University of Wisconsin – La Crosse
Occupational Therapy Program
OT 770: Evidence Based Practice

Critically Appraised Topic Template Instructions

Title: *Modified Constraint Induced Movement Therapy is as effective as conventional therapy in improving motor function and activity in clients 2 weeks to 3 months post-CVA*

Prepared by: Emily Alcott, OTS (Alcott.emily@uwlax.edu)
Alicia Frederick, OTS(Frederic.alicia@uwlax.edu)
Casey Heinle, OTS (heinle.casey@uwlax.edu)
Nicholas Scheuing, OTS (scheuing.nichola@uwlax.edu)

Date: December 7, 2016

Clinical Scenario:

Condition/Problem

- A cerebral vascular accident (CVA), also known as a stroke, results when there is a decrease in oxygen and blood to an area of the brain which leads to cell death in that part of the brain. The two main categories of types of stroke are ischemic and hemorrhagic. An ischemic stroke, the most common type of stroke, occurs when there is an obstruction of a blood vessel that supplies the brain. A hemorrhagic stroke occurs when a blood vessel ruptures (Gillen & Burkhardt, 2010). The outcomes of the two types of strokes are very similar, however, it is the area of the brain that is damaged that is more important in determining deficits.
- Individuals with CVAs have a natural healing process that occurs regardless of treatment. However, the sooner the individuals are able to receive therapy the better the outcome for recovery. For individuals with strokes, the recover process can be up to two years. This is all dependent upon the individual and varies from person to person (American Stroke Association, 2013).
- There are various residual problems that can occur when an individual has a stroke. While many can experience difficulties with speech, socio-emotions, and cognitive processing, the following are common physical difficulties that individuals can benefit from occupational therapy.
    - Hemiparesis
    - Neglect syndrome
    - Sensory loss
    - Deconditioning

Incidence/Prevalence

- Approximately 800,000 people in the United States have a stroke every year with three in four being first-time strokes.
- Someone in the United States has a stroke every 40 seconds.
- Stroke is the fifth leading cause of death in the United States.

- More women than men have strokes each year.
- African-Americans are more impacted by stroke than any other racial group within the American population (Impact of Stroke: Statistics, 2016).
- Nearly three-quarters of all strokes occur in people over the age of 65.
    - Risk more than doubles each decade after the age of 55 (Stroke Center, 2016).
- Recovery
    - 10% of stroke survivors recover almost completely .
    - 25% recover with minor impairments.
    - 40% experience moderate to severe impairments requiring special care.
    - 10% require care in a nursing home or other long-term care facility.
    - 15% die shortly after the stroke (National Stroke Association, 2016).

Impact of the Problem on Occupational Performance

Due to the weakness caused by the stroke in the affected arm, the individual may have difficulty performing daily occupations that may require two hands to perform the task or help stabilize.

- ADLs
    - Grooming
        - The individual may lack the ability to use their affected UE proficiently to comb their hair.
    - Feeding
        - The individual may not have the ability to bring their hand to their mouth, or have the coordination to keep food on a fork/spoon while bringing the utensil to their mouth. They also may lack the bilateral coordination to cut their food with a knife while also holding it in place with a fork.
    - Bathing/showering
        - The individual may have difficulty washing their unaffected side with their affected arm.
    - Toileting and toilet hygiene
        - The individual may have difficulty stabilizing with the affected side while performing toilet hygiene.
- IADLs
    - Meal prep and clean up
        - The individual may have difficulty using the affected UE in many cooking tasks that require two hands (stabilizing a pot while stirring it, holding vegetables while chopping them, etc).
    - Shopping
        - The individual may have difficulty reaching for objects on shelves, pushing a cart, or carrying groceries.
    - Work/Job performance
        - Many job tasks require the use of both arms either independently or working in coordination.
    - Leisure activities

- The individual may have difficulty performing certain leisure activities that involve BUE, or the affected limb, such as knitting, playing an instrument, or playing video games.

