

Modified Constraint Induced Movement Therapy for Lower Extremities' Rehabilitation in Patients with Stroke: A Narrative Review of Literature

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ABSTRACT

Background: Learned non-use is a common complication after stroke in patients who neglects the use of the affected limb for longer periods. Modified Constraint Induced Movement Therapy (m-CIMT) is a form of rehabilitation therapy that limits the unaffected side and through repeated and concentrated training improve the function of the paretic side. Use of m-CIMT for lower extremities rehabilitation is relatively less explored avenue. Aim of the present study was to review literature evaluating the effectiveness of m-CIMT for recovery of lower extremities (LE) function in stroke patients.

Methodology: Articles published in English language from 2011 to 2022 were searched from various online databases. Out of total 6 search results, 5 full texts were screened and selected for review based on selection criteria. The review included randomized control trial, pilot study, and experimental study designs.

Result: The review of available literature suggested that m-CIMT is an effective approach for LE rehabilitation in stroke patient. It has showed promising results on outcomes such as gait parameters, balance, ambulation, and symmetry.

Conclusion: Based on this review, it can be concluded that m-CIMT intervention is effective for rehabilitation of paretic LE function in patient with stroke and therefore it may be used in addition to a conventional treatment.

Keywords: Balance, gait, lower extremity function, modified constraint induced movement therapy, rehabilitation, stroke.

INTRODUCTION

According to World Health Organization (WHO) stroke is defined as, "a clinical syndrome consisting of rapidly developing clinical signs of focal disturbance of cerebral function lasting more than 24 hours or leading to death with no apparent cause other than a vascular origin".¹ Stroke accounts for almost half of death which means stroke is the second largest cause of death around the world.² It is one of the main causes of death and disability worldwide with a very high incidence and prevalence rate.¹ Recent study

suggest that crude incidence of stroke in India ranged from 108 to 172/100,000 people per year, crude prevalence from 26 to 757/100,000 people per year, and one month case fatality rates from 18% to 42%.³

The loss of motor control, abnormal movement pattern, tone disorders, coordination difficulties and sensory dysfunction on the lower extremities which arise post-stroke period reduces motor function.⁴ Disturbance in balance after stroke is a major problem which increases the risk of fall. Impairment in balance after stroke

exist more while reacting to destabilizing external force and during self-initiating movement. Due to motor weakness, asymmetry, altered muscular tone, and somatosensory deficits in lower extremities patients will have disturbed balance and postural control as well as gait abnormalities.⁵

Impairment in the lower-limb post stroke severely induces alterations in the gait parameters such as the instability of walking gait, loss of balance, the slower pace, increase of energy consumption, and asymmetry in movement angles and gait parameters between the two sides of lower limb, which may affect walking and increase the risk of fracture.⁵ Asymmetric steps are a characteristics of hemiparetic gait, with the paretic limb having a shorter stance time and step length than that of the non- paretic limb.⁶ Constraint induced movement therapy (CIMT) is an approach to stroke rehabilitation involves the forced use of the affected limb.⁶ The two main component of constraint induced movement therapy (CIMT) are the constraint of the non-paretic extremity and the massed practice of the paretic extremity.⁴ Due to the bipedal nature of the humans, restraint of the non-affected lower extremity is practically not possible and probably unnecessary.⁴ Gait asymmetry leads to increased energy consumption and liability to fall. So, enhancement of symmetry can be considered a clinical marker of functional recovery.⁶ As majority of functions in ADLs include unilateral use of upper extremities interventions using CIMT can be more relevant in recovery of the motor functions.⁷

A somewhat different approach of conventional CIMT, a modified constraint induced movement therapy (m-CIMT) is a form of rehabilitation therapy that limits the less paretic side and through repeated and concentrated training.⁸ Most of the patients do not comply with application of standard CIMT protocols due to rigorous practice and the complete restriction schedule on non-affected side.⁴ m-CIMT is reported to be an effective treatment created to enhance the

function of paretic upper extremities.⁸ Applications of m-CIMT for lower extremities is a less explored avenue and different studies have shown inconclusive findings for the same.^{4,9} Some researchers have applied method for partial restriction in different ways, such as the whole leg orthosis, the below knee prosthesis, or the addition of a shoe insert to study the effects of m-CIMT for lower limb on motor function in stroke patients.⁹ Aim of the present study was to review literature evaluating the effectiveness of m-CIMT for recovery of lower extremities (LE) function in stroke patients.

MATERIALS & METHODS

• Search strategy:

A systematic search of papers in English, published in peer-reviewed journals between January 2011 and December 2022, was carried out using MEDLINE and PubMed electronic databases. Key words and abstracts were searched, using the following descriptors: "stroke," "CIMT/constraint induced movement therapy," "gait/walking" and "balance." The idea was to focus on the most recent and relevant research accessible in digital format.

