CRITICALLY APPRAISED TOPIC

TITLE

Does the use of Constraint-Induced Movement Therapy (CIMT) result in improved upper limb function for children with hemiplegic Cerebral Palsy?

AUTHOR

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CLINICAL SCENARIO

Children with upper limb hemiplegia often experience decreased ability to participate effectively and efficiently in tasks and occupations requiring bilateral hand use, which may include climbing the monkey bars during play, fastening buttons while getting dressed, school activities such as opening a gym locker, or completing a standardized academic assessment using a keyboard.

Historically, Occupational Therapists have used a variety of strategies to address the needs of their clients. Traditional interventions used to address upper limb hemiplegia include participation in bilateral tasks, strengthening of the affected limb, fine motor skill reinforcement, Electrical Muscular Stimulation (EMS), and Neurodevelopmental Treatment (NDT) techniques. Occupational Therapists have also implemented constraint-induced movement therapy programs as one type of intervention. This treatment intervention was first used with adult clients and since the late 1990s has been used increasingly with children.

Evidence to support the use of constraint-induced movement therapy with children demonstrating upper limb hemiplegia has typically considered the use of CIMT in combination with medical interventions such as Botox, however we are interested to know whether children demonstrate improvements in hand and upper limb function when CIMT is used alone.

FOCUSSED CLINICAL QUESTION

Does use of constraint-induced movement therapy increase skills and use of the affected upper limb allowing for greater participation in age appropriate occupations, including self-care and play for children with hemiplegic cerebral palsy?

SUMMARY OF SEARCH, Best evidence appraised and key findings:

- Nineteen studies were located that met the inclusion/exclusion criteria, including 3 systematic reviews or meta-analysis of randomized control trials (RCT), 5 RCT, and 5 low quality RCTs, controlled trials or cohort studies. Three studies providing the supporting evidence were reviewed and discussed.
- Statistically and clinically significant improvement in self-care and bilateral upper extremity use was noted following a two-week period of constraint-induced movement therapy for children with hemiplegic cerebral palsy.
- Children demonstrated the greatest improvement when CIMT was paired with goal directed therapeutic intervention programs. The intensity of use of the CIMT did not appear to have any significant influence on the overall outcomes and improved motor skills.
- Key points for future research included further examination of factors related to compliance with intervention, effect of intervention on daily function and performance of occupations, and programs or ideas to continue with and further enhance skills achieved from intervention provided.

CLINICAL BOTTOM LINE

Evidence suggests that constraint-induced movement therapy results in increased use of the affected limb, especially when paired with therapeutic interventions designed to increase control, strength, and functional use. Children who wore the restraint for 3.5 hours per day demonstrated similar improvement to those who wore it for 10 hours. The greatest improvement in functional skills was observed when Constraint Induced Movement Therapy was paired with goal specific interventions. Further research is required to determine the optimal wearing protocols for CIMT

Important note on the limitation of this CAT

This critically appraised topic has been individually prepared as part of a course requirement and has been externally peer-

reviewed by two professionals.

SEARCH STRATEGY

Terms used to guide the search strategy
• **P**atient/Client Group: Children with hemiplegic Cerebral Palsy, under that age of 10 years • **I**ntervention: Constraint-induced movement therapy • **C**omparison: Performance before and after use of constraint-induced movement therapy intervention related to self-care skills, bilateral extremity use, and level of independence • **O**utcome(s): Increased use of affected extremity for participation in daily age appropriate occupations

Databases and Sites Searched (Search completed during July 2012)	**Search Terms**	**Obtained** (Some duplications)	**Inclusion Terms Used**
Systematic Review Sites:			
OT Seeker	Constraint-Induced Movement Therapy, Cerebral Palsy, Hemiplegia, Forced Use Therapy, Movement Therapy	7	Required cerebral palsy and constraint-induced movement therapy or forced use therapy.
PERdo		10	
Cochrane Library		8	
General Databases:			
EBSCO	Constraint-Induced Movement Therapy, Cerebral Palsy, Hemiplegia, Forced Use Therapy, Movement Therapy	10	Required cerebral palsy and constraint-induced movement therapy or forced use therapy
CINAHL		2	
PubMed		10	
Google Scholar		10	
AJOT search		6	
ERIC		0	

INCLUSION and EXCLUSION CRITERIA

Inclusion Criteria
• Studies that measured active and automatic use of affected limb following use of constraint-induced movement therapy or forced use therapy for children with cerebral palsy • Studies that measured function related to self-care, play, bilateral hand and arm skills and greater independence, following the use of constraint-induced movement therapy or forced use therapy. • Studies that measured skills with bilateral limb tasks and activities.
Exclusion Criteria
• Studies that did not include constraint-induced movement therapy or forced use therapy. • Studies that included participants who had received surgical interventions, Botox injections, or other medical interventions to manage tone in the 6 months prior to participation. • Studies that involved children with a neurological diagnosis other than Cerebral Palsy (e.g. stroke, TBI). • Studies that did not target specific outcomes related to improve UE function and bilateral UE use, greater independence with self-care or occupations appropriate to age of child. • Studies published in languages other than English. • Research published prior to 1997 or after July 2012.