Intervention

Traditional constraint induced movement therapy

Constraint induced movement therapy (CIMT) is a treatment approach that can be used with patients who have had a CVA. In order to be eligible for the therapy, the clients must have at least 10 degrees of active wrist and finger extension. During this treatment the unaffected limb is restrained (usually with a sling or a mitt) for 90% of their waking hours. This treatment forces the client to use the affected limb throughout their daily tasks in order to combat learned non-use of the affected limb. Along with the constraint aspect of the therapy, clients also attend therapy sessions for "shaping". During these sessions, clients perform graded tasks and a lot of positive feedback is provided after each improvement. Once the individual is able to accomplish their given task, the task is made more difficult to challenge the client. The intensity and duration of the shaping aspect of the treatment varies depending on the abilities of the client. The grading scale depends on the client's active range of motion (ROM) in the affected wrist and fingers. Clients that have greater active ROM receive a lower grade and require less of the shaping treatment, while clients that have a smaller ROM have a higher grade and require a more intense shaping treatment (Taub, Bowman, Griffin & Morris, 2008).

Modified CIMT

With modified CIMT (mCIMT) the protocol is less intensive (the limb is constrained for less time) and spread out over a longer period of time. In the literature reviewed, the mCIMT protocols varied in the amount of time the client's arm was constrained and the number of weeks the client received therapy. The unaffected limb is constrained for several hours throughout the day during times of most use. In addition to the constraint, the patient is usually receiving therapy for "shaping" in order to promote function of the affected limb (Gillen & Burkhardt, 2010). The shaping protocol for mCIMT is similar to the shaping protocol of traditional CIMT.

In the three articles analyzed, the constraint portion of the treatment was performed between 4 and 10 hours per day, and were usually instructed to have the arm constrained during periods of heaviest use. One article retained the original constraint protocol of 90% of the clients waking hours. The therapy intervention was performed for 1-7 hours per day for 5 days of the week. The constraints used in all of the experiments were similar, using either a mitt or a sling to constrain the unaffected limb. The shaping protocol used for each of the experiments were similar to the protocol established by Taub et al. (2008), changing only the intensity and duration of the treatments.

OT Theoretical Basis

- Motor Control and Motor Learning

- After a CVA has occurred, the individual has lost the function of one or more of their limbs due to the damage of the neuropathways in the brain. Research suggests that multiple repetitions of an activity can create new neural pathways. During shaping therapy, the individual is required to perform a high number of repetition of graded tasks with only the affected limb. This promotes the development of new neural pathways in the brain which may potentially lead to regaining movement of the affected limb(s). With mCIMT, the individual's unaffected limb is constrained and the affected limb is forced to be used. If using only the affected limb during ADLs and IADLs, then motor function will improve due to newly developed neuropathways (Ciuffrida, 2003; Cole & Tufano, 2008).

Science Behind the Intervention

Mechanism of change

- The mCIMT protocol is designed to counteract learned nonuse of the affected extremity and begin to build new neuropathways in the brain by forcing use of the affected extremity.
- Through the use of the affected extremity there will also be some muscle strengthening and improvements in ROM occurring.

Key aspects of the intervention protocol

- Constraint of the unaffected limb through the use of slings or restrictive gloves.
- Patients perform the constraint intervention in their home environment during the hours of "most frequent arm use".
- One of the three articles stated that their individuals participated in physical therapy sessions for balance, gait training and stretching in addition to the mCIMT shaping sessions.

Mechanisms of change believed to occur in this intervention

- Creating new neuropathways
- Improvement in ADL and IADL performance
  - Building strength and increasing ROM of the affected limb
- Reverse the learned disuse of the affected limb

Why is this intervention appropriate for OT?

This intervention could be classified as a preparatory task because the shaping theory involves performing repeated tasks and not a whole occupation. It is a "bottom-up" approach that focuses on building strength, endurance, and ROM in order to improve the performance of ADLs and IADLs of the affected limb. The intervention could also be considered a occupational intervention because the individual is required to use only their affected limb during their ADL and IADL tasks in their home environment.

