

Effectiveness of Constraint Induced Movement Therapy (CIMT) in Comparison with Other Therapeutic Interventions in Treatment of Adult Stroke Patients: A Systematic Review

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ABSTRACT

Background: Stroke is a leading cause of adult disability. Among the various therapeutic modalities used for improving upper extremity function post stroke, Constraint Induced Movement Therapy (CIMT) is one of the most investigated interventions.

Objectives: To review the available literature to find evidence for CIMT intervention in overcoming upper extremity impairment in adult stroke patients.

Methods: A literature search was conducted on PubMed, Cochrane, EMBASE, CINAHL, and Google Scholar databases. Free full text articles from 2015 - April 2021 with interventional studies, comparing CIMT with other therapeutic interventions for stroke patients with unilateral upper limb involvement were reviewed

Results: Twenty-five articles were reviewed after applying the inclusion exclusion criteria. Sample size in case of interventional studies ranged from 19-159 participants. Fifteen studies (60%) concluded that CIMT is superior to conventional therapy in overcoming non-use of affected upper limb, two articles (8%) concluded CIMT brings about limited improvements functionally. 50% studies denied long term gains or improvements, one article

(4%) specifically denying any effects lasting post 6 months, three studies (12%) reported better results when CIMT was used in combination with other therapies, one study (4%) has shown Botox and CIMT combination to be a promising treatment method for improving motor function.

Conclusion: We found CIMT a useful therapy in adult stroke patients with more studies showing a significant improvement in early phases of rehabilitation. Even if the articles have denied long-term gains or improvements beyond six months, none have shown deterioration in CIMT group

Keywords: Adult stroke, Constraint induced movement therapy (CIMT), systematic review

INTRODUCTION

Stroke is a global health problem and is the second commonest cause of death and a leading cause of adult disability worldwide.^[1] Various therapeutic interventions for improving upper limb function post stroke like Bobath approach, Constraint Induced Movement Therapy (CIMT), mental practice, mirror therapy, robot assisted therapy, task specific

training, virtual reality, etc. have been described in literature.^[2] CIMT developed by Taub et al^[3] is one of the most investigated intervention effective in overcoming upper limb impairments post stroke.^[4,5] Another program, modified CIMT (mCIMT) with shorter training duration has been described by Page et al.^[6-8]

Rationale: CIMT has been widely used as a treatment method for both paediatric and adult patients. However, the systematic reviews and interventional studies conducted before 2015 have shown an inconclusive evidence about effectiveness of CIMT in adult stroke patients.^[9-14] Hence, a literature review was conducted to find further evidence for effectiveness of CIMT in adult stroke patients.

METHODS

A literature search was conducted to meet this above objective. PubMed, Cochrane database, EMBASE, CINAHL, and Google Scholar databases were used to search the literature between January 2015 till April 2021. Freely available full text articles about CIMT in English, from the year 2015 till April 2021 which included interventional studies conducted on individuals beyond 20 years of age, comparing CIMT with other therapeutic

interventions for stroke patients with unilateral upper limb involvement were reviewed for the study. Single case studies, case series and articles comparing CIMT with adjunct interventions like needling, acupuncture were excluded from the study. Specific key words and their combinations were used for the literature search:

1. CIMT AND adult stroke
2. Constraint induced movement therapy AND adult stroke
3. CIMT OR Constraint induced movement therapy AND Stroke
4. Constraint induced movement therapy AND Arm Rehabilitation AND stroke
5. Constraint induced movement therapy AND hemiplegia

The full text of available articles was screened by four reviewers and details of articles meeting the eligibility criteria were entered in an Excel sheet created for easy access and analysis of articles. The Excel sheet included the details of each article as: Website link, type of study, duration and follow-up, no. of groups compared, names of groups compared, age group, gender of population, sample size, sampling method, outcome measures used, place of study, journal of publication, results and statistical significance. Figure 1 shows the PRISMA guidelines flowchart which summarizes the details and results of the literature search.

