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Constraint-Induced Movement Therapy (CIMT) as a Post Stroke Intervention

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Constraint-Induced Movement Therapy (CIMT) as a Post Stroke Intervention

Disciplines
Occupational Therapy

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CRITICALLY APPRAISED TOPIC

TITLE

Constraint-Induced Movement Therapy (CIMT) as a Post Stroke Intervention

AUTHOR

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Date 4/21/13

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Review date Spring 2013

CLINICAL SCENARIO

According to the Centers for Disease Control and Prevention (n.d.) more than 795,000 Americans have a stroke every year; these strokes cost the United States $38.6 billion dollars annually, resulting in lasting hemiplegia for many individuals, negatively affecting motor function in the upper extremity (UE). If neglected, the impaired UE loses the potential for improved functionality due to learned non-use. CIMT can be employed in stroke rehabilitation to address this issue.

Constraint induced movement therapy was developed by Edward Taub and his colleagues in response a concept known as learned non-use. Learned non-use is the idea that if a person tries to use their affected limb and does not get the results they want they will stop using it; this non-use will result in further limitation in functional use of the limb. In 1993 Taub and his colleagues published a standard protocol for CIMT for use with patients who have sustained a stroke. This standard protocol is what is now referred to as high intensity CIMT. (Thorne, 2009)

The standard CIMT protocol uses a padded mitt or sling on the less-impaired UE for 90% of waking hours over 2 weeks, while additionally performing monitored behavioral shaping and repetitive task practice 5 days/week for 6 hours/day. Modified protocols are common with decreased time required to wear the mitt and/or decreased hours of clinical therapy. Eligibility requirements typically include 10-20 degrees of active wrist extension, at least 10 degrees of thumb abduction/extension, and at least 10 degrees of extension in at least two other digits. Patients are expected to have adequate balance, ability to transfer independently, and the ability to stand for at least 2 minutes without upper extremity support. In addition, patients are screened with a cognitive exam, such as the Mini Mental State Examination (MMSE), and are only included if they score greater than 24. Some of these criteria can vary depending on the study.

In addition, CIMT can be used as an isolated therapy or in conjunction with traditional rehabilitation therapy. Results vary regarding the CIMT intervention timeline post-stroke. CIMT has been studied thoroughly and has proven to be effective in most intervention timelines for individuals that meet the eligibility requirements. This intervention approach is a valuable resource in stroke rehabilitation.
FOCUSSED CLINICAL QUESTION

Does combining constraint-induced movement therapy with traditional therapy in stroke patients improve UE motor function in the affected limb more so than traditional therapy alone?

SUMMARY OF SEARCH

We began our search by looking at CINAHL, OTDBASE, MEDLINE, and other databases to find available research regarding CIMT use in patients post-stroke. From the 379 articles located, nine articles were found to be most relevant and were included in this CAT.

Our most compelling research came from a systematic review and meta-analysis of CIMT by McIntyre et al (2012). The review found that participants in CIMT experimental groups continued to experience functional improvements 6 months or more post-stroke. This finding challenged previous theories that CIMT would improve function only within a brief window of time post-stroke.

A study by Wolf et al (2010) examined the results of administering CIMT to the same cohort of participants at two different intervals [3-9 months (early group) and 15-21 months (delayed group)] post-stroke. This study, known as the EXCITE Trial, showed that both participant groups showed significant improvements (with greater gains in the early group) in arm motor function with CIMT.

The VECTORS study, which focused on very early intervention, demonstrated that high-intensity CIMT (standard protocol) produced significantly less functional improvement when administered within one month post-stroke. This result showed that CIMT was dosage-dependent (Dromerick, A.W., 2009).

CLINICAL BOTTOM LINE

Constraint-induced movement therapy has produced significant UE functional improvements in patients as early as 3 months post-stroke. Improvements have also been clinically-demonstrated up to 2 years or longer after presentation of stroke. Several clinical outcome tests have been used to support these findings, including the Action Research Arm Test, Wolf Motor Function Test, and Functional Independence Measure.

