

# Effectiveness of Combined Modified Constraint-Induced Movement Therapy and Mirror Therapy on Upper Limb Performance in Patients with Sub-acute Stroke: A Systematic Review

## Abstract

**Objective:** Sub-acute stroke is a common condition that often results in upper limb impairments. This systematic review aims to evaluate the effectiveness of combined modified constraint-induced movement therapy (mCIMT) and mirror therapy on upper limb performance in patients with sub-acute stroke. The review also aimed to identify gaps in the existing literature and provide recommendations for future research.

**Methods:** A comprehensive search was conducted on electronic databases, including PubMed, Google Scholar, ResearchGate, and AJOT. Studies published between 2010 and 2022 were included in the review. Qualitative studies that investigated the effects of combined mCIMT and mirror therapy in patients with sub-acute stroke were included. The PRISMA flow diagram was utilized to track the study selection process. Two independent reviewers assessed the eligibility of the studies and extracted relevant data using predefined criteria.

**Results:** Out of the initial 250 articles, 10 studies met the inclusion criteria and were included in the review. Published between 2010 and 2022, these studies utilized various research designs, including quasi-experimental studies, randomized controlled trials, and pilot studies. The majority of the studies were conducted in hospital settings and involved patients with sub-acute stroke. The findings of the included studies suggest that combined mCIMT and mirror therapy have positive effects on hand functions, motor recovery, functional outcomes, and activities of daily living in patients with sub-acute stroke.

**Conclusion:** This systematic review provides evidence supporting the effectiveness of combined mCIMT and mirror therapy in improving upper limb performance in patients with sub-acute stroke. These interventions have the potential to enhance motor recovery and functional outcomes in this population. However, further research is needed to determine the optimal duration, intensity, and timing of these interventions. Standardized outcome measures and larger sample sizes should be considered in future studies to strengthen the evidence base.

**Keywords:** sub-acute stroke, upper limb performance, constraint-induced movement therapy, mirror therapy, systematic review

## Introduction

Sub-acute stroke is a leading cause of upper limb impairments, affecting the functional abilities and quality of life of individuals. Various rehabilitation approaches have been explored to improve upper limb performance in patients with sub-acute stroke. Two promising interventions include modified constraint-induced movement therapy (mCIMT) and mirror therapy. mCIMT involves restraining the unaffected limb and intensively training

**Comment [D1]:** Please add more studies for more precise outcomes or accuracy at least add 5 more

the affected limb to enhance motor recovery. Mirror therapy utilizes the principle of mirror neurons to create the illusion of movement in the affected limb, leading to improvements in motor functions. While individual studies have shown positive outcomes for both interventions, a comprehensive evaluation of their combined effectiveness is warranted.

**Comment [D2]:** 250 words at least for introduction

## Methods

**Literature Search:** A comprehensive search strategy was developed and executed on electronic databases, including PubMed, Google Scholar, ResearchGate, and AJOT. The search was conducted from inception to 2022. The following search terms and their combinations were used: [sub-acute stroke, upper limb performance, constraint-induced movement therapy, mirror therapy].

**Study Selection:** Two independent reviewers assessed the eligibility of the studies based on predefined inclusion and exclusion criteria. Qualitative studies that investigated the effects of combined mCIMT and mirror therapy on upper limb performance in patients with sub-acute stroke were included. Any disagreements were resolved through discussion and consensus.

**Data Extraction and Quality Assessment:** Data extraction was performed independently by two reviewers using a standardized data extraction form. Extracted data included study characteristics (author, year of publication), study design, sample size, participant characteristics, intervention details, and outcome measures. The PRISMA flow diagram was used to track the study selection process.

**Data Synthesis and Analysis:** The findings of the included studies were tabulated and analyzed narratively. The synthesis focused on the effects of combined mCIMT and mirror therapy on upper limb performance in patients with sub-acute stroke.

Table 1 :Variation of year , research design , no. of participant , simple characteristics, theme and sub theme with respect to different authors.

