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Constraint Induced Movement Therapy (CIMT) for Children with Hemiplegic Cerebral Palsy

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Description

Constraint induced movement therapy (CIMT) is a therapeutic intervention originally intended for use in a patient with functional impairment of the upper limb following a cerebral vascular accident (CVA). This technique involves restraining the uninvolved upper limb through the use of a sling, glove, or cast so that the subject is forced to increase use of the involved upper limb. CIMT was introduced by Taub, et al, who suggested that the constraint be in place for 90% of waking hours for 2 weeks, with concentrated, repetitive training for the involved limb applied 6 hours daily.[1] In children, this intervention is most commonly used in the presence of hemiplegia as a result of cerebral palsy (CP).

History & Theory

Constraint induced movement therapy is based on the studies of Edward Taub in which somatosensory deafferentation was performed in young monkeys. Following the procedure, the monkeys demonstrated a phenomenon termed "learned non-use"; essentially, they resolved to disuse of the involved limb. However, if the uninvolved limb was constrained (for at least 7 days), thereby forcing use of the involved limb, the monkeys could, and would, overcome the learned non-use. CIMT was derived from this approach, and shaping techniques and repetitive practice principles were added later.[2,3]

The effectiveness of CIMT is thought to revolve around two mechanisms. First, forcing the increased use of the involved limb counteracts the learned non-use behavior, removing the limitations of the phenomenon. Second, increased use of the involved limb also acts to stimulate the contralateral cortical area, improving and enhancing the neural network and recruiting pathways from the adjacent ipsilateral areas.[4,5,6]

Types of Patients

There's a fair amount of research providing evidence of the benefits of CIMT for children with hemiplegic cerebral palsy. The literature varies widely, though, in regards to a number of variables, such as type of CP (i.e. spastic), age of subjects (i.e. 0-19 years), restraint device used (i.e. splint, sling, cast, mitt), protocol used (i.e. modified CIMT ranges from 2-24 hours per day of restraint use), etc. Supportive evidence can be found on nearly all of these variables; however, the presence of such variability makes it difficult to produce generalizations for the benefits of CIMT (covered below).

Potential Benefits

- Improved efficiency and quality of upper limb (UL) movement[3,7,9]
- Increased spontaneous use and/or increased frequency of use of involved UL in daily activity[3,7]
- Development of new UL motor skills[7]
- Improved upper limb function[8,10]
- Improvement in ICF domains: activity, participation, body structure and function[8]

Resources & Barriers

The cost of resources necessary to implement constraint-induced movement therapy is a barrier to CIMT being incorporated as a standard practice for rehabilitation of hemiplegia. The protocol for CIMT is time-intensive for both therapists and patients, which also contributes to increased financial costs for the patient and/or insurer. Protocols requiring 2-6 hours of one-on-one therapy daily is not conducive, or logical, for outpatient physical therapy practices. Other PT settings find the opportunity cost of not seeing other patients due to the committed attention required of the CIMT intervention to be prohibitive.[11,12]

Other barriers include:[11,12,13]

- Lack of facilities
- Therapist unfamiliarity with and/or apprehension of the intervention (time commitment, knowledge)
- Therapist hesitation of safety issues regarding restraints
- Patient eligibility and/or inability to tolerate the intensity and duration of treatment (i.e. cognition, motor level, behavior)
- Managed care payers are unlikely to fund or reimburse for CIMT

Efficacy & Effectiveness

A 2007 Cochrane systematic review[4] evaluated the effectiveness of CIMT, modified CIMT, and Forced Use in the treatment of children with hemiplegic cerebral palsy. The review found favorable and encouraging results, but concluded that these interventions need further research and clearer supportive evidence. Utilizing appropriately powered studies and uniform objective outcome measures were two suggestions for future research.[4]

A 2009 systematic review[3] investigated the effectiveness of CIMT in children with hemiplegic CP, and tried to identify associated characteristics. The review found significant variability in studies, including a wide variety of study designs, outcome measures, and subject/constraint/intervention characteristics. Overall, large and significant treatment effects were observed, including increased frequency of use of the involved upper limb. However, the authors were not able to identify an optimal treatment intensity threshold, and again suggested that future research utilize appropriately powered studies and standardized designs.[3]

