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Research Article

A Comparative Study on the Effectiveness of Constraint-Induced Movement Therapy and Conventional Physiotherapy in Improving Hand Function Among Hemiparetic Stroke Patients

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Abstract

Background: Stroke is one of the leading causes of long-term disability worldwide and frequently results in impaired upper limb function, which limits the performance of daily activities. Various rehabilitation approaches are available to improve upper limb recovery, among which Constraint-Induced Movement Therapy (CIMT) and Conventional Physiotherapy are commonly used.

Objective: The purpose of this study was to compare the effectiveness of Constraint-Induced Movement Therapy and Conventional Physiotherapy in improving hand function among patients with hemiparetic stroke.

Methods: A pre-test and post-test experimental study was conducted on 20 patients diagnosed with hemiparetic stroke. Participants were randomly allocated into two groups. Group A (n = 10) received Constraint-Induced Movement Therapy, while Group B (n = 10) received Conventional Physiotherapy. Both groups underwent treatment for 14 consecutive days. Hand function was evaluated using the Fugl-Meyer Assessment for the Upper Extremity before and after the intervention. The collected data were analysed using paired and unpaired *t*-tests.

Results: Both treatment groups demonstrated statistically significant improvements in hand function following the intervention ($p < 0.005$). However, participants who received Constraint-Induced Movement Therapy showed greater improvement (mean difference = 7.1) than those who received Conventional Physiotherapy (mean difference = 4.4). The comparison between the two groups was also statistically significant.

Conclusion: Both Constraint-Induced Movement Therapy and Conventional Physiotherapy were effective in improving hand function in patients with hemiparetic stroke. However, Constraint-Induced Movement Therapy produced superior functional outcomes compared with Conventional Physiotherapy.

Keywords: Stroke; Hemiparesis; Constraint-Induced Movement Therapy; Conventional Physiotherapy; Upper Limb Rehabilitation; Hand Function; Fugl-Meyer Assessment

Introduction

Stroke is a neurological disorder caused by an interruption of blood supply to the brain due to either vascular occlusion or haemorrhage. It remains one of the leading causes of mortality and long-term disability worldwide. The resulting neurological deficits often affect motor, sensory, cognitive, and functional abilities, significantly reducing an individual's independence and quality of life [1].

Hemiparesis is one of the most common consequences of stroke and is characterised by weakness on one side of the body. Impairment of upper limb function is particularly disabling because it interferes with essential daily activities such as eating, dressing, grooming, writing, and object manipulation. Therefore, restoration of upper limb function is considered a major objective of stroke rehabilitation [2].

Stroke is broadly classified into ischaemic and haemorrhagic types. Approximately 80–85% of all strokes are ischaemic, resulting from obstruction of cerebral blood flow, while the remaining cases are haemorrhagic and occur due to rupture of cerebral blood vessels. Risk factors include hypertension, diabetes mellitus, hyperlipidaemia, atrial fibrillation, smoking, obesity, sedentary lifestyle, and increasing age [3].

The severity and clinical presentation of stroke depend on the location and extent of brain injury. Patients may experience muscle weakness, impaired coordination, spasticity, sensory deficits, speech disturbances, balance impairment, and reduced manual dexterity. These deficits often limit functional independence and require comprehensive rehabilitation [4].

Constraint-Induced Movement Therapy (CIMT) is an evidence-based rehabilitation approach designed to improve the functional use of the affected upper limb. The technique involves restricting the unaffected upper limb while encouraging repetitive, task-oriented practice using the affected limb. This intervention promotes cortical reorganisation and enhances motor recovery by overcoming learned non-use [4].

Conventional Physiotherapy remains a widely accepted treatment approach for stroke rehabilitation. It includes muscle strengthening, range-of-motion exercises, stretching, balance training, coordination exercises, functional task practice, and manual dexterity training. These interventions aim to restore movement, improve muscle performance, and enhance functional independence [5].

The Fugl-Meyer Assessment (FMA) is a reliable and validated clinical outcome measure used to assess motor recovery following stroke. It evaluates motor performance, sensation, balance, joint range of motion, and pain, making it one of the most widely used assessment tools in stroke rehabilitation research [6].

Considering the increasing prevalence of stroke and the importance of effective upper limb rehabilitation, the present study was undertaken to compare the effectiveness of Constraint-Induced Movement Therapy and Conventional Physiotherapy in improving hand function among patients with hemiparetic stroke [4].

Methodology

Study design

A pre-test and post-test experimental study was conducted to compare the effectiveness of Constraint-Induced Movement Therapy (CIMT) and Conventional Physiotherapy in improving hand function among patients with hemiparetic stroke.

Study setting

The study was carried out at the Outpatient Department of RVS College of Physiotherapy, Sulur, Coimbatore, Tamil Nadu.

Study population

Twenty patients diagnosed with hemiparetic stroke who satisfied the inclusion and exclusion criteria were recruited for the study. Written informed consent was obtained from all participants before the commencement of the intervention.