The success of CIMT has proven to be dosage dependent, with high-intensity CIMT showing diminished functional improvements when used within one month post-stroke.

Important note on the limitation of this CAT

This critically appraised topic has /has not been peer-reviewed by one other independent person/lecturer, as an assignment. No claim is made for the completeness of this topic.

These writers are not claiming to be experts. They intend this CAT to be used solely for stimulation of discussion.
**SEARCH STRATEGY**

<table>
<thead>
<tr>
<th>Terms used to guide the search strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient/Client Group: Stroke</td>
</tr>
<tr>
<td>Intervention (or Assessment): <strong>Constraint-Induced Movement Therapy</strong></td>
</tr>
<tr>
<td>Comparison: <strong>Traditional Therapy</strong></td>
</tr>
<tr>
<td>Outcome(s): <strong>Improved Upper Extremity Motor Function</strong></td>
</tr>
<tr>
<td>Databases and Sites Searched</td>
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<tr>
<td>--------------------------------------</td>
</tr>
<tr>
<td>OTDbase</td>
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<tr>
<td>MEDLINE-OVID</td>
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<td>MEDLINE-OVID</td>
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<tr>
<td>Health Reference Center Academic</td>
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<td></td>
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<tr>
<td>Evidenced Based Medicine Reviews</td>
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<tr>
<td>Multifile</td>
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</tbody>
</table>
INCLUSION and EXCLUSION CRITERIA

**Inclusion Criteria**

Publications written in the last five years that addressed the effect of constraint-induced movement therapy on the population group of individuals that have experienced a stroke.

**Exclusion Criteria**

Articles written before 2008 were not included.

RESULTS OF SEARCH

A total of 379 articles were located in our search. We included nine articles in this CAT.

<table>
<thead>
<tr>
<th>Study Design/Methodology of Articles Retrieved</th>
<th>Level</th>
<th>Number Located</th>
<th>Author (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case Study</td>
<td>Tomlin’s Level IV</td>
<td>I</td>
<td>Thorne (2009)</td>
</tr>
</tbody>
</table>

Ø The above systematic review provided an extensive range of topic-specific research.

Ø The systematic review utilized a meta-analysis that included only research that had been conducted with scientific rigor.

Ø The systematic review studied the time frame that, according to research, has proven to be one of the most effective with regard to CIMT.

**SUMMARY OF BEST EVIDENCE**

**Table 2**: Description and appraisal of Systematic review and meta-analysis of constraint-induced movement therapy in the hemiparetic upper extremity more than six months post stroke by McIntyre et al (2012)

<table>
<thead>
<tr>
<th>Aim/Objective of the Study/Systematic Review:</th>
</tr>
</thead>
<tbody>
<tr>
<td>The objective of this study was to conduct a systematic review and meta-analysis on the effectiveness of CIMT on the hemiparetic upper extremity of individuals 6 months or more post-stroke.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study Design:</th>
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<tbody>
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</table>

<table>
<thead>
<tr>
<th>Search Strategy:</th>
</tr>
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<tbody>
<tr>
<td>The authors used MEDLINE, CINAHL, and EMBASE to search for available literature, using the key terms: “stroke”, “constraint-induced movement therapy”, and “constraint-induced therapy”. If needed, variations of these terms were used depending on that database being used. Additionally, the search restricted the articles to being written in English and automatically excluded any animal studies.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Selection Criteria:</th>
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</thead>
<tbody>
<tr>
<td>Resulting articles were screened for the following inclusion criteria:</td>
</tr>
<tr>
<td>● 50% or more of the sample size had sustained a stroke</td>
</tr>
<tr>
<td>● Research design was a Randomized Controlled Trial</td>
</tr>
<tr>
<td>● Mean time since stroke was &gt;6 months for both the treated group and the control group at the time the randomization took place</td>
</tr>
<tr>
<td>● Treatment group received CIMT and control group received traditional rehabilitation as therapy</td>
</tr>
<tr>
<td>● Functional improvement of UE was assessed pre and post treatment using one or more of six outcome measures</td>
</tr>
</tbody>
</table>
Methods:
Two reviewers used a five point selection system to assess the relevance of each study. A physiotherapist also reviewed each study to ensure treatments studied met the report criteria for CIMT. Articles were excluded from the review for any of the following reasons:
1. Data could not be accurately extracted from the article.
2. Time since stroke could not be determined.
3. A complete explanation of the CIMT protocol was not available or the claimed CIMT was not truly CIMT.
4. The control group consisted of individuals receiving less intense CIMT, as opposed to a form of traditional rehabilitation.