RESULTS OF SEARCH

A total of 19 relevant studies were located and categorised as shown in Table 1 (based on Levels of Evidence, Centre for Evidence Based Medicine, 2011)

Table 1: Summary of Study Designs of Articles Retrieved

Study Design / Methodology of Articles Retrieved	Level	Number Located	Author (Year)
Systematic Reviews and Meta-analysis of RCTs	1a	3	Hoare et al. (2007) Huang et al. (2009) Sakzewski (2009)
Randomized Control Trial (RCT)	1b	5	de Brito Brandao et al. (2010) (PEDro 8/10) Eugster-Buesh et al. (2012) (PEDro 7/10) Gordon et al. (2011) (PEDro 7/10) Hsin et al. (2012) (PEDro 7/10) Wallen et al. (2011) (PEDro 8/10)
Low quality RCTs, controlled trials, cohort studies	2b	5	Charles, J. R. (2006) (PEDro 5/10) Deluca et al. (2006) (PEDro 4/10) Eliasson et al. (2005) (PEDro 5/10) Eugster-Buesch et al. (2012) Taub et al. (2004) (PEDro 5/10)
Systematic Reviews of Case Control Studies	3a	2	Charles, J. & Gordon, A. M. (2005) Cope et al. (2008)
Individual case control studies	3b	2	Crocker et al. (1997) Dickerson & Brown (2007)
Case series (and poor quality cohort and case control studies)	4	2	Martin et al. (2008) Ramachandra & Thakur (2011)
Expert opinion without explicit critical appraisal, or based on physiology, bench research, or “first principles”	5	1	van der Lee (2003)

BEST EVIDENCE

Three studies/papers was identified as the ‘best’ evidence and selected for critical appraisal. Reasons for selecting these studies were:

- Highest level of evidence that specifically addressed the research question.
- The studies focused on the use of CIMT in children with hemiplegic Cerebral Palsy who had not received any medical interventions to manage their tone.

SUMMARY OF BEST EVIDENCE

Table 2a: Description and appraisal of modified constraint-induced therapy for children with hemiplegic cerebral palsy: a randomized trial by Wallen et al. (2011).

Aim / Objective of the Study:
The aim of this study was to determine the effects of modified constraint-induced therapy compared with intensive occupational therapy on activities of daily living and upper limb outcomes in children with hemiplegic CP.” (Wallen et al., 2011, p. 1091)

Study Design

- An assessor blinded pragmatic randomized trial.
- Participants were randomly assigned using a concealed allocation procedure to one of two eight-week interventions and were grouped using the Manual Ability Classification System (MACS); level I n=2, level II n=37, level III n=8 and level IV n=1.
- The programs were identified as intensive occupational therapy (n=25) and modified constraint-induced therapy (n=25) who worn a mitt for two hours daily while participating in targeted therapy sessions.
- Participants completed baseline assessment prior to randomization. Assessments were repeated at 10-weeks and 6-months after randomization. Outcome measures were obtained using the Canadian Occupational Performance Measure (COPM) and a variety of other data gathering tools.
- After the intervention period, families were instructed to resume usual therapy and avoid constraint-based interventions, until the 6-month reassessment was completed.

Setting

Participants attended therapy at their local therapy center, where they had previously received services. The Children's Hospital at Westmead in Sydney, Australia was used if participant's local therapists were not available.

Participants

- 50 participants, 27 males and 23 females, with a diagnosis of spastic hemiplegic cerebral palsy.. Participants were between 19 months and 7 years, 10 months. Range of participants considered was 18 months through 8 years of old.
- Participants were required to demonstrate at least 10 degrees of active wrist extension and/or finger extension in the affected limb and possess functional passive range of motion (120 degrees shoulder flexion and abduction 30-120 degrees of elbow movement, neutral wrist and finger extension. Minimum of 45-degrees supination).
- Participants were grouped using the Gross Motor Function Classification System (GMFCS); level I n=33, level II n=15, and level III n=1.
- Participants were recruited using the following method: Clinical staff provided information sheets to potential participants, letters were sent to families on the New South Wales Cerebral Palsy Register and parents of children receiving care from the study sites, and the trial was advertises in newsletters and on websites.

Intervention Investigated

Control-Intensive Occupational Therapy

- Families were provided a block of therapy including a weekly session and home program, specifying intervention goals were determined as areas for growth.
- Interventions for the intense 8-week occupational therapy group were designed to achieve the parent's identified goals and included techniques aimed at minimizing impairment and enhancing activities.
- Guidelines suggest that parents spend 20-minutes each day participating with their child in a home program. This time could be adjusted to mesh with family activities and personal preferences.
- Therapy provided to the control group was goal directed, intensive, supervised, and involved a formal home program.