• Selection criteria:

✓ Inclusion criteria:

- i. Study design: pilot study, experimental study, and randomized controlled trial
- ii. Full text articles included in this study

✓ Exclusion criteria:

- i. Any other languages than English
- ii. Any study conducted prior to 2011
- iii. Study including other than stroke patients

• Screening and data extraction:

The full texts of articles considered relevant by both the reviewers were obtained and analysed. In addition, the reference lists of included papers were examined to identify any additional articles that might have been missed by the search strategy. Out of total 38 search results, 14 full texts were screened and

5 were selected for review based on selection criteria.

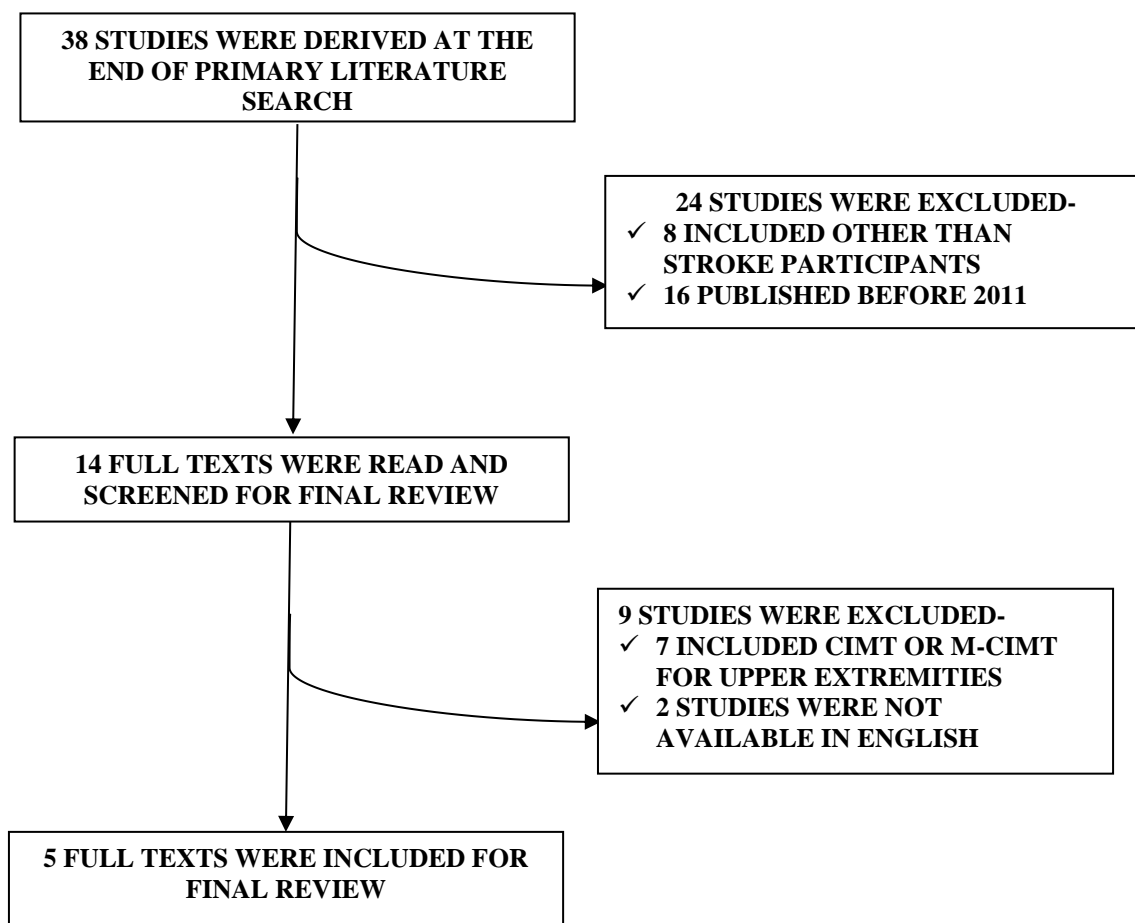


Figure 1: Process of Screening & Selection of Articles

As the heterogeneity among the articles was vast, it was difficult to find a critical appraisal tool (CAT) that could prove suitable for them all. Moreover, the recent literature on CATs highlights their lack of validation and reliability, while highlighting the fact that the tools are usually based on each appraiser's concept of research quality. For both these reasons, it was considered more appropriate to conduct a descriptive analysis rather than a critical appraisal of the work. The information was tabulated after

being properly cross-checked by two authors independently.