Focused Clinical Question- PICO

Does modified constraint induced movement therapy show improvement in motor function and activity involved in the use of the affected upper extremity more than conventional therapy alone in patients that are 2 weeks-3 months post CVA?

Population: Stroke patients with unilateral hemiparesis 2 weeks-3 months post-stroke
Intervention: Modified Constraint Induced Movement Therapy
Comparison Intervention: Conventional occupational therapy treatment
Outcome Variables: Motor function and activity

Search Summary

- Number of data bases searched: EBSCOHost,
- Total number of relevant articles located: 4 articles (see Table 1)
- Number/strength of articles located: 1b (see Table 1)
- Rationale for selection of articles to critique:
    - Articles were selected based on their timeline. The timeline was eventually narrowed to 2 week to 3 months post-CVA. Articles were also given preference if they scored higher on the PEDRO scale (≥7/11).
- Summarize state of literature on this intervention:
    - All articles reviewed found that mCIMT is a valuable intervention for improving motor functions, and activity in post-CVA clients unilateral hemiparesis. The number of hours for the therapy may vary, but the general guidelines state that the individual must receive OT shaping therapy and wear a mitt ~90% of their waking hours.

Clinical Bottom Line

Modified Constraint Induced Movement Therapy is as effective as conventional therapy in improving motor function and activity in clients 2 weeks to 3 months post-CVA.

Limitation of this CAT: This critically appraised paper (or topic) has been reviewed by occupational therapy graduate students and the course instructor.

Table 1: Search Strategy

Prepared by Emily Alcott, Alicia Frederick, Casey Heinle and Nicholas Scheuing (11/3/16)

Table 2: SUMMARY OF STUDY DESIGNS OF ARTICLES RETRIEVED

Level	Study Design/ Methodology of Articles Retrieved	Total Number Located	Citation (Name, Year)
1a	Systematic Reviews or Metanalysis of Randomized Control Trials		
1b	Individualized Randomized Control Trials	4	• Page et al., 2002 • Singh et al., 2013 • Treger et al., 2012 • Wang et al., 2011
2a	Systematic reviews of cohort studies		
2b	Individualized cohort studies and low quality RCT's (PEDro ≤4)		
3a	Systematic review of case-control studies		
3b	Case-control studies and non-randomized controlled trials (quasi experimental or clinical trials)		
4	Case-series and poor quality cohort and case-control studies		
5	Expert Opinion		

Search Terms	Inclusion and Exclusion Criteria
"CIMT" and "Stroke" "CIMT" and "Stroke" and "Subacute" "Modified" and "CIMT" and "Stroke" and "Subacute" "Modified Constraint Induced Movement Therapy" and "Stroke" and "Subacute" and "Upper Extremity" CIMT Constraint Induced Movement Therapy Stroke Modified Subacute Upper Extremity	Inclusion • Post-stroke 2 weeks to 6 months • Unilateral hemiparesis • Modified CIMT • Peer Reviewed • Full-text • English Exclusion • Receptive Aphasia

Table 3:

	Study 1 Singh & Pradhan, 2013	Study 2 Treger et al., 2012	Study 3 Wang et al., 2011
Design	Randomized Control Trial	Randomized Control Trial	Randomized Control Trial
Level of Evidence	1b	1b	1b
Rigor Score	7/11	9/11	7/11
Population	Stroke patients w/ unilateral hemiparesis 2-4 weeks post-stroke Mean age: mCIMT 55.2 years Control 56.4 years Both genders included 20 participants in each group (40 total)	Stroke patients w/ unilateral hemiparesis Mean days post stroke: CIMT 39.8 Control 23.3 Mean age: CIMT 62 Control 61.5 9 participants in the mCIMT group, and 19 participants were on the control group (28 total)	Stroke patients w/ unilateral hemiparesis 9.4-11.9 weeks post-stroke Mean age: mCIMT 59.4 Control 67 10 participants in each group (20 total)
Intervention Investigated	mCIMT: Shaping: Received 2 hours/day for 2 weeks, for 5 days/week. Tasks were selected by the individual and completed the task with small steps that increased in difficulty.	mCIMT: OT sessions 5x per week. 30 minutes of individual sessions. 30 minutes of group exercises for 2 weeks. Intensive training of the affected UL using a task oriented approach. Repetitive practice of functional activities and behavioral shaping.	mCIMT: Received 3 hours of consecutive OT sessions, 5 days per week for 4 weeks. The individuals performed tasks with only the affected limb. Resting hand splint on unaffected arm: 90% of waking hours, but excluding