Experimental-Modified constraint-induced therapy

- Participants randomized to the modified constraint-induced therapy (CIMT) groups wore a mitt on the unaffected hand for two hours each day and during the time the child participated in targeted therapy.
- Participants unaffected hand was constrained using a fabric mitt with a solid thermaplastic volar insert preventing grasp and release.
- Protocol stated that the mitt was to be worn for 2-hours per day, including a minimum of 30-minutes during therapy sessions for 7 days per week for an 8 weeks period. The mitt could be worn in any environment where therapeutic activities may occur.
- Home program activities, based on motor learning principles and involving self generated voluntary repetitions of specific movements, were completed while wearing the mitt. Movements focused on were those often were incorporated in play.

Outcome Measures

All measures were completed at baseline, at the completion of the intervention (10 week period) and at the 6-month follow up time frame.

- Standard procedures for the COPM were used to assist parents identify up to five areas of difficulty experienced in completing self-cares, school/preschool, or leisure activities and identify five areas as intervention priorities.
- Parents rated the child's performance and their own satisfaction with performance using a 10-point scale on the five priorities at 10-weeks and then re-rated the priorities without blinding at 6-months.
- Mean ratings of both performance and satisfaction scores at 10-weeks and 6-months were used for data analysis.
- Perception of the smallest worthwhile result from intervention were identified by the parents and documented. The COPM was used to determine a baseline using the benefit-harm-trade-off methods.
- Small Kids and School Kids versions of the Assisting Hand Assessment (AHA) were used to measure how effectively the children spontaneously used their affected hand in bilateral play tasks. The AHA demonstrated strong psychometric properties, strong alternative-form reliability, and therefore scores from the versions were pooled for analysis.
- Parents used separate three-point scales (0-2) to rate 'how often' and 'how well' their child used his or her affected arm in a number of everyday tasks.
- Revised Pediatric Motor Activity Logs provided adequate psychometric properties. The researcher chose to reflect missing scores; total scores were reported in percentages of the total possible scores for each scale.
- Parent questionnaires, developed for this study and piloted in a feasibility study, were used to determine perceptions of change and of participation in CIMT. These questionnaires have not been validated.
- Parent Logs reflecting time spent using mitt, the nature of interventions, time spent engaged in therapy were collected and analysed. Families were asked to report the amount of therapy the participant engaged in between the 10-week and 6-month assessments.

Main Findings

- ✓ All participants were included in analysis. Between groups differences for all outcomes were neither clinically important nor statistically significant. The mean difference in COPM was 0.3 (95% confidence interval; CI =0.8 to 1.4; p=0.61) and mean difference in COPM satisfaction was 0.1 (95% confidence interval; CI= -1.1 to 1.2; p=0.90).
- ✓ Minor adverse events were reported by five of the 25 participants in the modified constraint-induced therapy group and by one of the 25 in the intensive occupational therapy group. All adverse events were related to participants' lack of acceptance of therapy. (Wallen et al., 2005, p. 1091)
- ✓ There was no difference between the groups on the Modification Ashworth Scale or in proportion of goals achieved at 10-weeks, with CIMT 75% of goals, intensive OT 73% of goals and at 6-months, CIMT 85% of goals, intensive OT 81%.
- ✓ The majority of participants met one or more goals at 10-weeks (CIMT 92%, intensive occupational therapy 100%) and at 6 months (CIMT 96%, intensive occupational therapy 100%). Goals identified by parents, as being achieved, included dressing (26% of all goals, e.g. pulling up pants, donning a shirt), leisure (22%, e.g. catching a ball, holding a book) and eating (20%, e.g. holding a bowl, cup, plate).
- ✓ Responses to parent questionnaires yielded similar results between both groups. Despite the statistical data reported, both groups made clinically meaningful improvements related to participation in daily living skills. Improvements for both groups may be accounted for due to such factors as maturation and increased opportunities to participate in structured bimanual tasks.

Original Authors' Conclusions

"The two interventions yielded similar outcomes, suggesting that the inclusion of constraint is not the primary determinant of effect in programs of CIMT. Modified constraint-induced therapy, as implemented in this study, was acceptable to most families and was feasible to implement across a range of service delivery settings." (Wallen et all, 2005, p. 1097)

Wallen et all. (2005) determined modified constraint-induced therapy to be no more effective than intensive occupational therapy for improving completion of activities of daily living or upper limb function in children with hemiplegic cerebral palsy.

Critical Appraisal

Validity: This study did not provide evidence related to the comparison of children using CIMT and those receiving no interventions.

