (Mitii for 20wks; 26 males, mean age 11y 8mo [2y 4mo], Manual Ability Classification System level I=11, II=39, III=1) or control (standard care; 25 males, mean age 11y 10mo [2y 5mo], Manual Ability Classification System level I=13, II=37). Outcomes were the Assessment of Motor and Process Skills (AMPS), Assisting Hand Assessment, Jebsen

-Taylor Test of Hand Function (JTTHF), Melbourne Assessment of Unilateral Upper Limb Function (MUUL), Canadian Occupational Performance Measure (COPM), and Test of Visual Perceptual Skills (TVPS-3). RESULTS: Participants completed on average 32.4 hours of Mitii (range 3.7-74.7h). The Mitii group demonstrated significantly greater post-intervention scores than the comparison group on the AMPS, JTTHF dominant upper limb, COPM, and TVPS-3. The differences between groups were not clinically significant. There were no differences between groups on measures of impaired upper limb function. INTERPRETATION: Mitii delivers individualized, web-based therapy at home and has potential to increase therapy dose. Mitii can be considered as an option to enhance occupational performance and visual perception for children with UCP.

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**3. J Biomech. 2015 Apr 22. pii: S0021-9290(15)00238-9. doi: 10.1016/j.jbiomech.2015.04.018. [Epub ahead of print]**

**Wrist range of motion and motion frequency during toy and game play with a joint-specific controller specially designed to provide neuromuscular therapy: A proof of concept study in typically developing children.**

Crisco JJ1, Schwartz JB2, Wilcox B2, Brideau H2, Basseches B2, Kerman K3.

Upper extremities affected by hemiplegic cerebral palsy (CP) and other neuromuscular disorders have been demonstrated to benefit from therapy, and the greater the duration of the therapy, the greater the benefit. A great motivator for participating in and extending the duration of therapy with children is play. Our focus is on active motion therapy of the wrist and forearm. In this study we examine the wrist motions associated with playing with two toys and three computer games controlled by a specially-designed play controller. Twenty children (ages 5-11) with no diagnosis of a muscular disorder were recruited. The play controller was fitted to the wrist and forearm of each child and used to measure and log wrist flexion and extension. Play activity and enjoyment were quantified by average wrist range of motion (ROM), motion frequency measures, and a discrete visual scale. We found significant differences in the average wrist ROM and motion frequency among the toys and games, yet there were no differences in the level of enjoyment across all toys and games, which was high. These findings indicate which toys and games may elicit the greater number of goal-directed movements, and lay the foundation for our long-term goal to develop and evaluate innovative motion-specific play controllers that are engaging rehabilitative devices for enhancing therapy and promoting neural plasticity and functional recovery in children with CP.

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**4. J Bone Joint Surg Am. 2015 May 6;97(9):782-7. doi: 10.2106/JBJS.N.00468.**

**Spinal fusion for scoliosis in patients with globally involved cerebral palsy: an ethical assessment.**

Whitaker AT1, Sharkey M2, Diab M1.

[PMID: 25948526](#) [PubMed - in process]

**5. J Child Orthop. 2015 May 6. [Epub ahead of print]**

**Hip reconstruction is more painful than spine fusion in children with cerebral palsy.**

Shrader MW1, Jones J, Falk MN, White GR, Burk DR, Segal LS.

PURPOSE: Concerns about pain control in patients with cerebral palsy (CP) are especially anxiety provoking for parents, given the fact that spasticity, communication issues, and postoperative muscle spasms are significant problems that make pain control difficult in these patients. A better understanding of the magnitude and quality of

the pain these patients experience after our surgical procedures would better prepare the patients and their families. The purpose of this study is to quantify the amount of postoperative pain in children with CP undergoing hip reconstruction and spinal fusion. Specifically, the study will compare pain scores and the amount of narcotics used between the two groups. **MATERIALS AND METHODS:** This is a retrospective chart review of a consecutive series of children with CP (GMFCS levels IV and V) over a 5-year period undergoing hip reconstruction (femoral osteotomy, pelvic osteotomy, or both) and posterior spinal fusion (PSF) at a tertiary-care pediatric hospital. The primary end point was the total opioid used by the patient during the hospitalization, by converting all forms of narcotics to morphine equivalents. The secondary end point was the documentation of pain with standard pain scores at standard time points postoperatively. Adverse effects related to pain management were documented for both groups. Student's t-tests were utilized to statistically compare differences between the groups, with significance determined at  $p < 0.05$ . **RESULTS:** Forty-two patients with CP who underwent hip reconstruction (mean age 8.8 years) were compared to 26 patients who underwent PSF (mean age 15.4 years). The total opioid used, normalized by body weight and by days length of stay (DLOS), in the hip group was 0.49 mg morphine/kg/DLOS, compared to 0.24 for the spine group ( $p = 0.014$ ). The mean pain score for the hip group was 1.52, compared to 0.72 for the spine group ( $p = 0.013$ ). There were no significant differences in the occurrence of adverse effects related to pain management between the two groups. **CONCLUSION:** Patients with CP undergoing hip reconstruction surgery had significantly more pain, as exhibited by requiring more narcotics and having higher pain scores, than those patients undergoing PSF. The knowledge that hip reconstruction is more painful than PSF for patients with CP will better prepare families about what to expect in the postoperative period and will alert providers to supply better postoperative pain control in these patients.