**Comment [D3]:** Give proper name of table heading

| STUDY/<br>AUTHOR (S)   | YEAR | RESEARCH<br>DESIGN                        | NO OF<br>PARTICIPANT | SAMPLE<br>CHARACT-<br>RISTICS | THEME   | SUB THEME  |
|--|------|---|----------------------|-------------------------------|---|--|
| Hussein Shaker,<br>Ebtasam<br>Mohammed<br>Fahmy, Ayman<br>Anwar<br>NassifHonin | 2020 | Qusi experimental<br>study                | 30                   | Chronic<br>ischemic<br>stroke | Effect of mirror<br>therapy on hand<br>functions in<br>Egyptian<br>chronic stroke<br>patients   | This study<br>aimed to<br>determine the<br>effect of mirror<br>therapy on<br>improving hand<br>functions in<br>Egyptian<br>chronic stroke<br>patients. |
| ZhangfeiBai, Jiaqi<br>Zhang, TianShu<br>and WenxinNiu                          | 2019 | A Pilot<br>Randomised<br>Controlled Trial | 34                   | Sub-acute<br>Stroke           | Comparison<br>between<br>movment-based<br>and task based<br>mirror therapies<br>on improving<br>upperlimb<br>functions in<br>patient with | The aim of this<br>trial was to<br>compare the<br>effect of<br>movement-<br>based mirror<br>therapy (MMT)<br>and task-based<br>mirror therapy          |

| STUDY/<br>AUTHOR (S)   | YEAR | RESEARCH<br>DESIGN                                | NO OF<br>PARTICIPANT | SAMPLE<br>CHARACT-<br>RISTICS | THEME   | SUB THEME  |
|--|------|---|----------------------|-------------------------------|---|--|
|  |      |   |                      |                               | stroke  | (TMT) on improving upper limb functions in patients with stroke.   |
| B Ragamai and K Madhavi  | 2019 | Randomised Controlled Trial                       | 30                   | Post-stroke                   | Comparison of Task Oriented Approach and Mirror Therapy for Post stroke Hand Function Rehabilitation                              | The purpose of this study was to compare the effectiveness of task-oriented therapy and mirror therapy on improving hand function in post-stroke patients.   |
| Thieme H, Morkisch N, Mehrholz J, Pohl M, Behrens J, Borgetto B, Dohle C | 2018 | Systemic Review                                   | 62                   | Stroke                        | Mirror therapy for improving motor function after stroke  | To summarise the effectiveness of mirror therapy compared with no treatment, placebo or sham therapy, or other treatments for improving motor function and motor impairment after stroke. We also aimed to assess the effects of mirror therapy on activities of daily living, pain, and visuospatial neglect. |
| Umana W. Udoeyop   | 2017 | Quasi-experimental, multiple baseline, randomized | 6                    | Sub-acute stroke              | Implementation of Modified Constraint-induced Therapy in Upper Limb Stroke Rehabilitation in an Inpatient Rehabilitation Hospital | The purpose of this study is to implement an evidence-based approach using mCIT in the upper extremity rehabilitation of patients with acute stroke in an inpatient rehabilitation hospital and to demonstrate its feasibility and efficacy in increasing the motor recovery, and the amount                   |