- o PEDro Score: 8/10 based on Eligibility Criteria: Yes; Random Allocation: Yes; Concealed Allocation: Yes; Baseline Comparison: Yes; Blind Subjects: No; Blind Therapist: No; Blind Assessors: Yes; Adequate Follow-up:

Yes; Intention-to-treat analysis: Yes; Between Group Comparison: Yes; Point Estimates and Variability: Yes. (Eligibility score does not contribute to total score.)

Interpretation of Results

- There is some evidence that constraint-induced therapy improves upper extremity function for children with hemiplegic Cerebral Palsy. (p. 1096)
- There are no important differences between groups in the study in terms of outcomes at either 10-weeks or 6-month assessment points.
- Increase intensity of modified Constraint Induced Therapy (CIMT) did not demonstrate an advantage over intensive OT in this study.
- The lack of differences between the groups may be a result of a sufficient level of intense Occupational Therapy interventions and/or participant's maturation.
- Therapy focused interventions may result in greater participation and improved overall outcomes.
- Useful information on the feasibility of implementing a CIMT program was obtained.
- Family members felt the use of CIMT was valuable and would consider using this strategy to improve skills again.
- Neither intervention was superior to the other in terms of effect on performance of ADLs.
- Data suggest that determination of types of intervention should be based on what best suits the child, and which is most consistent with family goals.

Table 2b: Description and appraisal of adaptive version of constraint-induced movement therapy promotes functioning in children with cerebral palsy: a randomized controlled trial by de Brito Brandao et al. (2010).

Aim/Objective of the Study:
To evaluate the effects of constraint-inducted movement therapy on the use of the affected arm and on daily functioning in children with hemiplegic cerebral palsy.
Study Design
• A single blinded randomized clinical trial, with 16 children with hemiplegic cerebral palsy. The sample size was based on the effect size obtained from Taub et al. (2004). • The experimental group was required to restrict movement of non-affected limb throughout hours awake through use of a constraint. The control group was involved in regular occupational therapy sessions once per week. • Blinded and trained assessors completed Assessments for the control and intervention groups prior to study initiation, at one-week after intervention phase, and one-month after intervention phase, using the Gross Motor Function Classification System (GMFCS), Manual Ability Classification System (MACS), Pediatric Evaluation Disability Inventory (PEDI), and Jebsen-Taylor Hand Function Test (JTHFT). • Data were collected prior to the start of the study by two investigators trained to use all the assessment tools and reliability coefficients were calculated (inter-examiner coefficient ranged between 0.86 and 0.98; intra-examiner coefficients ranged between 0.98 ad 0.99).
Setting
Services were provided within a pediatric clinic setting for the experimental group. The control group continues to receive therapy services delivered in the same method as prior to participation in the study.
Participants
• 16 children with cerebral palsy randomized to interventions, 8 males and 8 females with a diagnosis of spastic hemiplegic cerebral palsy and are able to comprehend simple verbal instructions and execute activities proposed during intervention. • Intervention group: *N=8*; 4 males, 4 females, mean age 5 years, 6 months. Control group: *N=8;* 4 males, 4 females, mean age 6 years, 7 months. • Participants were recruited from local rehabilitation facility occupational therapy programs.
Intervention Investigated
Control Group

- Participants were provided no interventions or recommendations, through the study, but were encouraged to continue with routine activities, events, appointments, and strategies, generally one therapy session per week.

Experimental/Intervention Group

- The intervention group was involved in an adaptive constraint-induced movement therapy protocol, consisting of 3 hours of upper extremity training everyday for two weeks (10 out of 12 consecutive days), in association with the immobilization of the non-affected arm during the entire day. After this period, the restriction was removed and the participant participated in sessions of functional training of bilateral activities relevant to their daily context.
- A custom resting hand splint restricting hand and finger movements was constructed for each participant in the intervention group, the day before the study began. In addition to the splint, the intervention group participants worn a sling to restrict elbow and shoulder movements.
- Participants were engaged in a 3-hours daily intervention protocol, following Sterr et al. (2002) design, in the clinical setting. The structured activities were designed to maintain the functional relevance of the activities and interest of the participant. Activities were planned according to shaping procedures with increased complexity achieved by changing activities, demand of speed, dexterity and versatility.
- After the 2-week period, the restriction was removed and bilateral functional task training was initiated. The sessions consisted of three 45-minutes sessions during one week.
- Following the study, the participants in the experimental group maintained regular involvement in weekly 45-minutes sessions of OT with a focus on functional orientation, bilateral task training, and sensory stimulation.

Outcome Measures

- Assessments were completed one-week before the start of the intervention (pre-intervention measure), one-week after then end of intervention (post-intervention measure), and one-month after the end of the intervention (follow up measure) by an examiner blinded as to the participant's group.
- Standard procedures for the PEDI, JTHF, GMFCS, MACS were used to establish a platform for change based on pre-participation, mid participation and end of participation assessments.
- Percentage changes were used to determine outcomes of the study.