LEVEL OF EVIDENCE: III (case control series).

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## **6. Foot Ankle Surg. 2015 Jun;21(2):77-85. doi: 10.1016/j.fas.2015.02.001. Epub 2015 Feb 26.**

### **Gastrocnemius recession for foot and ankle conditions in adults: Evidence-based recommendations.**

Cychoz CC1, Phisitkul P2, Belatti DA1, Glazebrook MA3, DiGiovanni CW4.

**BACKGROUND:** Gastrocnemius recession is a surgical technique commonly performed on individuals who suffer from symptoms related to the restricted ankle dorsiflexion that results when tight superficial posterior compartment musculature causes an equinus contracture. Numerous variations for muscle-tendon unit release along the length of the calf have been described for this procedure over the past century, although all techniques share at least partial or complete release of the gastrocnemius muscle given its role as the primary plantarflexor of the ankle. There exists strong evidence to support the use of this procedure in pediatric patients suffering from cerebral palsy, and increasingly enthusiastic support-but less science-behind its application in treating adult foot and ankle pathologies perceived to be associated with gastrocnemius tightness. The purpose of this study, therefore, was to evaluate currently available evidence for using gastrocnemius recession in three adult populations for whom it is now commonly employed: Achilles tendinopathy, midfoot-forefoot overload syndrome, and diabetic foot ulcers. **METHODS:** A systematic review of the literature was performed on December 21, 2013 using the PubMed, Scopus, and Cochrane databases along with the search term "(gastrocnemius OR gastrosoleus) AND (recession OR release OR lengthening)." This search generated 1141 results; 12 articles found in the references of these papers were also screened for inclusion. In total, 18 articles met our inclusion criteria. These articles were reviewed and assigned a classification (I-V) of Level of Evidence, according to the criteria recommended by the Journal of Bone & Joint Surgery. Based on these classifications, a Grade of Recommendation was assigned for each of the indications of interest. **RESULTS:** Grade B evidence-based literature ("fair") exists to support the use of gastrocnemius recession for the treatment of isolated foot pain due to midfoot/forefoot overload syndrome in adults. There are some data in support of utilizing gastrocnemius recession to treat midfoot or forefoot ulcers and non-insertional Achilles tendinopathy in adults, but to date this evidence remains Grade Cf. Insufficient evidence (Grade I) is currently available to make any recommendation either for or against this procedure for the treatment of insertional Achilles tendinopathy. **CONCLUSION:** Scientific literature continues to grow in support of using isolated gastrocnemius recession as an effective treatment strategy for a variety of lower limb pathologies, although it remains clear that higher evidence levels and more carefully controlled investigations will be necessary to more convincingly define the true efficacy and ideal applications of gastrocnemius recession in the adult population.

LEVEL OF EVIDENCE: Level IV systematic review.

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**7. Gait Posture. 2015 Apr 23. pii: S0966-6362(15)00447-6. doi: 10.1016/j.gaitpost.2015.04.006. [Epub ahead of print]**

**The validity and reliability of modelled neural and tissue properties of the ankle muscles in children with cerebral palsy.**

Sloot LH1, van der Krogt MM2, Groep KL3, van Eesbeek S4, de Groot J3, Buizer AI2, Meskers C2, Becher JG2, de Vlugt E4, Harlaar J2.

Spastic cerebral palsy (CP) is characterized by increased joint resistance, caused by a mix of increased tissue stiffness, as well as involuntary reflex and background muscle activity. These properties can be quantified using a neuromechanical model of the musculoskeletal complex and instrumented assessment. The construct validity of the neuromechanical parameters was examined (i.e. the internal model validity, effect of knee angle, speed and age, sensitivity to patients versus controls, spasticity severity and treatment), together with the repeatability. We included 38 children with CP and 35 controls. A motor driven footplate applied two slow (15°/s) and two fast (100°/s) rotations around the ankle joint, at two different knee angles. Ankle angle, torque and EMG of the gastrocnemius (GA), soleus (SO) and tibialis anterior (TA) muscle were used to optimize a nonlinear neuromuscular model. Outcome measures were tissue stiffness, reflex and background activity for GA, SO and TA. The internal model validity showed medium to high parameter confidence and good model fits. All parameter could discriminate between patients with CP and controls according to CP pathology. Other measures of external model validity (effect of test position, speed and age) showed behaviour along the lines of current knowledge of physiology. GA/SO background activity was sensitive to spasticity severity, but reflex activity was not. Preliminary data indicated that reflex activity was reduced after spasticity treatment. The between-trial and -day repeatability was moderate to good. The large variance between patients in the ratio of stiffness and neural resistance indicates that the method could potentially contribute to patient-specific treatment selection.