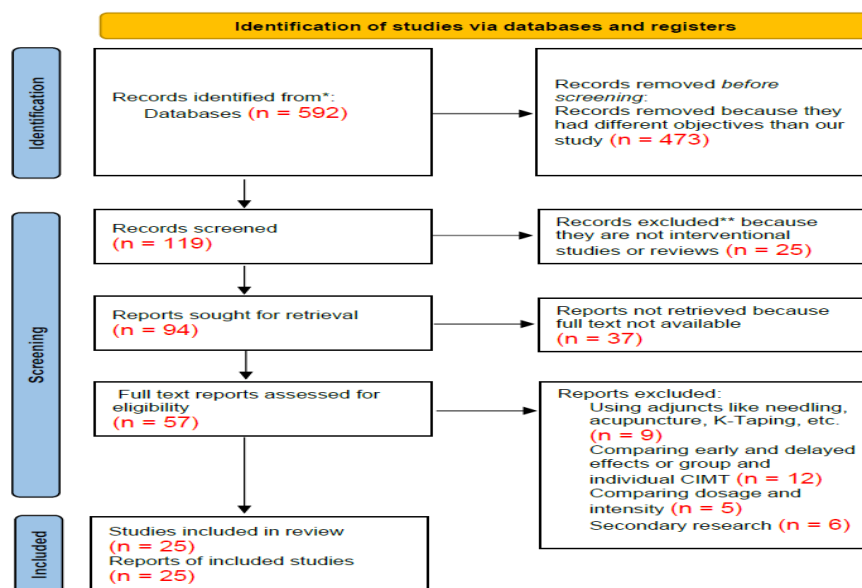


Fig 1: PRISMA Flowchart

RESULTS

The search identified 592 articles, of which 567 articles were excluded as they did not meet the inclusion criteria. In all 25 articles met the inclusion criteria and subsequently they were retrieved for full text assessment. Out of 25 articles included in the study, 22 were randomized control trials (RCTs), two

were non randomized control trials (non-RCTs) and one was a systematic review. Figure 2 shows this distribution in percentage. Duration of interventions ranged from two-four weeks with an average follow-up of six months in a few studies.

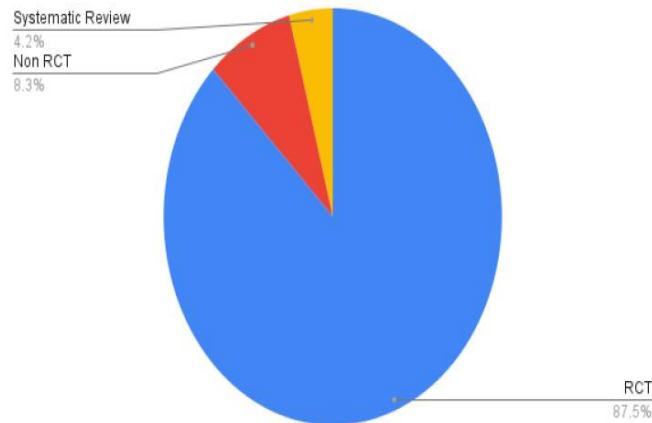


Fig 2: Types of Study Designs

Names Of Groups	Frequencies
mCIMT and conventional	9
CIMT and conventional	7
Home-Based CIMT and conventional	1
e CIMT and conventional	1
mCIMT, SR-mCIMT and conventional	1
Botox-CIMT and Botox-conventional	1
CIMT+ placing techniques of Bobath and only CIMT	1
mCIMT+ TR and mCIMT	1
mCIMT-conventional and EMG-NMS- conventional	1
mCIMT and auditory feedback in TR with mCIMT	1
Robotic therapy and mCIMT+ RT	1

Table 1: Comparison Groups with Frequencies

Abbreviations: CIMT- Constraint Induced Movement Therapy;
 mCIMT- modified constraint induced movement therapy;
 e CIMT- expanded constraint induced movement therapy;
 SR-mCIMT- self regulated constraint induced movement therapy;
 TR- trunk restraint; RT- robotic therapy

Table 1 shows the comparison groups and their frequencies i.e. number of articles that have used those respective patterns of comparison groups. In this table, conventional therapy groups stand for use of different conventional techniques such as Bobath approach, Motor Relearning program, stretching, strengthening, PNF

techniques, range of motion, functional task, bimanual task training, etc.

Sample size in case of interventional studies ranged from 19-159 participants.

Outcome measures used have been shown in figure 3 which includes a graph explaining the names and frequencies of the outcome measures used.

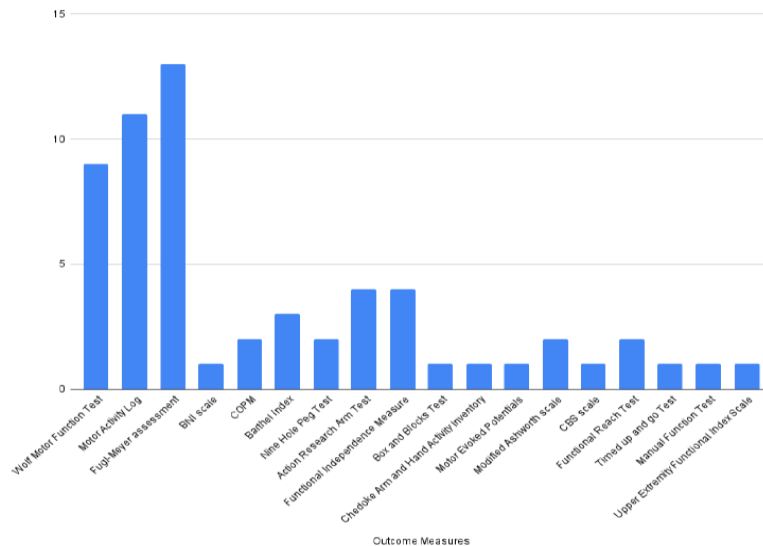


Fig 3: Frequencies of Outcome Measures Used

Abbreviations: BNI scale- Barrow Neurological Institute scale, CBS scale- Catherine Bergego scale