In addition, the two reviewers independently used the Physiotherapy Evidence Database (PEDro) 12-point scoring system to assess the quality of every selected article. Studies were chosen using only fair, good and excellent PEDro scores, which ranged from a numerical score of 4 on the low end of fair and 8 being excellent.

The reviewers used Comprehensive Meta-Analysis software to conduct six meta-analyses. Results were pooled using multiple relevant items, including: patient characteristics, sample size, study design and origin, treatment and control group protocol, and outcome measure pretreatment and post-treatment scores.

A fixed effects model was used when little heterogeneity was present and a random effects model was used for great heterogeneity.

Setting

Little information was provided regarding the setting in which studies were conducted. The systematic review did include an international range of countries that conducted studies. Articles from Norway, Taiwan, the Netherlands, Switzerland, Thailand, and United States of America were reviewed in the meta-analysis.

Participants

All studies in the review featured random samples of participants. The overall pooled sample size across all 16 selected studies was 572 participants. Of the 572 participants, 190 were females and 358 were males. Sample sizes ranged from 12 to 69 participants with a mean sample size of 36.

Six studies specified that participants had sustained a previous single stroke. The rest of the studies did not specify whether participants had sustained one or more previous strokes. Across all selected studies, the mean time since stroke was 22.7 months. One study, Suputtitada et al, did not specify a mean time since stroke, but stated all participants were more than 12 months post-stroke (McIntyre, 2012). Twelve studies did not report mean ages, but the remaining studies showed a mean age of 58.2 years with a range of 30-87 years.

Participants were also screened for additional physical and mental criteria. Each participant had to score 20 or greater (out of 30 possible points) on a Mini Mental State Examination (MMSE) to be included in the study. The MMSE evaluates cognitive functioning based on questions related to Orientation to Time, Orientation to Space, Attention and Calculation, Recall, and other factors (U.S. National Library of Medicine, 2013). Participants receiving scores of 20 or better would be assessed as having moderate cognitive impairment or better (Katz, A. & Ruiz, J.G., 2013). Therefore, only participants with moderate cognitive impairment or a
higher level of functioning were included in the systematic review. In addition, many studies included only individuals who were mobile without ambulatory aid or serious balance issues.

Half the studies included individuals with baseline Motor Activity Log (MAL) scores of less than 2.5. The MAL is a structured interview used to assess how well a participant uses his/her affected arm outside a clinical or laboratory setting. A score of less than 2.5 equates to a “poor” score and means the participant responded to arm use questions with, “The weaker arm was of some use during that activity but needed some help from the stronger arm or moved very slowly or with difficulty” (Taub et al, 2011). Wrist and hand ROM inclusion criteria were not addressed in the review.

**Intervention Investigated**

**Control**

All studies included in the systematic review involved Randomized Controlled Trials. Therefore, each study randomized subjects to control groups (as well as experimental groups). Most studies included one control group that received traditional therapy as the control factor. As stated above, it was required that the control group receive only traditional therapy for a study to be included in this review.

Four studies included two control groups to compare to the experimental CIMT group. In these study designs, one control group received no therapy at all, while the other control group received traditional therapy. The researchers conducting the systematic review eliminated the control groups that did not receive any form of therapy from their meta-analysis.