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**8. Int Orthop. 2015 May 7. [Epub ahead of print]**

**The split anterior tibialis tendon transfer procedure for spastic equinovarus foot in children with cerebral palsy: results and factors associated with a failed outcome.**

Limpaphayom N1, Chantarasongsuk B, Osateerakun P, Prasongchin P.

**PURPOSE:** The aims of the study were to evaluate the outcomes and predictive factors of the split anterior tibialis tendon transfer (SPLATT) procedure for the treatment of the spastic equinovarus deformity in children with cerebral palsy (CCP). **METHODS:** Forty-five ambulatory CCP with 68 equinovarus feet, positive for the flexor withdrawal reflex test, aged  $8.1 \pm 2.5$  (range four to 15) years were enrolled. All feet underwent a soft tissue release procedure combined with the SPLATT procedure and were followed for at least 12 months after surgery. The functional outcome was rated using the criteria of Kling and co-workers. Pre-treatment gross motor functional classification system (GMFCS) levels were compared to the patients' latest evaluations. Factors associated with outcomes and success rate were assessed. **RESULTS:** At an average follow-up of  $5.5 \pm 3.3$  (range 1.1-16) years, feet were rated as excellent in 48 cases (70 %), good in ten (15 %) and poor in ten (15 %), respectively. Thirty-four CCP showed an improvement for the GMFCS level,  $P < 0.001$ . The factor that could predict a poor outcome was the pre-treatment GMFCS levels 3-4 with an odds ratio (95 % CI) of 4.92 (0.96-25.2),  $P = 0.03$ . The ten years success rate of the SPLATT procedure between CCP with GMFCS levels 1-2 and levels 3-4 were not different with a mean  $\pm$  SD (95 % CI) of  $0.85 \pm 0.1$  (0.5-0.96) versus  $0.6 \pm 0.1$  (0.3-0.8),  $P = 0.08$ , respectively. **CONCLUSIONS:** The SPLATT procedure provides a balanced function of the foot, thus improving the ambulatory ability in CCP and should be integrated into the surgical plan. Pre-treatment GMFCS levels 3-4 predicted unfavourable outcomes and should be addressed during pre-operative parental counselling.

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**9. Dev Med Child Neurol. 2015 May 6. doi: 10.1111/dmcn.12790. [Epub ahead of print]**

**Longitudinal assessment of bone growth and development in a facility-based population of young adults with cerebral palsy.**

Grossberg R1, Blackford MG, Kecskemethy HH, Henderson R, Reed MD.

**AIM:** Osteoporosis is a significant clinical problem in persons with moderate to severe cerebral palsy (CP), causing fractures with minimal trauma. Over the past decade, most studies examining osteoporosis and CP have been cross-sectional in nature, focused exclusively on children and adolescents and only involving one evaluation of bone mineral density (BMD). The purpose of this study was to assess BMD in a group including adults with CP, and changes in each individual's BMD over a 5- to 6-year period. **METHOD:** The study group included 40 residents of a long-term care facility aged 6 to 26 years at the time of their initial evaluation. Twenty-one patients (52.5%) were male, 35 (88%) were white, and 38 (95%) were in Gross Motor Function Classification System level V. BMD was assessed by dual-energy X-ray absorptiometry on the right and left distal femurs for three distinct regions of interest. **RESULTS:** Five residents had a fracture that occurred during the study period; this represented a fracture rate of 2.1% per year in the study group. Longitudinally, annualized change in the median BMD was 0.7% to 1.0% per year in the different regions of the distal femur, but ranged widely among the study group, with both increases and decreases in BMD. Increase in BMD over time was negatively correlated with age and positively correlated with change in weight. **INTERPRETATION:** Changes in BMD over time in profoundly involved persons with CP can range widely, which is important to recognize when evaluating potential interventions to improve BMD. Age and changes in body weight appear the most relevant factors.

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**10. Dev Med Child Neurol. 2015 May 6. doi: 10.1111/dmcn.12793. [Epub ahead of print]**

**Assessing bone accrual in cerebral palsy: new longitudinal data and future needs.**

Wren TA1.