RESULT

Table-1 presents an overview of the 5 empirical articles that were analysed. It highlights the type of study, purpose, population, grouping and intervention, total duration of intervention and follow up, the variables and measures of the studies, and the main findings. Most of them (n=3) were experimental studies, one was randomized controlled trial, and one was pilot study.

Table: 1 Summary Characteristics of the Reviewed Studies (n=5)

Author Year	Study design	Population	N	Grouping and intervention	Total duration	Outcome measures used	Findings
Sevim et al 2019 ¹⁰	E	Late sub-acute and chronic stroke patients	30	EG: m-CIMT protocol CG: conventional care	4 weeks, 3 session /wk, 60min per session	SS-QOL, Stroke impact scale	m-CIMT effective treatment to improve paretic LE strength and QOL

Sevim AC et al 2017 ⁹	R	Late sub-acute and chronic stroke patients	30	EG: m-CIMT protocol CG: standard usual care	2 weeks 5 days/wk, 60 min per session	BBS, 10 Meter walk test, step length ratio, cadence	m-CIMT useful to enhance motor function. Gait and balance
Yulian Zhu et al 2016 ⁴	P	Late sub- acute and chronic stroke patients	22	EG: m-CIMT CG: conventional therapy	4 weeks, 5 days/wk 45 minutes per session	COM displacement and gait parameters	m-CIMT improves COM displacement and gait parameters
Katja K et al 2014 ¹¹	E	Elderly chronic stroke patients	3	EG: m-CIMT CG: standard rehabilitation	4 weeks, 2 hours every day in a week	TUG, 6 min and 10 meter walk test and LE motor function	m-CIMT give positive result in balance and motor function improvement
Amanda CF et al 2011 ¹²	E	Hemiparetic post stroke patients	37	EG: m-CIMT CG: conventional physiotherapy	4 weeks, 5days/week	SIS, BBS, TUG, Fugl meyer	m-CIMT is effective treatment for improving gait and balance
Here, N: number of participants E: Experimental Study R: Randomized Controlled Trial P: Pilot Study EG: Experimental Group CG: Control Group QOL: Quality of life				m-CIMT: Modified Constraint Induced Movement Therapy SS-QOL: Stroke Specific Quality of Life BBS: Berg Balance Scale COM: Center of Mass TUG: Timed-up and Go SIS: Stroke Impact Scale LE: Lower extremity			

DISCUSSION

Based on the selection criteria, only 5 studies published in English could be selected for review as their full texts were available. Out of 5, three studies were experimental type of design and whereas only one study each had pilot and randomized controlled designs.

Majority of the reviewed studies included late sub- acute and chronic stroke patients and as the design was experimental, the number of subjects in them were around 30 only. In majority of the studies, duration of intervention was 45-60 minutes for 3-5 days per week for 4 weeks^{10,11,12}. Katja k et al (2014) included only 3 chronic elderly stroke patients where the intervention was given for two hours every day for 4 weeks¹¹. Sevim AC et al 2017 provided the intervention for five days a week, only for two weeks for 60 minutes per session⁹.

Katja K et al (2014) reported that most of the patients do not comply with application of standard CIMT protocols due to need of rigorous practice and the complete restriction schedule on non-affected side¹¹. Compliance to the prescribed exercise intervention protocol is a very important factor for rehabilitation. The reasons for less compliance or non-compliance for stroke patients was reported to be difficult application of constraint, need of consistent practice, tardiness of mobility related

activities, and restrictions of daily life activities on affected as well as unaffected sides^{4,9-12}.

Applications of m-CIMT for lower extremities is a less explored avenue and different studies have shown inconclusive findings for the same.^{4,9} Some researchers have applied method for partial restriction in different ways, such as the whole leg orthosis, the below knee prosthesis, or the addition of a shoe insert to study the effects of m-CIMT for lower limb on motor function in stroke patients.⁹ The result of the study reviewed were positive indicating that m-CIMT useful for LE rehabilitation in stroke patient^{4,10-12}. It has showed promising results on outcomes such as gait parameters, balance, ambulation, and symmetry.

Lesser number of studies with weaker evidence supporting the use of m-CIMT for lower extremities in subacute and chronic stroke patients increases need for future studies including it and creating stronger evidence for use of m-CIMT in clinical rehabilitation protocols.

CONCLUSION

Recent literature confirms that the m-CIMT is a useful intervention for upper extremity function rehabilitation but its use in rehabilitation of lower extremities is under studied. This scenario is due to multiple

reasons and factors, and future research aimed at developing strong evidence must be undertaken. Based on this review, it can be concluded that m-CIMT intervention helpful for rehabilitation of paretic lower extremity function in patient with stroke and therefore it may be used in addition to a conventional treatment.

Declaration by Authors

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