Across all studies, treatment times ranged from a minimum of 10 days to a maximum of 10 weeks. The typical duration of therapy studied was 3 weeks. The systematic review did not specify the clinical settings in which therapy was administered nor did the review list the specific individuals who delivered the traditional therapy for control groups.

**Experimental**

The experimental groups included in the systematic review all came from Randomized Controlled Trials. For two studies in the review, the experimental group received standard CIMT, as outlined by Taub’s (1977) original CIMT work with deafferented monkeys. This form of CIMT includes unaffected limb restriction for 90% of a patient’s waking hours over the duration of two weeks. In addition, this protocol involves 6 hours per day of therapy for the 10 days that the unaffected limb is restricted. The therapy protocol involves highly repetitive, graded task-specific therapy during each of the 6 hours of the 10-day therapy course.

For the remaining 14 studies, a variation of the Modified CIMT (mCIMT) protocol was used. This variation of mCIMT involved an average of 3 weeks of therapy with constraint applied 5-to-6 hours daily. In addition, therapy was provided for 2-to-3 hours per day for 5 days per week. According to the systematic review, these variations of mCIMT are considered standard variations and have proved to be equally effective compared to the traditional CIMT protocol.

The clinicians administering CIMT therapy were not specified, though occupational therapists and physical therapists were mentioned as related to the studies.

The clinical environments in which CIMT was administered were not specified. However, the RCTs in the
systematic review come from the following countries: Norway, Taiwan, the Netherlands, Switzerland, Thailand, and United States of America.

Treatment duration across all studies ranged from 10 days to 10 weeks, with a typical therapy duration of 3 weeks.

**Outcome Measures**

Motor Activity Log (MAL) 2 subscales: Quality of Movement (QOM) and Amount of Use (AOU)

The Motor Activity Log (MAL) is a scripted, structured interview that measures the effects of CIMT therapy on use of the more-impaired arm to determine functional use in ADLs. Scores range from 0-5 for the MAL as well as the QOM and AOU (Van der lee, Bekerman, Knol, deVet & Bouter, 2004). The QOM asks patients to rate how well they can use their more impaired arm and the AOU asks patients to rate how much they use their more impaired arm in real world activities. Good reliability and validity have been established for both measures of the MAL, and this outcome has been found to exhibit good convergent validity ($r>0.68$).

The AOU subscale meta-analysis was compiled from 11 studies and pooled pre-score mean was 1.0 and pooled post-score mean was 2.04 for the treatment group. For the control group, pre-score mean was 1.11 and post-score was 1.62.

The QOM subscale meta-analysis included data from 11 studies. Pooled pre-score mean was 1.0 and post-score was 2.7 for treatment group. For the control group, pre-score mean was 1.19 and post-score was 1.72.

Fugl-Meyer Assessment (FMA)

The FMA examines recovery in post-stroke hemiplegic patients. It assesses motor function, balance, sensation quality, joint range of motion, and joint pain. It has been shown to have excellent validity, internal consistency, and inter-rater reliability. Items are scored on a 3 point ordinal scale; the maximum score is 226 points. Subscales can be given without administering the whole assessment (Ali & Moore, 2010).

The FMA meta-analysis included 7 studies. The pooled pre-score mean was 42.27 and the post-score mean was 50.12, both for the treatment group. For the control group, pre-score mean was 43.42 and post-score was 46.49.

Action Research Arm Test (ARAT)

The ARAT observationally measures upper limb functioning in the areas of grasp, grip, pinch, and gross arm movement. It has been shown to have excellent inter-rater reliability and internal consistency. It is a 19 item test divided into grasp, pinch, grip, and gross arm movement. Each item is scored on an ordinal scale from 0-3. The maximum score possible is 57 (Raad & Moore, 2010).

The ARAT meta-analysis was taken from 5 studies. The pooled pre-score mean was 32.23 and the post-score mean was 41.24, both for the treatment group. The control group had a pooled pre-score mean of 27.63 and a post-score mean of 31.95.