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**11. Dev Med Child Neurol. 2015 May 8. doi: 10.1111/dmcn.12791. [Epub ahead of print]**

**Impact of child and family characteristics on cerebral palsy treatment.**

Rackauskaite G1, Uldall PW2, Bech BH3, Østergaard JR1.

**AIM:** The aim of the study was to describe the relationship between the child's and family's characteristics and the most common treatment modalities in a national population-based sample of 8- to 15-year-old children with cerebral palsy. **METHOD:** A cross-sectional study, based on the Danish Cerebral Palsy Registry. The parents of 462 children answered a questionnaire about their child's treatment and the family's characteristics (living with a single parent, having siblings, living in a city, parental education level). Descriptive and logistic regression analyses were performed for every treatment modality, stratified by Gross Motor Function Classification System (GMFCS) level. **RESULTS:** An IQ below 85 was associated with weekly therapy in GMFCS level I (adjusted odds ratio [ORadj] 2.5 [CI 1.1-5.7]) and the use of oral spasmolytics in GMFCS levels III to V (ORadj 3.1 [CI 1.3-7.4]). Older children in GMFCS levels III to V used daily orthoses less frequently (ORadj 0.7 [CI 0.6-0.9] per year). Of all of the family characteristics studied, only the parents' education level had significant associations with more than one treatment modality. **INTERPRETATION:** A child's cognitive function showed an impact on treatment of the motor impairment in children 8 to 15 years of age with cerebral palsy. Parental education level may influence the choice of treatment.

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**12. J Paediatr Child Health. 2015 May 4. doi: 10.1111/jpc.12908. [Epub ahead of print]**

**Parental satisfaction with inpatient care of children with cerebral palsy.**

Iannelli M1, Harvey A, O'Neill J, Reddihough D.

**AIM:** Children with cerebral palsy (CP) have complex health-care needs. This study examines levels of parental satisfaction with inpatient care for children with CP at a tertiary care hospital to identify areas for improvement. **METHODS:** Parents/guardians of children with CP and parents/guardians of children without a disability admitted to hospital completed a custom-designed questionnaire assessing six areas of the hospital admission: (i) the admission process; (ii) the child's personal care; (iii) the child's medical care; (iv) overall care of the child; (v) the parent's experience in hospital; and (vi) keeping up to date in hospital. Differences between the two groups were analysed using Student's t-tests. **RESULTS:** Parents of children with CP were significantly less satisfied with the inpatient care as compared with parents of children without a disability in four of the six categories: 'my child's personal care' (P = 0.0033), 'my child's medical care' (P = 0.0350), 'overall care' (P = 0.0081) and 'my experience in the hospital' (P = 0.0209). When the overall questionnaire was compared between the two groups, parents of children with CP were less satisfied with care than parents of children without a disability (P = 0.0036). **CONCLUSION:** Parents of children with CP are less satisfied with the inpatient care of their child compared with parents of children without a disability. This information should be instrumental in informing change to ensure that parent satisfaction levels improve to a level consistent with other children admitted to a tertiary care setting.

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**13. Pediatr Res. 2015 May 7. doi: 10.1038/pr.2015.91. [Epub ahead of print]**

**Efficacy and safety of acupuncture in children: An overview of systematic reviews.**

Yang C1, Hao Z2, Zhang L1, Guo Q3.

**BACKGROUND:** In recent years, acupuncture has increasingly being integrated into pediatric health care. It was used on approximately 150,000 children (0.2%). **METHODS:** We aim to update the evidence for the efficacy and safety of acupuncture for children and evaluate the methodological qualities of these studies to improve future research in this area. **RESULTS:** We included 24 systematic reviews, comprising 142 RCTs with 12787 participants. Only 25% (6/24) reviews were considered to be high quality ( $10.00 \pm 0.63$ ). High-quality systematic reviews and Cochrane systematic reviews tends to yield neutral or negative results (P=0.052, 0.009 respectively). The efficacy of acupuncture for five diseases (Cerebral Palsy (CP), nocturnal enuresis, tic disorders, amblyopia and pain reduction) is promising. It was unclear for Hypoxic Ischemic Encephalopathy (HIE), Attention Deficit Hyperactivity Disorder (ADHD), mumps, Autism Spectrum Disorder (ASD), asthma, nausea/vomiting and myopia. Acupuncture is not effective for epilepsy. Only six reviews reported adverse events (AEs) and no fatal side effects were reported. **CONCLUSION:** The efficacy of acupuncture for some diseases is promising and there have been no fatal side effects reported. Further high quality studies are justified, with five diseases in particular as research priorities.

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