Main Findings

- Adaptations in the constraint-induced movement therapy protocol for a pediatric population reducing the total time of intervention from 3 to 6 hours per day was effective in promoting gains in self-care functioning in children and family intervention.
- The adapted protocol of constraint-induced movement therapy associated with bimanual intensive training promoted improvements in daily functioning in children with hemiplegia.
- Gains in functional skills and independence in ADLs was significantly higher in the experimental group.
- No group differences in manual dexterity gains were observed.
- No significant difference was determined between groups using the Jebsen-Taylor Hand Function Test.

Original Authors' Conclusions

The protocol associating constraint-induced movement therapy and bimanual functional training was effective in promoting daily living functioning among children with cerebral palsy. Specifically, improved functional skills and independence in activities of daily living were documented. (de Brito Brandao et al., 2010, p. 644.)

The results suggest that constraint-induced movement therapy associated with bimanual functional training is an effective clinical strategy, compared with traditional rehabilitation interventions, to promote functional gains in children with cerebral palsy. (de Brito Brandao et al., 2010, p. 645)

Critical Appraisal

Validity: PEDro Score: 8/10 based on Eligibility Criteria: Yes; Random Allocation: Yes; Concealed Allocation: Yes; Baseline Comparison: Yes; Blind Subjects: No; Blind Therapist: No; Blind Assessors: Yes; Adequate Follow-up: Yes; Intention-to-treat analysis: Yes; Between Group Comparison: Yes; Point Estimates and Variability: Yes. (Eligibility score does not contribute to total score.)

Interpretation of Results

The study supports the use of modified constraint-induced movement therapy paired with bimanual functional training

as an intervention to improve the functional skills and independence in ADLs. This modified protocol allows parents and children to be more compliant with the intervention technique. When compared to children who receive no intervention, the children who were following the modified constraint-induced therapy protocol in conjunction with bimanual functional training demonstrated greater functional skill attainment and increased independence with ADLS.

Table 2c: Description and appraisal of efficacy of constraint-induced therapy in functional performance and health-related quality of life for children with cerebral palsy: a randomized controlled trial by Hsin et al. (2012).

Aim / Objective of the Study:
To investigate the efficacy of home-based constraint-induced therapy on functional performance and health-related quality of life. The hypothesis is that children with cerebral palsy receiving home-based constraint-induced therapy will have better outcomes in upper limb skills, functional performance, and health-related quality of life when compared to those receiving traditional rehabilitation, and the beneficial effects will be retained at 3 months follow-up.
Study Design
• A randomized controlled trial, involving 23 children with hemiplegia cerebral palsy. • All participants underwent assessments to determine primary and secondary outcomes and skills prior to randomization and were randomly assigned to either the home-based constraint-induced therapy (n=11) or traditional rehabilitation group (n=12). • Assessments were completed before, immediately after, and at 3 months after the 4-week study. • Both groups received individualized home intervention programs of 3.5 to 4 hours per day, twice per week for 4-weeks from a physical therapist. • Constraint-induced therapy focused on functional training for the affected limb, using shaping and repetitive task practice strategies. Participants in the constraint-induced therapy group were required to wear an elastic bandage and restraint glove limiting wrist and individual finger movements for 3.5 to 4 hours per day while engaged in the above-mentioned activities. • The control group participated in function-orientated activities, NDT techniques, and motor learning and control principles. • Outside of therapy sessions, both groups were encouraged to exercise and perform daily activities under the supervision of a parent.
Setting
The study was conducted through the Rehabilitation Department of Chang Gung Memorial Hospital, Taiwan, ROC and within the participant's homes.
Participants
• 23 children with cerebral palsy aged 6 to 8 years, 10 males and 13 females. One participant left the study before completion. • Recruited for study from the Rehabilitation Department of Chang Gung Memorial Hospital, Taiwan, ROC, a tertiary medical center. • Criteria for inclusion included a) diagnosis of congenital unilateral spastic cerebral palsy; b) considerable non-use of the more affected upper limb (use scored on the Pediatric Motor Activity Log < 2.5); c) Active extension movement of the wrist and metaphalangeal joint $\geq$ 10 degrees; and d) no excessive muscle tone (Modified Ashworth Scale $\leq$2 for any joint on the upper limb). • Exclusion criteria included a severe cognitive, visual, or auditory disorder; a severe concurrent illness or disease not typically associated with cerebral palsy; active medical conditions such as pneumonia; any major surgery or nerve blockage within 6 months before interventions; and poor cooperation during assessments.
Intervention Investigated
Control
• 11 Participants, with hemiplegic cerebral palsy. • Received an individualized home-based intervention program to participate in for 3.5 to 4 hours per day for two days per week for a 4-week period provided by a physical therapist. • Engaged in functional unilateral or bilateral arm training based on function-orientated activities, NDT, and motor

learning and control principles used during therapy sessions.