WOLF Motor Function Test (WMFT)

The WFMT assesses upper extremity ability through performance time and quality of functional task performance. It consists of 3 parts; time, functional ability, and strength. Each item is ranked on a 6 point ordinal scale from 0-5. The assessment uses 15 function based tasks, the maximum score possible is 75 (Ali & Raad, 2010b).
The WFMT is found to be excellent in the areas of test/re-test reliability, inter-rater reliability, and internal consistency.

This study could not use the performance time subscale in an accurate way, so the meta-analysis was only calculated for the function subscale from 3 studies. Pooled mean pre-test scores were 2.99 and mean post-test were 3.64, both for the treatment group. Pooled mean pre-test scores were 2.93 and post-test scores were 3.41, both for the control group.

Functional Independence Measure (FIM)

The FIM measures motor ability in 13 ratings and cognitive ability in 5 ratings and measures how much assistance is required to perform ADLs. Each task is rated on a 7 point ordinal scale ranging from 1-7, the maximum score possible is 156 and the lowest is 18. The FIM is found to score excellent in inter-rater reliability, internal consistency, and adequate in convergent validity for stroke (Ali & Raad, 2010a).

The meta-analysis for the FIM was taken from 6 studies. Pooled mean pre-test scores were 106.84 and post-test were 112.75, both for treatment group. The control group had a pooled mean pre-test score of 107.32 and a mean post-test score of 108.93.

Main Findings

Six meta-analyses were performed, one for each outcome measure. All outcome measures showed statistically significant results except for the FMA and the WMFT.

<table>
<thead>
<tr>
<th>Assessment tool</th>
<th>Treatment group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pooled pre</td>
<td>Pooled post</td>
</tr>
<tr>
<td>FMA</td>
<td>43.27</td>
<td>50.12</td>
</tr>
<tr>
<td>FIM</td>
<td>106.84</td>
<td>112.75</td>
</tr>
<tr>
<td>AOU</td>
<td>1.00</td>
<td>2.04</td>
</tr>
<tr>
<td>QOM</td>
<td>1.00</td>
<td>2.07</td>
</tr>
<tr>
<td>ARAT</td>
<td>32.23</td>
<td>41.24</td>
</tr>
<tr>
<td>WMFT</td>
<td>2.99</td>
<td>3.64</td>
</tr>
</tbody>
</table>

Note: AOU = Amount of Use; ARAT = Action Research Arm Test; FMA = Fugl-Meyer Assessment; MAL = Motor Activity Log; QOM = Quality of Movement; WMFT = Wolf Motor Function Test.

Original Authors’ Conclusions

The results of this study showed that stroke patients who participated in CIMT therapy continued to recover functional use of their affected upper extremities at 6 months post stroke and well beyond. This goes against previous postulations of the time frame for recovery within the field of CIMT, which have held that CIMT therapy is only effective at recovering function in upper extremity when it is used early in post-stroke recovery. These findings create more options for stroke rehabilitation in individuals with prolonged functional impairment. Researchers should be encouraged to study other treatment avenues that may be effective in improving function for chronic post-stroke patients.
Critical Appraisal

Validity

The systematic review and meta-analysis utilized MEDLINE, CINAHL, and EMBASE to search keywords, “stroke”, “constraint-induced movement therapy”, and “constraint-induced therapy”. The search yielded 156 articles, 16 of which met the inclusion criteria. The 16 studies included in the analysis were Randomized Controlled Trials published between 1999 and 2011.

Six meta-analyses of included studies were completed using Comprehensive Meta-Analysis software. Two reviewers conducted an independent assessment of the studies for methodological quality using the Physiotherapist Evidence Database (PEDro) scoring system. PEDro scores for the studies were: 1 “excellent” study, 9 “good” studies, and 6 “fair” studies.