Sample size

A total of 20 participants were included in the study and were equally divided into two groups.

- **Group A (n = 10):** Constraint-Induced Movement Therapy (CIMT)
- **Group B (n = 10):** Conventional Physiotherapy

Study duration

The intervention was administered for 14 consecutive days.

Variables

Independent variables

- Constraint-Induced Movement Therapy
- Conventional Physiotherapy

Dependent variable

- Hand function.

Outcome measure

Hand function was evaluated using the Fugl-Meyer Assessment (Upper Extremity Section). Assessments were performed before the intervention (pre-test) and immediately after completion of the treatment programme (post-test).

Intervention

Group A – Constraint-induced movement therapy (CIMT)

Participants assigned to Group A received Constraint-Induced Movement Therapy. The unaffected upper limb was restrained using a sling with a Velcro strap to encourage active use of the affected upper limb during therapeutic activities. Patients also continued to use the affected limb for functional activities at home under therapist guidance.

The intervention consisted of repetitive task-oriented exercises, including:

- Turning the pages of a book
- Pegboard activities
- Writing practice
- Picking up a cup and bringing it to the mouth
- Opening bottle lids and containers
- Holding and carrying a book
- Folding towels
- Picking up small objects and placing them accurately
- Reaching activities in different directions to improve shoulder control, coordination, and upper limb function

Training schedule

- Treatment duration: 14 consecutive days
- Frequency: One session per day
- Session duration: 4 hours
- Rest interval: 5 minutes after every 15 minutes of activity

Group B – Conventional physiotherapy

Participants in Group B received conventional physiotherapy focusing on improving muscle strength, coordination, dexterity, balance, and functional hand activities.

The treatment programme included:

- Grasp and release exercises
- Finger tapping exercises
- Hand cupping exercises
- Rubber band strengthening exercises
- Resisted finger flexion exercises
- Resisted finger extension exercises
- Finger squeezing exercises
- Fingertip pinch exercises
- Sitting and standing balance training
- Functional reaching activities
- Weight-bearing exercises using the affected upper limb

Training schedule

- Treatment duration: 14 consecutive days
- Frequency: One session per day
- Session duration: 4 hours
- Rest interval: 5 minutes after every 15 minutes of activity

Data Analysis and Results

Data collection procedure

Baseline assessment of hand function was performed using the Fugl-Meyer Assessment before the intervention. Following completion of the 14-day treatment programme, all participants underwent post-intervention assessment using the same outcome measure. The pre-test and post-test scores were recorded for statistical analysis.

Statistical analysis

The collected data were analysed using appropriate statistical methods. Descriptive statistics were used to calculate the mean and standard deviation. Paired *t*-tests were performed to compare

pre-test and post-test scores within each group, while an unpaired *t*-test was used to compare the improvement between the two groups. Statistical significance was established at $p < 0.005$.

Mean value, mean difference, standard deviation and paired 't' values of the hand function in group A.

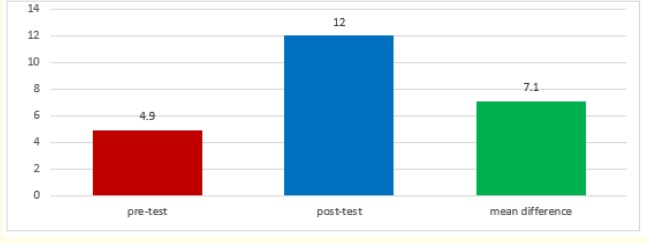
Measurement	Mean	Mean difference	Standard deviation	Paired 't' value
Pre-test Post-test	4.9 12	7.1	1.1	20.59*

*0.005 level of significance.

Table 1

In group A for hand function the calculated 't' value is 20.59 and the 't' table value is 3.250 at 0.005 level of significance. Since the calculated 't' value is more than the 't' table value, there is significant difference in hand function following Constraint induced movement therapy among hemiparetic stroke subjects.

Graphical representation of pre-test and post-test mean and mean difference values of hand function in group A subjects.



Graph 1

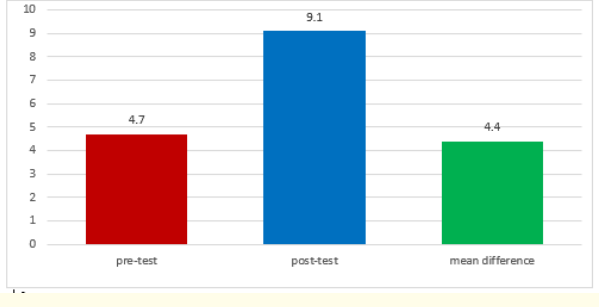
Mean value, mean difference, standard deviation and paired 't' values of hand function in group B.

Measurement	Mean	Mean difference	Standard deviation	Paired 't' value
Pre-test Post-test	4.7 9.1	4.4	1.58	8.79*

*0.005 level of significance.