- Encouraged to exercise outside of sessions engaging in reaching, grasping, manipulating, and self-care activities under the supervision of a parent.

Experimental/Intervention

- 12 participants, with hemiplegic Cerebral Palsy
- Received an individualized home-based intervention program to participate in for 3.5 to 4 hours per day for two days per week for a 4-week period provided by a physical therapist.
- Participants were required to wear a restraint on the non-affected limb for 3.5 to 4 hours daily.
- Engaged in functional training of the affected limb with the principles of shaping and repetitive task practice used during therapy sessions.
- Encouraged to exercise outside of sessions engaging in reaching, grasping, manipulating, and self-care activities under the supervision of a parent.

Outcome Measures

- Outcomes measured by the Bruininks-Oseretsky Test of Motor Proficiency using subtest 8, which evaluated arm movement speed and dexterity where unilateral tasks were completed using the affected limb. Higher raw scores indicate better performance on the assessment.
- Parents completed the Pediatric Motor Activity Log, where a higher score indicated better performance. Parents rated how much and how well their child used the affected limb. The subtests reflecting Amount of Hand Use and the Quality of Hand Use were used.
- The Cerebral Palsy-specific Quality of Life assessment assessed social well being and acceptance, participation and physical health, functioning, emotional well being and self-esteem, pain and impact of disability, access to services, and family health. The mean of items values was computed for each area with a higher mean value indicating a higher quality of life (except for pain and impact of disability).

Main Findings

- ✓ There were no adverse physical effects or harm related to the intervention during the study, however some children did experience frustration in the early stages of constraint-induced therapy.
- ✓ The average constraint time in the constraint-induced therapy groups is 3.5 (SD= 0.1) hours, reported time of restraint use ranged from 3.3 to 3.8 hours per day.
- ✓ Both groups demonstrated improvements with upper limb skills based on scores obtained from the analysis identified greater improvement for the constraint-induced therapy group when compared to the control group with a large effect at the post-treatment assessment. (p. 995)
- ✓ Both groups showed improvement in functional performance. Scores from the Pediatric Motor Activity Log at post-treatment and 3-month follow-ups were analysed. ANCOVA showed the constraint-induced therapy group improved more on the subscale Amount of Hand Use when compared to the control group, with a large effect at post-treatment and 3-month follow-up, respectively. (p. 995)
- ✓ Scores for both groups improved at post-treatment and 3-month follow up assessments using the Cerebral Palsy-specific Quality of Life assessment. The ANCOVA indicated the constraint-induced therapy group improved more in the social well-being and acceptance domains. (p. 995)
- ✓ The level of significance was set at .05 for this trial. Effect size n2 was calculated for each outcome variable to index the magnitude of group differences. A large effect is represented by an n2 of at least .138, a moderate effect is represented by an n2 of .059, and a small effect by an n2 of .01.

Original Authors' Conclusions

"This follow-up home-based randomized controlled trial provided evidence that home-based constraint-induced therapy has both immediate and maintaining large positive effects on upper limb skills and functional performance for children with cerebral palsy. Furthermore, the home-based constraint-induced therapy program induced greater long-term gains in health-related quality of life rather than in the short term. Home-based constraint-induced therapy may be an effective alternative to conventional constraint-induced therapy. The home-based therapy protocol used in this study had relatively moderate intensity and shortened restraint time, which might balance effectiveness and compliance of children with cerebral palsy and their caregivers. Further research will use a larger sample, kinematic measures, and different treatment doses to investigate the mechanism underlying functional improvement and identify the optimal treatment protocol." (p. 997)

Hsin et al. (2012) further concluded, "Knowledge of this study will broaden clinicians' understanding of the overall health status of children with cerebral palsy after constraint-induced therapy." (p. 993)

Critical Appraisal

Validity: PEDro Score: 7/10 based on Eligibility Criteria: Yes; Random Allocation: Yes; Concealed Allocation: Yes; Baseline Comparison: Yes; Blind Subjects: No; Blind Therapist: No; Blind Assessors: Yes; Adequate Follow-up: Yes; Intention-to-treat analysis: No; Between Group Comparison: Yes; Point Estimates and Variability: Yes. (Eligibility score does not contribute to total score.)