Interpretation of Results

The systematic review and meta-analysis listed several significant results reflected in the included outcome measures. For example, the ARAT and FMA showed favorable, statistically significant outcomes (P = .001 and P = .014, respectively) for CIMT patients. Eleven of the studies using the MAL-QOM subscale and MAL-AOU subscale also reported significantly greater scores in these areas, with both subscales showing P < .001. Traditionally, the MAL-QOM subscale has proven particularly reliable and valid in assessing actual functional status and UE rehabilitation. Therefore, these statistically significant findings suggest a demonstrated clinical effectiveness of CIMT 6 months or more post-stroke.

Six studies used the FIM to detect functional independence of CIMT participants. These studies did not show statistical significance, as evidenced by P = .07. This finding may have been due to the fact that the FIM is usually more sensitive to functional changes in individuals starting with lower functional scores at baseline. Since the 6 studies used participants with higher functional levels at baseline (Mean FIM = 106.8), CIMT-related functional improvements may have been more difficult to detect using the FIM.

Surprisingly, the WMFT did not demonstrate statistical significance with P = .120. Since the WMFT measures fine motor, gross motor, and strength tasks similar to the ARAT, the authors expected the WMFT to show statistically significant results. However, the authors theorized the WMFT’s focus on functional tasks may have led to stress and fatigue on the part of participants. These factors may have lead participants to focus on finishing the WMFT tasks quickly (rather than effectively) to minimize stress and fatigue. This hurry to finish the testing could have been reflected in lower scores.

Overall, the above findings showed clinically promising results for individuals more than 6 months post-stroke. In particular, the review determined CIMT was more effective than traditional therapy alone in improving UE functional ability. Improvements were shown in hand and arm placement control, as well as in hand and arm strength. Significant improvement was also observed in quality of UE movements and involvement of affected UE in daily activities.

The studies in the systematic review challenged the previous notion that CIMT could produce significant UE functional improvement only between 3 to 6 months post-stroke. The authors concluded the same level of functional UE improvement could occur as late as 21 months post-stroke as could occur 3-to-9 months post-stroke. Therefore, CIMT proved to be an effective therapy for a much longer duration post-stroke than
previously thought. This finding provided practitioners with additional evidence supporting the use of CIMT as part of a long-term therapeutic program post-stroke.

## Summary/Conclusion

McIntyre, et al. (2012) showed evidence from 16 studies, using a total of 6 different outcome measures, that CIMT therapy is effective at 6 months post-stroke and beyond. Four of the 6 outcome measures showed significant results for the use of CIMT therapy. Wolf, et al. (2010) looked at the use of CIMT in an early treatment group of 3-9 months post stroke and a delayed treatment group of 15-21 months post-stroke. Findings were a significant improvement in both treatment groups 12 months post treatment; early treatment group had greater gains in 2 out of 3 outcome measures. Findings from Wolf, et al. (2010) support the findings from McIntyre, et al. (2012) in that CIMT therapy can be effective to treat stroke survivors with chronic upper extremity loss of function. Both of these findings contradict postulations made in this field of research that no gains can be made using CIMT unless it is prior to 6 months, although the question remains if more gains can be made at an earlier stage. Findings from Dromerick, et al. (2009) give strong evidence that intensive CIMT therapy prior to 1 month post-stroke can have negative results on functioning. These findings showed that with more intensive CIMT compared to modified CIMT, or standard therapy, there was actually significantly less improvement in the upper extremity at 90 days.