Fifteen articles (60%) showed statistically significant improvement in motor and functional outcomes through use of CIMT/mCIMT and concluded that CIMT is superior to conventional therapy in overcoming non-use of affected upper limb and the resulting impairment in acute or subacute phase post stroke.^[15-29] Two articles (8%) showed that CIMT brings about limited improvements functionally but does not reduce significant disability and is not superior to conventional therapy in motor gains.^[30,31] Most of the articles (50%) have denied long term gains or improvements lasting more than six months after use of CIMT; with 1 article (4%) specifically denying any effects lasting post six months.^[32] One study (4%) has shown Botox and CIMT combination to be a promising treatment method for improving motor function.^[33] Three studies (12%) included CIMT in both the groups that is, CIMT alone and CIMT in combination with Trunk restraint; placing techniques of Bobath and auditory feedback for trunk control. In those studies, the combination groups have shown greater and statistically significant effects in improving upper limb function post stroke. They have shown improvements in motor functions like balance, weight bearing, weight shifts and also in ADL performance.^[34-36] One article

(4%) has shown that a combination of Robotic Therapy and mCIMT uniquely improved motor control strategies of affected limb and improved independence in performance of instrumental ADL.^[37] One study (4%) did not approve of CIMT as a useful intervention for upper extremity owing to the limitations of study such as limited generalizations to stroke population or limited demand of intervention.^[38] One article (4%) has shown mCIMT to be more effective than mirror therapy in improving the function of hemiparetic upper extremity in sub-acute stroke patients.^[39]

DISCUSSION AND CONCLUSION

This review included 25 articles that discussed the effect of CIMT on improving upper extremity functioning post stroke in comparison with other therapeutic interventions. Majority of the articles have highlighted the importance of CIMT in improving motor and functional impairments post stroke. They have concluded that CIMT is superior to conventional therapy in overcoming upper limb impairments post stroke. Most of these articles have expressed that CIMT emphasizes massed practice of affected upper limb by restraining the non-affected upper limb and training the affected upper limb by shaping movements. These

repetitive movements of affected limb in CIMT have shown to induce cortical reorganization.

Regarding the article that showed that CIMT is not superior to conventional therapy in motor gains and brings about only limited improvements functionally, it was a home-based CIMT program which might have shown negative results because the patients had non-professional coaches supervising their therapy at home. Not all factors can be optimal to conduct therapy sessions at home.³¹ Most studies have denied long-term gains or improvements lasting for more than six months maybe because study period would have ended in one-two months and not all patients would have continued using CIMT as a sole mode of rehabilitation and some might have dropped out in the follow-up period too. The noticeable improvement in upper extremity function post stroke in case of combination of Botox-mCIMT group than in Botox-conventional group could be attributed to the ability of Botox to reduce spasticity which facilitated the repetitive performance of functional tasks in CIMT without spasticity hindrance. Both being promising interventions, the combination was found to be superior than Botox-conventional therapy combination.³⁴

Few findings suggest that combination of mCIMT with some therapeutic intervention is more effective than mCIMT alone. In case of using trunk restraint or trunk restraint with auditory feedback combined with CIMT, the trunk restraint helps to decrease the trunk compensatory strategy to improve upper extremity function through CIMT. Auditory feedback provided during intervention for trunk control stimulates the pressure sensors and helps the individual in making a cognitive decision to control the trunk in response to an auditory feedback signal.³⁷ The authors here had concluded that this combination facilitates intensive physical training in relearning of motor skills while restraining the compensatory movement.^{35,37} CIMT induces independent cortical reorganization and placing

techniques of Bobath facilitate by stimulation of proximal key points. Thus, CIMT with Bobath combination gives independent and controlled movement and therefore, is found to be effective than use of CIMT alone.³⁶ mCIMT in combination with Robotic Therapy was concluded to be superior than Robotic Therapy alone in motor improvement post stroke possibly because Robotic Therapy would have improved the motor control strategies as seen on kinematic analysis which leads to better smoothness and efficacy of a particular movement.³⁸ In the study comparing CIMT with mirror therapy, CIMT was seen to be more effective than mirror therapy because as against mirror therapy, in CIMT unaffected arm is restrained and affected arm is voluntarily used thereby resulting in formation and growth of new neural pathways.⁴⁰

CONCLUSION

Overall, from the literature that we reviewed, we found CIMT as a useful therapy in adult stroke patients with more studies showing a significant improvement in early phases of rehabilitation. These improvements in the early phases of rehabilitation may help in promoting functional independence in the early phases of rehabilitation. Even if the articles have denied long-term gains or improvements lasting more than six months, none of the studies have shown deterioration in CIMT group. Hence, CIMT appears to be a promising therapeutic intervention for overcoming upper extremity non-use post stroke in adults.

Implications For Further Research:

1. Since a Cochrane review has suggested about the implications of CIMT not translating to any reduction in disability, hence, maybe the interventions which combine CIMT with other disability improving parameters can be studied in future.
2. Systematic review emphasizing on optimal time after stroke when CIMT

can be started and optimal dosage of CIMT.

Limitations:

1. Full text of only freely available articles was retrieved.
2. CIMT was compared with numerous other interventions and hence it was a heterogenous comparison.

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Conflict of Interest: None

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