Interpretation of Results

- There was evidence that modified constraint-induced therapy resulted in increased gains in motor efficacy and functional performance and created greater gains in health-related quality of life over long-term versus short-term. "The study showed that the home-based constraint-induced therapy program improved motor efficacy to a greater extent and induced greater gains in functional performance than traditional rehabilitation at post-treatment and the 3-month follow-up." (p. 995)
- The modified protocol provides a balance to effectiveness and compliance of participation.
- Increased family participation and the child's ability and confidence in performing daily activities with the affected limb may impact outcomes related to those in the intervention group.
- Non-use of the affected limb is reduced as a result of the constraint-induced therapy protocol, generally the result of forced increased use of the weaker or affected limb.
- Results identify significant changes supported by statistics in the areas of motor function and health related quality of life.
- Clinical significance related to the study suggests that modified constraint-induced therapy has positive outcomes and encourage therapists to consider this intervention for clients.

IMPLICATIONS FOR PRACTICE, EDUCATION and FUTURE RESEARCH

Current implementations to practice:

The evidence reviewed in this appraisal supports the use of modified constraint-induced movement therapy (CIMT) in conjunction with an established home program designed to address functional skills and the inclusion of direct therapy services/sessions. Comments by the authors suggest that a protocol requiring periods of 3.5 hours of time wearing the CIMT may increase compliance and reduce frustration for the child. The best evidence presented in the described studies suggests improved functional skills and greater independence are achieved when the CIMT is paired with a home program and/or direct therapeutic services by a skilled therapist, with a focus on increased use of the affected limb. The evidence supports and helps to direct therapist to better select clients to implement the use of CIMT, as well as identifies clear measurement criteria.

Constraint-induced movement therapy has been considered one strategy or intervention, which may improve upper limb bilateral motor skills. Children with hemiplegic cerebral palsy frequently participate in occupational therapy interventions, with the goals often focussing on improved use of the affected limb yielding improvement in participation in daily tasks and activities and greater independence. Occupational Therapists can create and present activities which encourage the use of the affected limb, providing opportunity to experience the movement pattern in therapeutic environment, however the child will return home completing tasks in fashions which have become routine and comfortable for them to use. Developing a home-based constraint-induced movement therapy protocol or plan, with the cooperation and acceptance of the family or caregiver may provide additional opportunities for the child to practice and experience movement patterns in their affected limb in a natural setting.

Based on the evidence provided in the above studies, the combination of constraint-induced movement therapy with a well-defined home program and regular structured therapy sessions may improve bimanual skills and lead to greater independence for children with hemiplegic cerebral palsy. Careful selection of children who would most benefit from CIMT is vital to successful outcomes as well as well defined goals and a strong commitment from the family, child, and therapist to follow the protocol accurately and to communicate any challenges related to the intervention.

Occupational Therapists should review the findings of these and other related studies to determine the optimal protocol to implement with individual children. After discussing the program and establishing goals and time lines with the family or caregivers, the occupational therapist should provided the appropriate support and home-program to best meet the child's needs and accommodate the family's situation. Continued direct occupational therapy services would be important to the success, allowing for ongoing training opportunities, monitoring the use and effect of the constraint device, and to carry out clinical observations related to the desired outcomes related to the intervention.

The research provided valuable information related to involving the family in the establishment of the goals or outcomes. Families need to be receptive of the intervention and recognize the challenges related to bathing and dressing if the restrictive device is not removable. The evidence supports use of a removable restrictive device for between 3.5 hours and 10 hours. This would resolve one concern of the parents and allow for close monitoring of possible skin breakdown or pressure points.

Barriers to implementation of a constraint-induced movement therapy program include the non-compliance of the family and frustrations associated with the restraint for the child. It is vital to establish open communication with the family or caregiver to establish clear and measureable goals prior to implementing the program to provide objective measures of

improvement and to provided a rationale for the ongoing use of this intervention.

Current implementations to research:

The studies reviewed in this appraisal used CIMT for between 3.5 and 10 hours per day. Although the use of the restraint varied greatly between studies, all reported similar outcomes. As suggested by Hsin et al. (2012), future research should include "larger sample sizes, kinematic measures, and different treatment doses to investigate the mechanism underlying functional improvement and identify the optimal treatment protocol." (Hsin et al., 2012, 997)

Wallen et al. (2011) states that future research should include a comparison of both modified constraint-induced movement therapy and intensive occupational therapy with a no-treatment comparison group. It is further suggested that an evaluation of different formats for implementing a modified constraint-induced movement therapy and intensive occupational therapy would be beneficial to the therapy community. (p. 1098)

De Brito Brandao et al. (2010) extended period of time (10 hours per day) modified constraint-induced movement therapy supports positive outcomes related to the restricted use of the non-affected limb. Results support the use of constraint-induced movement therapy paired with intensive affected arm training when compared to the control group who received weekly therapy sessions. They further suggest that it would be valuable to explore these interventions with larger groups and explore a variety of focused therapy goals and interventions to use in conjunction with constraint-induced movement therapy.

REFERENCES

de Brito Brandao, M., Mancini, M. C., Vaz, D. V., Pereira de Melo, A. P., Fonseca, S. T. (2012). Adapted version of constraint-induced movement therapy promotes functioning in children with cerebral palsy: a randomized controlled trial. *Clinical Rehabilitation, 7*, 639-647.