CIMT proves effective in multiple time frames for post-stroke treatment, from 3 months through 21 months; it is contraindicated within the first 28 days. The optimal time frame for treatment remains unknown. Viana & Teasell (2012) brought to light the many barriers that exist to putting CIMT to use in clinical practice. Among these barriers is the fact that CIMT requires the resource of time from the therapists who are administering it, and many therapist and patients are resistant to using the protocol. Henderson & Manns (2012) showed a significant effect for CIMT used in group therapy in most of the outcomes used in their study. Also noteworthy, was the fact that both therapists and patients reviewed the CIMT treatment as a positive experience. Group therapy has the potential to alleviate some of the time demands on therapists as well as alleviate the resistance of both patients and therapists, as evidenced in the positive review. These studies reviewed confirm that CIMT is effective and has the potential to be modified to suit a treatment setting or a population. All studies stated that the intensive massed practice may be more important to the protocol than the constraint of the less affected upper extremity. More studies need to be done to determine an answer to this particular detail, as well as other issues, which will help alleviate the barriers to using CIMT more effectively in clinical practice.
Table 3: Characteristics of included studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Intervention investigated</th>
<th>Study Design</th>
<th>Outcomes used</th>
<th>Findings</th>
</tr>
</thead>
</table>
| Study 2 | CIMT | The purpose of this study is to test whether CIMT is more effective than an equal amount of traditional occupational therapy for stroke patients, and whether or not CIMT is dose-dependent. The low-intensity group received 2 hours of shaping therapy each day, and wore a mitt 6 hours per day for 2 weeks. The high-intensity group received 3 hours of shaping therapy each day, and wore a mitt 90% of waking hours for 2 weeks. | - NIH Stroke Scale  
- ARAT  
- FIM  
- Stroke Impact Scale (SIS); hand function subscale  
- Pain Ratings  
- Geriatric Depression Scale | During acute inpatient stroke rehab, CIMT is not more effective than |
| Study 3 | CIMT | Compare functional improvements between stroke patients randomized to receive CIMT within 3-9 months (early group) to participants randomized to receive identical intervention 15-21 months (delayed group) after a stroke. Both groups received 6 hours of shaping and repetitive task practice each day, and wore a safety mitt over the less-impaired UE during 90% of waking hours for 2 weeks. | - WMFT  
- MAL  
- SIS | Both groups showed significant improvements from pretreatment to 12 |
| Study 4 | CIMT | The purpose of this study was to review best evidence to identify barriers to implementation of CIMT. | | CIMT is effective. The Systematic Review identified 5 barriers to implementation of CIMT |

Authors compiled and reviewed 55 meta-analysis, RTCs, recent case reports, case series, and pilot studies.
High-intensity CIMT led to significantly less UE motor improvement at 90 days.

No significant differences were found between the dose-matched CIMT and the control group (traditional therapy) at 90 days.

months after treatment. Early group greater improvement than the delayed group in WMFT, Performance Time, and the MAL (p<0.0001), as well as in SIS and Activities domain (p<0.0009 and 0.0214).

Early and delayed group comparison of scores on these measures 24 months after enrollment showed no statistically significant differences between groups.

and proposed future direction to address these barriers.

Barriers identified:
1) Limited Generalizability
2) Resource Intensity
3) Therapist Factors
4) Patient Factors
5) Protocol Factors

<table>
<thead>
<tr>
<th>Study Design</th>
<th>Intervention investigated</th>
<th>Study Design</th>
<th>Intervention investigated</th>
<th>Study Design</th>
<th>Intervention investigated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eligibility for CIMT and mCIMT post stroke at 1-2 weeks, 4 weeks, and 3 months.</td>
<td>CIMT</td>
<td>Assessed effectiveness of administering CIMT in a group setting. Participants received 3.5 hours of shaping and adaptive task practice each day for 2 weeks.</td>
<td>CIMT</td>
<td>Compare cerebral blood flow before and after CIMT. Experimental group participants were in subacute phase after having their 1st ischemic stroke. Control group were healthy individuals that had not experienced a stroke.</td>
<td>CIMT</td>
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<th>Outcomes used</th>
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| - ARAT  
  - Nine Hole Peg Test  
  - Mini-Mental State Examination | - WMFT  
  - MAL  
  - COPM | - Mean Blood Flow Velocity (MFV); as measured using Transcranial Doppler Sonography  
  - Pegs transfer test  
  - Ball grasping test |
| Findings | Eligibility for CIMT/mCIMT should be considered at 4+ weeks post stroke. However, CIMT and/or mCIMT is not applicable for a large group of patients due to cognitive problems (~50% of stroke survivors). | Significant improvements (<0.001) in all measurement areas except MAL for motor recovery, functional use, and participation. Improvement was maintained over 3 months. Positive experience for both therapists and participants. | Significant increase in MFV for experimental group to their affected Middle Cerebral Artery, which is evidence of neuroplastic changes as a result of CIMT. More research would be required to link MFV and CIMT in later stages of stroke recovery. |