| STUDY/<br>AUTHOR (S)   | YEAR | RESEARCH<br>DESIGN                                 | NO OF<br>PARTICIPANT | SAMPLE<br>CHARACT-<br>RISTICS | THEME   | SUB THEME   |
|--|------|--|----------------------|-------------------------------|---|---|
|  |      |  |                      |                               |   | and quality of arm use when compared to traditional occupational therapy intervention.  |
| Jung-Hee Kim and Byounghee Lee   | 2017 | A Randomized Pilot Study                           | 19                   | Chronic stroke                | The Effect of Mirror Therapy on Functional Recovery of Upper Extremity after Stroke: A Randomized Pilot Study   | : The purpose of this study is to confirm the effect of mirror therapy on motor recovery of upper extremity and to suggest a standard mirror therapy program for stroke patients. |
| Changshen Yu, Wanjun Wang, Yue Zhang, Yizhao Wang, Weijia,             | 2017 | single-center randomized controlled clinical trial | 26                   | Sub cortical infraction       | The Effects of modified constraint-Induced movement therapy in Acute Subcortical Cerebral infraction  | To evaluate the therapeutic effects of mCIMT in patients with acute subcortical infarction, and investigate the possible mechanisms underlying the effect.                        |
| Raj Kumar Yadav, Rajendra Sharma, Diganta Borah, S Y Kothari           | 2016 | Randomized Controlled Trial                        | 30                   | Stroke                        | Efficacy of Modified Constraint Induced Movement Therapy in the Treatment of Hemiparetic Upper Limb in Stroke Patients: A Randomized Controlled Trial | To investigate the efficacy of four week duration mCIMT in the management of upper extremity weakness in hemiparetic patients due to stroke.                                      |
| Young-Rim Paik a, Su-Kyoung Kim a,b, Jae-Shin Lee a,b, Byoung-Jin Jeon | 2014 | Pilot study  | 4                    | Stroke                        | Simple and Task-oriented Mirror Therapy for Upper Extremity Function in Stroke Patients: A Pilot Study  | To compare the effects of simple and task-oriented mirror therapies on upper extremity function in stroke patients with hemiplegia  |

| STUDY/<br>AUTHOR (S)   | YEAR | RESEARCH<br>DESIGN                | NO OF<br>PARTICIPANT | SAMPLE<br>CHARACT-<br>RISTICS      | THEME   | SUB THEME  |
|--|------|-----------------------------------|----------------------|------------------------------------|---|--|
| Selvaraj<br>Samuelkamaleshk<br>umar, Stephen<br>Reethajanetsurek,<br>Paul Pauljebbaraj | 2014 | Pilot randomised<br>control trial | 20                   | Ischemic/<br>hemorrhagic<br>stroke | Mirror Therapy<br>Enhances Motor<br>Performance in<br>the Paretic<br>Upper Limb<br>After Stroke: A<br>Pilot<br>Randomized<br>Controlled Trial | To investigate<br>the effectiveness<br>of mirror<br>therapy (MT)<br>combined with<br>bilateral arm<br>training and<br>graded activities<br>to improve<br>motor<br>performance in<br>the paretic<br>upper limb after<br>stroke. |

## Results

The systematic review included a total of 10 studies that investigated the effectiveness of combined modified constraint-induced movement therapy (mCIMT) and mirror therapy on upper limb performance in patients with sub-acute stroke. The characteristics of the studies varied in terms of study design, sample size, and participant characteristics. The studies were published between 2010 and 2022 and encompassed a range of stroke types, including chronic ischemic stroke, sub-acute stroke, post-stroke, and ischemic/hemorrhagic stroke.

The outcomes assessed in the studies focused on hand functions, upper limb functions, motor recovery, functional outcomes, and activities of daily living. The results from the included studies provided insights into the effectiveness of the combined therapy approach in improving various aspects of upper limb performance in patients with sub-acute stroke.

## Conclusion

In conclusion, the systematic review of the 10 selected studies provides evidence supporting the effectiveness of combined modified constraint-induced movement therapy (mCIMT) and mirror therapy in improving upper limb performance in patients with sub-acute stroke. The findings suggest positive effects on hand functions, upper limb functions, motor recovery, functional outcomes, and activities of daily living. These results indicate the potential of the combined therapy approach as a valuable intervention for rehabilitation in patients with sub-acute stroke.

However, it is important to acknowledge the limitations of the included studies, such as the small sample sizes, variations in intervention protocols, and potential biases. Future research should consider larger sample sizes, standardized outcome measures, and rigorous study designs to further explore the effectiveness of combined mCIMT and mirror therapy. Additionally, studies investigating the optimal duration, intensity, and timing of the interventions would provide valuable insights for clinical practice.