Another 2009 systematic review with meta-analysis[7] evaluated the efficacy of four different nonsurgical upper limb interventions for children with congenital hemiplegia. Regarding CIMT, the study found that the intervention contributes to improved efficiency and quality of UL movement, increased spontaneous use of the involved UL, improved UL speed and dexterity, and the development of new UL motor skills. However, since the outcome measures used have not been validated in children with congenital hemiplegia, and since there was variability in control groups, the review concluded that the reported improvements could not definitively be contributed to CIMT.[7]

Finally, a 2014 systematic review and meta-analysis[8] was conducted with the intent to evaluate the effects of CIMT on arm function in children with CP. The review found that CIMT was similarly effective for children with CP as it is for adults following stroke. Furthermore, improvements in activity level were found to disappear without continuous practice, while improvements in participation level may require extended time to manifest. Intervention setting, time of follow-up, and presence of a dose-equivalent comparison group were found to have significant associations with effect size. The authors concluded that CIMT “overall is an effective intervention to improve arm function in children with cerebral palsy”.[8]

Translation to Practice

Although more research is needed, current evidence suggests that constraint induced movement therapy is an effective intervention for improving functional use of the involved upper limb in children with hemiplegic cerebral palsy. However, barriers such as time-intensity, therapist apprehension, and financial reimbursement produce significant barriers to the incorporation of CIMT as a standard rehabilitation practice.

References

1. Taub E, Uswatte G, Pidikiti R. Constraint-induced movement therapy: a new family of techniques with broad application to physical rehabilitation – a clinical review. J Rehabil Res Dev. 1999. 36(3): 237-51
2. Taub E. Movement in nonhuman primates deprived of somatosensory feedback. Exerc Sport Sci Rev. 1976. 4: 335-74
3. Huang HH, Fetters L, Hale J, McBride A. Bound for success: a systematic review of constraint-induced movement therapy in children with cerebral palsy supports improved arm

and hand use. Phys Ther. 2009. 89(11): 1126-41
4. Hoare B, Imms C, Carey L, Wasiak J. Constraint-induced movement therapy in the treatment of the upper limb in children with hemiplegic cerebral palsy: a Cochrane systematic review. Clin Rehabil. 2007. 21(8): 675-85
5. Morris DM, Taub E. Constraint-induced therapy approach to restoring function after neurological injury [abstract]. Top Stroke Rehabil. 2001. 8(3): 16-30
6. Liepert J, Miltner WH, Bauder H, et al. Motor cortex plasticity during constraint-induced movement therapy in stroke patients. Neurosci Lett. 1998. 250(1): 5-8
7. Sakzewski L, Ziviani J, Boyd R. Systematic review and meta-analysis of therapeutic management of upper limb dysfunction in children with congenital hemiplegia. Pediatrics. 2009. 123(6): e1111-22
8. Chen YP, Pope S, Tyler D, Warren GL. Effectiveness of constraint-induced movement therapy on upper-extremity function in children with cerebral palsy: a systematic review and meta-analysis of randomized controlled trials. Clin Rehabil. 2014. 28(10): 939-53
9. Gordon AM, Charles J, Wolf SL. Efficacy of constraint-induced movement therapy on involved upper-extremity use in children with hemiplegic cerebral palsy is not age-dependent. Pediatrics. 2006. 117(3): e363-73
10. Chen HC, Kang LJ, Chen CL, et al. Younger children with cerebral palsy respond better than older ones to therapist-based constraint-induced therapy at home on functional outcomes and motor control. Phys Occup Ther Pediatr. 2016. 36(2): 171-85
11. Viana R, Teasell R. Barriers to the implementation of constraint-induced movement therapy into practice [abstract]. Top Stroke Rehabil. 2012. 19(2): 104-14
12. Sterr A, Saunders A. CI therapy distribution: theory, evidence and practice [abstract]. NeuroRehabilitation. 2006. 21(2): 97-105
13. Daniel L, Howard W, Braun D, Page SJ. Opinions of constraint-induced movement therapy among therapists in southwestern Ohio [abstract]. Top Stroke Rehabil. 2012. 19(3): 268-75

Pictures

1. http://2.bp.blogspot.com/_Pz_xW9ZfEJo/S3tI8ktGXCI/AAAAAAAACp0/-r05BArTlXI/s400/constrainttherapy.JPG
2. http://media-cache-ec0.pinimg.com/736x/93/ef/ea/93efea6b77ad09d0e0c06a2083a6d4e4.jpg
3. http://therapyfunzone.net/blog/wp-content/uploads/2013/09/boys-casted_thumb.jpg