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Critically Appraised Paper for "The Effect of Modified Constraint-Induced Movement Therapy on Spasticity and Motor Function of the Affected Arm in Patients with Chronic Stroke."

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Evidence Exchange

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CRITICALLY APPRAISED PAPER (CAP)

Siebers, A., Öberg, U., & Skargren, E. (2010). The effect of modified constraint-induced movement therapy on spasticity and motor function of the affected arm in patients with chronic stroke. *Physiotherapy Canada, 62*(4), 388–396. https://doi.org/10.3138/physio.62.4.388

CLINICAL BOTTOM LINE:

This study explored the effect of modified constraint-induced movement therapy (CIMT) on the spasticity and functional use of the affected arm and hand among persons of working age who presented with spastic hemiplegia resulting from a stroke that occurred more than 6 months ago. The researchers developed a modified CIMT program for use in an outpatient rehabilitation clinic with intensive and varied exercise training aimed at targeting the negative symptoms of spastic hemiplegia. Previous research on CIMT has taken place in laboratory settings and has not specifically focused on CIMT's effects on spasticity.

The researchers used a battery of assessments to evaluate the effects of the modified CIMT program on spasticity, active range of motion (AROM), grip strength, daily hand use, functional change in dexterity, and gross manual dexterity of the affected limb. Participants took part in a 2-week modified CIMT intervention in which they were instructed to wear a restraint on their unaffected arm for 90% of each day and were encouraged to actively use the affected arm in daily activities at home. From Monday through Friday, participants completed an individualized training program for 6 hr/day at the outpatient clinic. On the weekends, participants were instructed to continue wearing the restraint; they were asked not to perform any exercise but continue with their daily activities.

The training program was implemented at an outpatient rehabilitation clinic by an occupational therapist and a physiotherapist. Participants were initially assessed for baseline data. They were then retested for changes in spasticity and functional use of the affected limb after the 2-week modified CIMT training period and again at the 6-month follow-up.

At the end of the 2-week training period and the 6-month postintervention follow-up, results showed that application of the modified CIMT program was successful in reducing spasticity in the affected elbow and wrist flexors, increasing AROM in the affected elbow and wrist, increasing grip strength of the affected hand, and increasing functional use in the affected arm and hand.

This study suggests that a 2-week modified CIMT program, using intensive and varied exercise training aimed at the negative symptoms of spastic hemiplegia, can be used in outpatient rehabilitation clinics to reduce spasticity and increase functional use among persons with poststroke upper extremity spastic hemiplegia. This study further suggests that these changes may persist 6 months after completion of the program.

This study lacks generalizability to populations outside the intervention group, because of its small sample size and noninclusion of patients older than 67 years. This study also lacks a control group, which diminishes its validity. In summary, a modified CIMT intervention shows promising results for reducing spasticity among persons ages 22–67 years with poststroke upper extremity spastic hemiplegia; however, research on this topic would benefit from further validation through studies that include a larger sample size, a control group, and a greater age range of participants.

RESEARCH OBJECTIVE(S)

List study objectives.

To explore the effect of modified CIMT on spasticity and functional use of the affected upper extremity among working-age patients with spastic hemiplegia more than 6 months after stroke. Also, to assess whether modified CIMT was effective in a real-world outpatient rehabilitation clinic setting.

DESIGN TYPE AND LEVEL OF EVIDENCE:

Level III: prospective consecutive quasi-experimental study design

SAMPLE SELECTION

How were subjects recruited and selected to participate? Please describe.

Patients were recruited and selected to participate in this study through referral to the rehabilitation clinic where the study was being conducted. Those who fulfilled the inclusion criteria for the modified CIMT training model between August 2000 and September 2004 were included in the study.