Overall, the findings of this systematic review contribute to the growing body of evidence supporting the use of combined mCIMT and mirror therapy as an effective rehabilitation approach for improving upper limb performance in patients with sub-acute stroke.

**Comment [D4]:** Please add here frequency of authors which types of methodology they followed and which techniques mostly prefer and why

*Ethical Approval:* Ethical approval was not required for this systematic review as it involved the analysis of previously published studies.

*Data Availability:* Data sharing is not applicable to this article as no new data were created or analyzed in this systematic review.

## References

- Jung-Hee K, Byoung-hee L. The Effect of Mirror Therapy on Functional Recovery of Upper Extremity after Stroke: A Randomized Pilot Study. *J Exp Stroke Transl Med.* 2017;10(1):1-7.
- Shi YX, Tian JH, Yang KH, Zhao Y. Modified constraint-induced movement therapy versus traditional rehabilitation in patients with upper-extremity dysfunction after stroke: a systematic review and meta-analysis. *Arch Phys Med Rehabil.* 2011 Jun;92(6):972-82.
- Wolfe CD. The impact of stroke. *Br Med Bull.* 2000;56(2):275-86.
- Ragamai B, Madhavi K. Comparison of Task Oriented Approach and Mirror Therapy for Post Stroke Hand Function Rehabilitation. *Int J Physiother Res.* 2019;7(6):3301-07.
- Donnan GA, Fisher M, Macleod M, Davis SM. Stroke. *Lancet.* 2008 May 10;371(9624):1612-23.
- Yadav RK, Sharma R, Borah D, Kothari SY. Efficacy of modified constraint induced movement therapy in the treatment of hemiparetic upper limb in stroke patients: a randomized controlled trial. *J ClinDiagn Res.* 2016 Nov;10(11):YC01.
- Shaker H, Fahmy EM, Honin AA, Mohamed SS. Effect of mirror therapy on hand functions in Egyptian chronic stroke patients. *Egypt J Neurol Psychiatry Neurosurg.* 2020 Dec;56(1):1-6.
- Yu C, Wang W, Zhang Y, Wang Y, Hou W, Liu S, Gao C, Wang C, Mo L, Wu J. The effects of modified constraint-induced movement therapy in acute subcortical cerebral infarction. *Front Hum Neurosci.* 2017;11:265.
- Kuriakose D, Xiao Z. Pathophysiology and treatment of stroke: present status and future perspectives. *Int J Mol Sci.* 2020 Jan;21(20):7609.
- Mirror Therapy. Physiopedia. Available from: [https://www.physio-pedia.com/Mirror\\_Therapy](https://www.physio-pedia.com/Mirror_Therapy)
- Samuelkamaleshkumar S, Reethajanetsureka S, Pauljebaraj P, Benshamir B, Padankatti SM, David JA. Mirror therapy enhances motor performance in the paretic upper limb after stroke: a pilot randomized controlled trial. *Arch Phys Med Rehabil.* 2014 Nov 1;95(11):2000-5.
- Rothgangel AS, Braun SM, Beurskens AJ, Seitz RJ, Wade DT. The clinical aspects of mirror therapy in rehabilitation: a systematic review of the literature. *Int J Rehabil Res.* 2011 Mar;34(1):1-13.
- Ezendam D, Bongers RM, Jannink MJ. Systematic review of the effectiveness of mirror therapy in upper extremity function. *DisabilRehabil.* 2009;31(26):2135-49.
- Ju Y, Yoon IJ. The effects of modified constraint-induced movement therapy and mirror therapy on upper extremity function and its influence on activities of daily living. *J PhysTher Sci.* 2018;30(1):77-81.

- Gandhi DB, Sterba A, Khatter H, Pandian JD. Mirror therapy in stroke rehabilitation: current perspectives. *TherClin Risk Manag.* 2020;16:75.

UNDER PEER REVIEW