	Mitt wearing schedule for unaffected arm: 10 hrs/day for 2 weeks. Mitt allowed for use of limb for transfers and ambulation, but restricted the use of fingers.	Unaffected limb Constrained using restrictive mitten 4 hours per day every day for 2 weeks.	activities when risk of injury might increase for 20 consecutive weekdays.
Comparison Intervention	Control Group: Received standard physical therapy which included learning compensatory strategies, UE strength, ROM, and positioning. Same number of therapy sessions was provided as the intervention group (5 days a week for 2 weeks)	OT sessions 5x per week. 30 minutes of individual sessions. 30 minutes of group exercises. Intensive training of the affected UL using a task oriented approach. Repetitive practice of functional activities and behavioural shaping.	Control Group: Received 45 minutes of consecutive OT sessions, 5 days per week for 4 weeks which included strength, balance, manual dexterity exercises, functional task practice, stretching/weight bearing with affected arm and teaching ADLs with less affected arm.
Dependent Variables	Body structures and body functions Activity	Body structures and body functions Participation and quality of life	Body structures and body functions Activity
Outcome Measures	Wolf Motor Function Test (WMFT), Fugl-Meyer Assessment (FMA)	Functional Independence Measure (FIM), Manual Function Test (MFT) National Institute of Health Stroke Scale (NIHSS)	Wolf Motor Function Test (WMFT)-Functional Ability Scale
Results	The intervention group had a total change in WMFT score (post-test	The change in FIM score between discharge and	Prior to treatment there were no significant differences between the

	minus pre-test) of 14.75±4.83, and the total change in the control group was 7.21±2.01. The intervention group had a total change in FMA score of 24.95±3.74, and the control group had a total change of 9.5±2.7.	admission was 16.3+/-8.0 fir the intervention group and 18.5+/-12.3 for the control group. The total change for the NIHSS scores were 3.1+/-2.4 for the intervention and 2.0+/-1.3 for the control. The total change in scores for the MFT was 5.4+/-3.4 for the intervention and 3.5+/-2.2 for the control group.	groups. After treatment there were significant differences in the scores of the WMFT between the mCIMT group and the conventional group. Only the mCIMT group showed significant improvement on the functional ability scale.
Effect Size	-WMFT Intervention Within Group ES: -2.83 -WMFT Control Within Group ES: -1.39 -FMA Intervention Within Group ES: 3.83 -FMA Control Within Group ES: .119	-FIM Between Group ES: .197 -NIHSS Between Group ES: -.641 -MFT Between Group ES: -.723 -Peg Transfer Between Group ES: -1.224 -Ball Grasp Between Group ES: -1.098 -Eating with a Spoon Between Group ES: -1.400	Not enough information provided. No means or standard deviations given.
Conclusion	Modified CIMT is effective in improving use of the affected upper extremity for post-stroke subacute individuals and demonstrated an improvement in function.	Subacute post-stroke patients may benefit from modified CIMT on improving function of the plegic hand.	Modified CIMT is more effective as a therapy on improving motor skills for individuals with acute and subacute than CR. There was no statistical significant change in motor functions between the ICR and mCIMT.

PICO Question:

Does modified constraint induced movement therapy show improvement in motor function and activity involved in the use of the affected upper extremity more than conventional therapy alone in patients that are 2 weeks-3 months post CVA?

Synthesis Section

Overall Conclusions:

The outcome variables included motor function and activity. Motor functions are considered to be upper extremity range of motion, timing, and strength. Activity is considered to be purposeful use of the upper extremity and ADL performance.