Inclusion Criteria

Participants had to be of working age, between 22 and 67 years old. They must have had a stroke at least 6 months ago that resulted in reduced ability to use the hemiparetic arm. Participants had to have completed primary rehabilitation and had to be living at home at the time of recruitment. They had to be able to actively extend the wrist at least 20° and extend the metacarpophalangeal and interphalangeal joints at least 10°. They were also required to walk and balance safely, without using the nonaffected hand, with or without the use of an assistive device. Furthermore, participants had to be absent of any cognitive or uncontrolled medical problem that negatively affected their ability to complete the training program. Before

beginning the study, participants were required to understand the content and motivation behind the training program. Last, they had to have a minimum spasticity score of 1 on the 5-point Modified Ashworth Scale (MAS) for wrist and elbow flexors.

Exclusion Criteria

Patients who were experiencing arm pain that affected exercise intensity were excluded from the study.

SAMPLE CHARACTERISTICS

N= (Number of participants taking part in the study)	20		
#/ (%) Male	13/(65%)	#/ (%) Female	7/(35%)
Ethnicity	NR		
Disease/disability diagnosis	Stroke at least 6 months ago that resulted in chronic spastic hemiparesis		

INTERVENTION(S) AND CONTROL GROUPS

Group 1: Intervention group

Brief description of the intervention	The intervention was based on motor control theory, motor learning theory, and recovery of function theory. Each participant was instructed to place his or her unaffected upper extremity comfortably in a restricting position belt for 90% of his or her waking hours for 7 days each week. The position belt restricts the use of the upper extremity while positioning the arm comfortably to allow for quick arm use in unsafe situations. The participants signed a contract agreeing to wear the position belt for exercise activities; however, they were allowed to use their unaffected arm for toileting, bathing, washing, and performing necessary tasks when they were not able to receive help. On weekends, participants were instructed to wear the position belt, but without performing any specific exercises other than their daily activities. Each participant was assigned an individualized training program based on individual resources and problems. Participants were asked to perform the assigned training program each day from Monday to Friday for 2 weeks. These training programs included patient-specific

	tasks that focused on improving strength, coordination, and speed. Tasks included practicing weight bearing, moving items as fast as possible, playing ball games, and writing or working in the kitchen. As functional level increased, exercise intensity was also increased.
How many participants in the group?	20 participants
Where did the intervention take place?	The study was conducted at an outpatient rehabilitation clinic. Participants were asked to wear the restricting position belt outside of the clinic in their everyday environments. Environments varied with each participant, depending on their daily routine, and might have included the physiotherapy gymnasium, the occupational therapy room, the kitchen, the dining room, the occupational workshop, and the rehabilitation garden.
Who Delivered?	The exercises were organized by one occupational therapist and one physiotherapist.
How often?	Each participant was asked to wear the restricting position belt over the unaffected upper extremity for 90% of his or her waking hours for 7 days a week. Participants were instructed to perform an individualized training program 6 hr each day, between 9:00 a.m. and 3:30 p.m., from Monday to Friday for 2 weeks. Participants who did not complete 6 hr of training during this time were assigned to additional practice at home.
For how long?	The duration of the intervention was 2 weeks.

Intervention Biases: *Check yes, no, or NR and explain, if needed.*

Contamination:

YES ☐ NO ☒ NR ☐	*Comment:* There was only one group in this study; thus, the information given to each participant was meant for that particular participant. One patient was treated at a time.

Co-intervention:

YES ☒ NO ☐ NR ☐	*Comment:* Participants continued to take medication without change.

Timing:

YES ☐ NO ☒ NR ☐	*Comment:* The length of the intervention was appropriate, given that 2 weeks is the standard treatment time for CIMT interventions.

Site:

YES ☒ NO ☐ NR ☐	*Comment:* The study was conducted at a single outpatient rehabilitation clinic; however, participants were asked to wear the restricting position belt in the clinic, at home, and during their normal routines, which increased the site bias. Furthermore, participants were also asked to perform an individualized training program both in and out of the clinic. The various environments in which the training programs were performed also increased site bias.