Table 2

In group B for hand function measurement the calculated 't' value is 8.79 and the 't' table value is 3.250 at 0.005 level of significance. Since the calculated 't' value is more than the 't' table value, there is significant difference in hand function following conventional physiotherapy subjects.



Graph 2

Graphical representation of pre-test and post-test mean and mean difference values of hand function in group B subjects.

Mean value, mean difference, standard deviation and unpaired 't' value Hand function between group A and Group B.

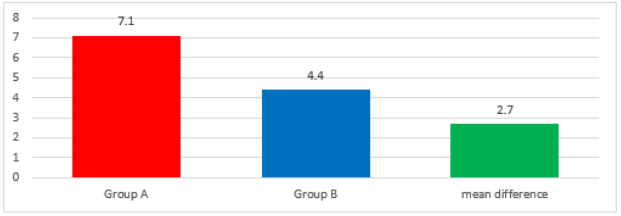
In group A and B for hand function measurement the calculated un paired 't' value is 4.46 and the 't' table value is 2.878 at 0.005 level, since the calculated 't' value is more than the 't' table value there is significant difference between Constraint induced movement therapy subjects and conventional physiotherapy subjects in hand function among hemiparetic stroke subjects.

Graphical representation mean and mean difference values of hand function in Group A and Group B.

S. No	Groups	Improvement		Standard deviation	Un paired 't' test
		Mean	Mean difference		
1	Group-A	7.1			
2	Group-B	4.4	2.7	1.36	4.46*

*0.005 level of significance.

Table 3



Graph 3

Results

Twenty patients with hemiparetic stroke who fulfilled the inclusion and exclusion criteria participated in this study. The participants were equally allocated into two treatment groups. Group A received Constraint-Induced Movement Therapy (CIMT), while Group B received Conventional Physiotherapy.

Within-group analysis

In Group A (CIMT), the mean Fugl-Meyer Assessment score improved from 4.9 before treatment to 12.0 after treatment, with a mean improvement of 7.1 points. The paired *t*-test value was 20.59, indicating a statistically significant improvement in hand function ($p < 0.005$).

In Group B (Conventional Physiotherapy), the mean score increased from 4.7 at baseline to 9.1 after the intervention, with a mean improvement of 4.4 points. The paired t-test value was 8.79, which also demonstrated a statistically significant improvement ($p < 0.005$).

Between-group analysis

Comparison of the mean improvement scores revealed that Group A achieved greater functional recovery than Group B. The unpaired *t*-test value was 4.46, indicating a statistically significant difference between the two treatment groups ($p < 0.005$).

These findings suggest that both treatment approaches improved hand function in patients with hemiparetic stroke; however, Constraint-Induced Movement Therapy produced significantly greater improvement than Conventional Physiotherapy.

Discussion

The present study was conducted to compare the effectiveness of Constraint-Induced Movement Therapy and Conventional Physiotherapy in improving hand function among patients with hemiparetic stroke [7].

The results demonstrated significant improvements in hand function in both groups following the intervention. However, participants treated with Constraint-Induced Movement Therapy showed greater functional gains than those receiving Conventional Physiotherapy. These findings indicate that intensive, repetitive, task-oriented practice combined with restraint of the unaffected upper limb enhances the functional use of the affected extremity.

The findings of the present study are consistent with previous research. Page., *et al*. (2008) reported that patients receiving Constraint-Induced Movement Therapy showed significantly greater improvements in upper limb motor performance and functional use than those receiving conventional exercise programmes. Similarly, Fleet., *et al*. (2014) concluded in their systematic review that Constraint-Induced Movement Therapy is an effective rehabilitation strategy for improving upper limb motor recovery and functional independence following stroke [8].

The superior outcomes observed in the CIMT group may be attributed to increased use of the affected upper limb during daily activities, repetitive task-specific training, and neuroplastic changes within the motor cortex. These mechanisms help overcome learned non-use and promote recovery of voluntary motor function.

Although Conventional Physiotherapy also produced significant improvements, the magnitude of recovery was lower than that achieved with CIMT. Conventional rehabilitation remains beneficial for improving muscle strength, joint mobility, coordination, and overall functional performance, but it may not stimulate functional upper limb use as intensively as Constraint-Induced Movement Therapy [8].

Overall, the findings of this study support the use of Constraint-Induced Movement Therapy as an effective intervention for enhancing hand function in individuals with hemiparetic stroke.

Conclusion

Both Constraint-Induced Movement Therapy and Conventional Physiotherapy significantly improved hand function in patients with hemiparetic stroke after 14 days of intervention.

However, participants who received Constraint-Induced Movement Therapy demonstrated significantly greater improvement than those treated with Conventional Physiotherapy. Therefore, Constraint-Induced Movement Therapy can be considered a more effective rehabilitation approach for enhancing upper limb function and promoting functional recovery in patients with hemiparetic stroke [9].

Future studies with larger sample sizes, longer follow-up periods, and multicentre participation are recommended to further validate these findings and improve the generalisability of the results.

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