| Study Design | Compared mCIMT to natural recovery post stroke in elderly adults. Study was conducted in an interrupted time series (ITS) design; participants were assessed 4 or 5 times before the intervention and were reassessed another 4 or 5 times after the intervention, both over a three-week span. Participants received 2 hours of daily therapy, and wore a safety mitt over the less-impaired for 6 hours each day for 2 weeks. | A case study examining Constraint-Induced Therapy (CIT) as a stroke intervention in acute rehabilitation setting. During CIT, participant wore mitt 80% of the day for 1 week. Mitt was removable if needed (i.e. task was too challenging with mitt). |

| Outcomes used | - Chedoke-McMaster Stroke Assessment Impairment Inventory  
- COPM  
- Self-report FIM  
- Chedoke Arm and Hand Activity Inventory  
- ARAT  
- Self-Written Daily Log | - FIM  
- WMFT  
- MAL |

| Study 8 | [McCall et al, 2011] |
| Study 9 | [Thorne, 2009] |
**Findings**

Positive change scores were noted for all participants on all outcome measures with two exceptions. Those two exceptions being: one individual had a small negative change on the FIM-SR and a different participant demonstrated a small negative change on the ARAT pinch. Overall, it was determined that participants showed positive effects in his or her participation and activity levels after mCIMT intervention.

Data was collected before CIT, at completion of CIT, and 1-month after completion of CIT. Motor function continued to improve for the participant each time measurements were taken.

**IMPLICATIONS FOR PRACTICE, EDUCATION and FUTURE RESEARCH**

Future research should be done to determine if the restraint worn in CIMT is what makes the therapy effective or if the effectiveness is likely due to the intense directed massed practice hours, as well as the repeated use of the affected limb. Additionally, future research should examine a variety of modified CIMT protocols, such as group therapy and home-based CIMT that can potentially alleviate some of the burden of resources required by standard CIMT. The population that can benefit from CIMT is currently very small and generalizability is limited; studies should be done to show the effects of CIMT on populations with more severe complications post-stroke.

It is imperative to educate therapists. Viana & Teasell (2012) found that many occupational therapists are intimidated by the six hour protocol of massed practice. The occupational therapists stated they do not have the background knowledge to perform CIMT, and that they are afraid it will take time away from other clients and job responsibilities. Therapists should recognize that CIMT can take place throughout a patient’s day, out of the clinic and in their home environment. The intensity of CIMT is likely to be the most beneficial factor in the therapy, therefore therapists can educate their patients to maintain a massing and shaping exercise program in their home environment.

Studies have shown that CIMT is clearly an effective therapy for patients with hemiplegia in order to help them regain function of their UE. CIMT therapy also has many barriers, including eligibility for patient participation in CIMT. Therefore, therapists can identify treatment approaches for each patient that will raise their cognitive and/or UE motor levels to be eligible for CIMT therapy. Possible complementary treatment interventions include, but are not limited to: e-stim; mental practice; and mirror therapy.

The bottom line is that the intensity of CIMT is the primary factor in this therapy’s large positive effect size. Research has proven a multitude of modified CIMT approaches that incorporate the same level of intensity without as much clinical time necessitated in the standard protocol. It’s up to therapists in each clinical setting to find ways of implementing CIMT into practice. By addressing specific research questions and alternative methods to implementation, this effective and recommended therapy can become more widely used and benefit the lives of many.
REFERENCES


Thorne, A.J. (2009). Early use of constraint induced therapy (CIT) following a CVA: A case study examining this treatment during the acute rehabilitation phase of recovery. Acute Care Perspectives. 18(1), 12-19.