Use of different therapists to provide intervention:

YES ☐ NO ☐ NR ☒	*Comment:* The individualized training program assigned to each participant was designed by one occupational therapist and one physiotherapist; however, the study did not state or confirm that each participant was only treated by one of these two therapists at the multidisciplinary outpatient rehabilitation clinic. Thus, therapist bias is possible but not certain. Furthermore, the authors did not discuss the training and education that the two therapists received. The different disciplines from which the two therapists stemmed might have increased the possibility for variation and therapist bias.

MEASURES AND OUTCOMES

Measure 1: MAS

Name/type of measure used:	The MAS measures muscle resistance of a relaxed group of muscles during passive movement and grades changes in muscle tone on a scale from 0 (indicating no increase in spasticity) to 5 (indicating rigid wrist or elbow in extension).
What outcome was measured?	Four passive motions of elbow flexors and wrist flexors were measured while the participant was in a supine position, moving both elbow and wrist from maximum flexion to maximum extension.
Is the measure reliable?	YES ☒ NO ☐ NR ☐
Is the measure valid?	YES ☐ NO ☐ NR ☒
When is the measure used?	Before and after the 2-week training period and 6 months later

Measure 2: AROM

Name/type of measure used:	Measured with goniometers in the conventional fashion
What outcome was measured?	Maximum active elbow extension was measured with the participant sitting and the arm hanging at his or her side. Maximum active wrist

	dorsiflexion was measured with the participant's forearm and wrist in neutral position and resting on the table.
Is the measure reliable?	YES ☒ NO ☐ NR ☐
Is the measure valid?	YES ☐ NO ☐ NR ☒
When is the measure used?	Before and after the 2-week training period and 6 months later

Measure 3: Grip strength

Name/type of measure used:	Measured with the Grippit instrument to record isometric muscle contractions
What outcome was measured?	Each participant's ability to squeeze the Grippit with his or her hand as hard as possible was measured, with isometric muscle contraction strength recorded in Newtons.
Is the measure reliable?	YES ☐ NO ☒ NR ☐
Is the measure valid?	YES ☐ NO ☐ NR ☒
When is the measure used?	Before and after the 2-week training period and 6 months later

Measure 4: Daily hand use

Name/type of measure used:	Daily hand use of the affected extremity was measured with a semistructured interview called the Motor Activity Log (MAL). The MAL includes questions about 30 daily tasks, with two assessment subscales to rate the use of the upper extremity. Ratings are based on a scale from 0 (indicating no use) to 5 (indicating normal use). Only the How Well subscale was used in this study.
What outcome was measured?	How well the affected upper extremity was used
Is the measure reliable?	YES ☒ NO ☐ NR ☐
Is the measure valid?	YES ☒ NO ☐ NR ☐
When is the measure used?	Before and after the 2-week training period and 6 months later

Measure 5: Functional change in dexterity

Name/type of measure used:	The Sollerman Hand Function Test was used to measure functional change in dexterity, as determined by eight common hand grips measured with 20

	items of daily life. A 5-point scale was used, from 0 (indicating not performed at all) to 4 (indicating performed without difficulties). The test was timed, with a maximum of 60 s given for each item.
What outcome was measured?	Pulp pinch, lateral pinch, tripod pinch, five-finger pinch, diagonal volar grip, transverse volar grip, spherical volar grip, and extension grip
Is the measure reliable?	YES ☒ NO ☐ NR ☐
Is the measure valid?	YES ☐ NO ☐ NR ☒
When is the measure used?	Before and after the 2-week training period and 6 months later

Measure 6: Gross manual dexterity

Name/type of measure used:	The Blocks and Box Test (BBT) was used to measure gross manual dexterity.
What outcome was measured?	The number of blocks the participant was able to transport to the other side of the box during a 60-s period.
Is the measure reliable?	YES ☒ NO ☐ NR ☐
Is the measure valid?	YES ☐ NO ☐ NR ☒
When is the measure used?	Before and after the 2-week training period and 6 months later

Measurement Biases

Were the evaluators blind to treatment status? *Check yes, no, or NR, and if **no**, explain*.

YES ☐ NO ☒ NR ☐	*Comment:* Because there was no control group, the evaluators knew that all participants had received the intervention.