Charles, J. R., Wolf, S. L., Schneider, J. A., Gordon, A. M. (2006). Efficacy of a child friendly form of constraint induced movement therapy in hemiplegic cerebral palsy: a randomized control trial. *Developmental Medicine and Child Neurology, 48*, 635-642.

Charles, J. Gordon, A. M. (2005). A Critical Review of Constraint-Induced Movement Therapy and Forced Use In Children with Hemiplegia. *Neural Plasticity, 12*, 245-261.

Cope, S. M., Forst, H. C., Bibis, D., Liu, X. C. (2008). Modified Constraint-Induced Movement Therapy for a 12 Month Old Child With Hemiplegia: A Case Report. *The American Journal of Occupational Therapy, 62*, 430-437.

Crocker, M. D., MacKay-Lyon, M., McDonnell, E. (1997). Force Use of the Upper Extremity in Cerebral Palsy: A Single Case Design. *The American Journal of Occupational Therapy, 51*, 824-833.

Deluca, S. C., Echols, K., Law, C. R., Ramey, S. L. (2006). Intensive pediatric constraint-induced therapy for children with cerebral palsy: randomized, controlled, crossover trial. *Journal of Child Neurology, 11*, 931-938.

Dickerson, A. & Eagle-Brown, L. (2007). Pediatric Constraint-Induced Movement Therapy in a Young Child with Minimal Active Arm Movement. *The American Journal of Occupational Therapy, 61*, 563-573.

Eliasson, A. C., Krumlinde-Sundholm, L., Shaw, K., Wang, C. (2005). Effects of constraint-induced movement therapy in young children with hemiplegic cerebral palsy: an adapted model. *Developmental Medicine & Child Neurology, 47*, 266-275.

Eugster-Buesh, F., de Bruin, E. D., Boltshauser, E., Steinlin, M., Kuenzle, C., Muller, E., Capone, A., Pfann, R., Meyer-Heim, A. (2012). Forced-use therapy for children with cerebral palsy in the community setting: A single-blinded randomized controlled pilot trial. *Journal of Pediatric Rehabilitation, 5*.

Gordon, A. M., Hung, Y. C., Brandao, M., Ferre, C. L., Kuo, H. C., Friel, K., Petre, E., Chinnan, A., Charles, J. R. (2011). Bimanual training and constraint-induced movement therapy in children with hemiplegic cerebral palsy: a randomized trial. *Neurorehabilitation and Neural Repair, 8*, 602-702.

Hoare, B., Imms, C., Carey, L., Wasiak, J. (2007). Constraint-induced movement therapy in the treatment of the upper limb in children with hemiplegic cerebral palsy: A Cochrane systematic review. *Clinical Rehabilitation, 8*, 675-685.

Hsin, Y. J., Chen, F. C., Lin, K. C., Kang, L. J., Chen, C. L., Chen, C. Y. (2012). Efficacy of constraint-induced therapy on functional performance and health related quality of life for children with cerebral palsy: a randomized controlled trial. *Journal of Child Neurology, 12*: E-publication ahead of print.

Huang, H. H., Fetters, L., Hale, J., McBride, A. (2009). Bound for success: a systematic review of constraint-induced movement therapy in children with cerebral palsy supports improved arm and hand use. *Physical Therapy, 89*, 1126-1141.

Martin, A., Burtner, P. A., Poole, J., Phillips, J. (2008). Case Report: ICF-Level Changes in a Preschooler After Constraint-Induced Movement Therapy. *The American Journal of Occupational Therapy, 62*, 282-288.

Ramachandran S. & Thakur, P. (2011). Upper Extremity constraint-induced movement therapy in infantile hemiplegia, *Journal of Pediatric Neurosciences, 1*, 29-31.

Sakzewski, L., Ziviani, J., Boyd, R. (2009). Systematic Review and Meta-analysis of Therapeutic Management of Upper-Limb Dysfunction in Children With Congenital Hemiplegia. *Pediatrics, 123*, 1111-1122.

Taub, E., Ramey, R. L., Deluca, S., Echols, K. Efficacy of Constraint-Induced Movement Therapy for Children with Cerebral Palsy with Asymmetric Motor Impairment. *Pediatrics, 113*, 305-312.

van der Lee, J. H. (2003). Constraint-Induced Movement Therapy: Some Thoughts About Theories and Evidence. *The Journal of Rehabilitation Medicine, Supplement 41*, 41-45.

Wallen, M., Ziviani, J., Naylor, O., Evans, R., Novak, I., Herbert, R. D. (2011). Modified constraint induced therapy for children with hemiplegic cerebral palsy: a randomized trial. *Developmental Medicine and Child Neurology, 12*, 1091-1099.