Motor function:

Two of the three articles addressed motor function. Singh and Pradhan (2013) found statistically significant improvement in strength and timing using standardized assessments (WMFT, FMA). Treger, Aidinof, Lehrer, & Kalichman (2012) displayed improvement completing functional tasks (peg transfer, ball grasping, "eating" with a spoon) but when standardized assessments were used (NIHSS, FIM, MFT), there were no significant improvements.

Activity:

Two of the three articles (Singh & Pradhan, 2013; Wang, Zhao, Zhu, Li, & Meng ., 2011) revealed that mCIMT displayed statistically significant improvements in activity using the WMFT standardized assessment.

All three of the studies had similar treatment interventions, however, there were slight variations in the intensity and total treatment time in each study. Singh and Pradhan (2013) required 2 hours of shaping per day individually, 5 days a week for 2 weeks for a total of 20 hours of treatment with mitt worn. The mitt was worn for 10 hours a day for 2 weeks for a total of 140 hours. Treger et al. (2012) required 30 minutes of shaping per day for each individual and 30 minutes of group shaping, 5 days a week for 2 weeks for a total of 10 hours of treatment with mitt worn. The mitt was worn 4 hours per day, 7 days a week for 2 weeks for a total of 56 hours outside of therapy. Wang et al. (2011) consisted of 3 hours of shaping per day individually, 5 days per week for 4 weeks for a total of 60 hours. Outside of shaping therapy, the functional hand was constrained with a resting hand splint for 90% of waking hours for 20 consecutive days.

Interventions treatment times

Article	Total Hours of Shaping	Total Hours of Additional Therapy (PT)	Total Hours of Constraint
Singh and Pradhan (2013)	20	0	140

Treger et al. (2012)	10	9	56
Wang et al. (2011)	60	0	90% of waking hour s for 20 days (290 total hours estimated based on 8 hours of sleep per night)

All of the studies included a baseline measure conducted immediately before the intervention, however, the post-test times varied. Singh and Pradhan (2013) conducted the WMFT and FMA post-test at the end of their 2-week intervention. Both groups showed significant improvement in motor function, however, there was greater improvement with the intervention group. Treger et al. (2012) conducted the post-test one month after the start of the intervention, even though the intervention was only two weeks long, in order to determine effects that lasted 2 weeks past the end of the study. At the one month post-test, both the mCIMT and control groups demonstrated significant improvement in all of the outcome measures, though there was not a significant difference between the groups. Wang et al. (2011) conducted the WMFT assessment two weeks into the intervention and again at four weeks at the end of the intervention. The control group did not demonstrate any significant improvement in the within group measurements, but the mCIMT group did demonstrate significant improvement in the within group measurements.

Modified Constraint Induced Movement Therapy is as effective as conventional therapy in improving motor function and activity in clients 2 weeks to 3 months post-CVA.

Boundaries:

There were a total of 88 participants combined in the three studies between the ages of 30 to 82. All the participants were in the subacute phase (2 weeks to 3 months) post-CVA with unilateral hemiparesis of the upper extremity. Common inclusion criteria consisted of no major cognitive deficits (Mini-Mental Status Examination score greater than or equal to 18), no pain that impacted the client's ability to participate in therapy, and some active range of motion of the affected limb (at least 10 degrees of active extension in each metacarpophalangeal and interphalangeal joint of all digits, and between 10-20 degrees of wrist extension). Two of the three studies provided exclusion criteria which included unilateral neglect, apraxia and aphasia.

Implications for practice:

The research suggests that mCIMT can help individuals post-CVA improve the motor function and activity of their upper extremity. Based on the results from the studies, mCIMT may be as good as conventional therapy in treating post-CVA hemiparesis.

The research does not explain the implications of how mCIMT affects participation (i.e. performance and satisfaction with their roles in their daily lives). Although all three studies address the change in upper extremity function it did not indicate if these gains will remain for the clients more than 2 weeks after the end of treatment. Further research will be needed to address these concerns.

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