Recall or memory bias. *Check yes, no, or NR, and if **yes,** explain*.

YES ☐ NO ☒ NR ☐	*Comment:* Although the same measures were used three times for each participant, this was not enough to produce any training effect. Additionally, because all the measures were of a physical nature, there was no recall or memory bias.

Others (list and explain):

N/A

RESULTS

List key findings based on study objectives

Include statistical significance where appropriate ($p<0.05$)
Include effect size if reported

After the 2-week modified CIMT training period, 4 of the 17 participants who initially presented with spasticity of their elbow flexor displayed improvements in spasticity. At the 6-month follow-up, 9 of the 17 participants displayed significantly improved elbow spasticity, whereas 1 had worsened spasticity. Furthermore, 11 of the 15 participants who initially presented with spasticity at their wrist flexor displayed improved spasticity scores at the end of the 2-week training period. At the 6-month follow-up, 12 of the 15 participants displayed significant improvements in wrist spasticity scores. At the end of the 2-week modified CIMT training period, there were significant increases in AROM for both elbow extension ($p = .002$) and wrist dorsiflexion ($p < .001$). Both continued to show significant increase at the 6-month follow-up. At the end of the 2-week modified CIMT training period, participants also showed significant improvement in grip strength of the affected hand ($p < .001$). These improvements continued at the 6-month follow-up. Functional use of the affected arm and hand, as measured by the MAL, the Sollerman Test, and the BBT, significantly increased after the 2-week modified CIMT training period ($p < .05$). Between the end of the training period and the 6-month follow-up, functional use continued to improve. At the 6-month follow-up, changes measured by the Sollerman Test were significant ($p < .05$).

Was this study adequately powered (large enough to show a difference)? *Check yes, no, or NR, and if **no**, explain.*

YES ☐ NO ☒ NR ☐	Sample size was not large enough, and no control group was present to demonstrate difference.

Were appropriate analytic methods used? *Check yes, no, or NR, and if **no**, explain.*

YES ☒ NO ☐ NR ☐	*Comment:* The changes in AROM and grip strength were analyzed with parametric tests. Changes in functional use of the affected arm and hand, as measured by the Sollerman Test and the BBT, were analyzed with Wilcoxon's nonparametric test. Results of the MAS and MAL were analyzed with Svensson's method.

Were statistics appropriately reported (in written or table format)? *Check yes or no, and if **no**, explain.*

YES ☒ NO ☐	*Comment:* Statistics for both the postintervention and the follow-up results were reported in written and table format. These reports included the results

NR ☐	for changes in spasticity, AROM, and functional use of the affected arm and hand. Statistical significance, indicated by *p* value, was also included when available.

Was the percent/number of subjects/participants who dropped out of the study reported?

YES ☒
NO ☐
NR ☐

Limitations:

What are the overall study limitations?

This study's results were limited by the inclusion of only participants between the ages of 22 and 67 years. This study lacks generalizability because of the high number of older persons in the stroke population. A further limitation of this study is the small sample size (20 participants). Additionally, this study is limited by the lack of a control group. A larger sample size, examination of the modified CIMT program for participants older than 67, and inclusion of a control group would have helped increase the generalizability of this study.

CONCLUSIONS

State the authors' conclusions related to the research objectives.

The authors concluded that 2 weeks of modified CIMT reduced spasticity, increased daily use of the affected arm, and increased functional use of the affected arm. These improvements were seen immediately after the 2-week training program and 6 months later, at the follow-up. On the basis of these results, the authors suggested that modified CIMT with intensive and varied exercise training can reduce spasticity and increase functional use for participants with chronic spastic hemiparesis. However, the authors believed that this study should be replicated with an experimental design, rather than a quasi-experimental design, with the addition of a control group.

This work is based on the evidence-based literature review completed by Jacqueline Bloom, OTS, Emily Lu ,OTS, Matthew Tong, OTS (students at Dominican University of California), and Kitsum Li, OTD, OTR/L, faculty advisor, Dominican University of California.