International Journal of Multidisciplinary Research and Development
www.allsubjectjournal.com
ISSN Online: 2349-4182 ISSN Print: 2349-5979
Received: 19-10-2025, Accepted: 18-11-2025, Published: 02-12-2025
Volume 12, Issue 12, 2025, Page No. 9-12

Effect of Modified Constraint-Induced Movement Therapy Combined with Task-Oriented Training on Upper Extremity Functional Performance in Patients with Sub-acute Stroke: A comparative Study

Sneha Sunil Gunale[1], R M Singaravellan[2]
[1] BPTH Intern, Maharashtra Institute of Physiotherapy, Latur, India
[2] Professor, Department of Neurophysiotherapy, Maharashtra Institute of physiotherapy, Latur, Maharashtra, India

Abstract
Background: Stroke frequently leads to upper extremity motor impairment, which limits functional independence and activities of daily living. Modified Constraint-Induced Movement Therapy (mCIMT) promotes use of the affected limb by restricting the unaffected limb, while Task-Oriented Training (TOT) emphasizes purposeful, goal-directed activities that enhance neuroplasticity and motor recovery. This study evaluated the combined effect of mCIMT and TOT on upper limb function in patients with sub-acute stroke.
Methods: Twenty-eight patients with sub-acute middle cerebral artery stroke (1 month to 1-year post-onset) were randomly allocated into two groups (n = 14 each). The experimental group received mCIMT combined with Task-Oriented Training, while the control group received conventional physiotherapy. Both groups received 1-hour sessions, 5 days/week, for 4 weeks. Upper limb motor function and functional performance were assessed pre- and post-intervention using the Fugl-Meyer Assessment for Upper Extremity (FMA-UE) and the Action Research Arm Test (*ARAT*). Data were analyzed using paired and independent t-tests, with $p < 0.05$ considered significant.
Results: The experimental group showed statistically and clinically significant improvements. Mean FMA-UE scores increased from 24.85 to 39.14, and *ARAT* scores from 14.71 to 26.71. The control group showed modest gains (FMA-UE: 22.07 to 23.92; *ARAT*: 11.21 to 12.28). Between-group differences in post-treatment FMA-UE and *ARAT* scores were significant ($p < 0.05$), favouring the experimental group.
Conclusion: The combination of Modified Constraint-Induced Movement Therapy and Task-Oriented Training is more effective than conventional physiotherapy alone in improving upper extremity motor function and task performance in sub-acute stroke patients.

Keywords: Stroke rehabilitation, modified constraint-induced movement therapy, task-oriented training, upper extremity, motor recovery, fugl-meyer assessment, action research arm test

Introduction

Stroke is an acute cerebrovascular event caused by interruption or rupture of cerebral blood flow, resulting in focal neurological deficits. It is one of the leading causes of death and long-term disability worldwide. Each year, approximately 15 million people suffer a stroke, and a considerable proportion are left with residual neurological impairment and functional limitations. In India, recent reports indicate an increasing stroke burden, with an estimated incidence of 105–152 per 100,000 population per year.

Common post-stroke complications include spasticity, bladder dysfunction, dysphagia, and cognitive impairment. Upper extremity paralysis occurs in nearly two-thirds of stroke survivors, and up to 85% present with arm paresis in the early phase. Only 20–60% regain functional strength in the upper limb within 3 months. Recovery of upper extremity function is slower and often less complete than recovery of lower extremity function, leading to persistent limitations in activities of daily living (ADL), reduced independence, and decreased quality of life.

Many patients develop 'learned non-use,' compensating with the unaffected upper limb and avoiding use of the paretic limb. Over time, this may contribute to joint contractures, muscle atrophy, and long-term disability. Motor recovery after stroke is based largely on neuroplasticity—the brain's ability to reorganize and form new neural connections in response to intensive, task-specific practice.

Modified Constraint-Induced Movement Therapy (mCIMT) is a rehabilitation approach that aims to reverse learned non-use by restraining the unaffected limb and compelling the patient to use the affected limb in structured tasks. It has been shown to improve motor ability and functional use of the involved upper extremity in stroke survivors.

Task-Oriented Training (TOT), based on principles described by Carr and Shepherd, emphasizes active participation in goal-directed, functional tasks. It focuses on problem-solving, repetition, and task variability, integrating the musculoskeletal and nervous systems. Evidence suggests that TOT improves arm function, hand use, and performance of ADL in individuals with stroke.

Although both mCIMT and TOT are effective individually, there is limited evidence regarding the combined effect of these two approaches in the sub-acute phase of stroke, when neuroplasticity is greatest. Therefore, this study was undertaken to evaluate the effect of combining Modified Constraint-Induced Movement Therapy with Task-Oriented Training on upper extremity functional performance in patients with sub-acute stroke and to compare it with conventional therapy

Materials and Methods

Study Design

Comp*ARAT*ive interventional study with two parallel groups (experimental and control).

Study Setting

Neurophysiotherapy Outpatient Department, YCRH, Maharashtra Institute of Physiotherapy, Latur, Maharashtra, India.

Study Duration

Total study duration: 6 months
Intervention duration for each participant: 4 weeks.

Study Population

Patients with sub-acute middle cerebral artery (MCA) stroke.

Sample Size and Sampling Technique

A total of 28 participants with sub-acute stroke were recruited using convenience sampling and then randomly allocated into:

- Experimental group (n = 14)
- Control group (n = 14)

Inclusion Criteria

- Age between 45 and 60 years
- First-ever MCA stroke of 1 month to 1-year duration
- Medically stable
- Both ischemic and haemorrhagic stroke
- Brunnstrom stage ≥ 3 for upper extremity
- FMA-UE score between 19 and 58
- Mini-Mental State Examination (MMSE) score ≥ 24
- Geriatric Depression Scale (GDS) score < 8
- Able to understand and follow simple instructions
- Both genders

Exclusion Criteria

- Previous upper limb injury, severe contracture, or deformity of the shoulder, elbow, or wrist
- No independent sitting balance
- Severe aphasia or significant language barrier
- Uncorrected visual problems
- Severe pain in the affected upper extremity
- Other neurological or musculoskeletal conditions affecting upper limb function

Ethical Considerations

Ethical approval was obtained from the Institutional Ethical Committee of Maharashtra Institute of Physiotherapy, Latur. All participants were informed about the study and provided written informed consent prior to participation.

Outcome Measures

1. **Fugl-Meyer Assessment for Upper Extremity (FMA-UE)**

- Assesses motor recovery of the upper limb after stroke
- 33 items scored on a 3-point ordinal scale (0–2), maximum score 66
- Sub-scores: shoulder/elbow (36), wrist (10), hand (14), coordination/speed (6)
- Severity classification:
- 10–29: severe impairment
- 30–49: moderate impairment
- ≥50: mild impairment
- Demonstrates excellent intra- and inter-rater reliability and validity.

2. **Action Research Arm Test (*ARAT*)**

- Evaluates upper extremity functional performance in grasp, grip, pinch, and gross movement
- 19 items, total score range 0–57
- 0–10: poor recovery
- 10–56: moderate recovery
- 57: good recovery

Shows high test–retest and inter-rater reliability and is widely used in stroke rehabilitation. Both scales were administered at baseline (pre-intervention) and after 4 weeks (post-intervention).

Intervention Protocol

Both groups received therapy for 1 hour per session, 5 days per week, for 4 weeks.

Control Group – Conventional Therapy

Participants in the control group received conventional physiotherapy, which included:

- Active and active-assisted range of motion exercises for upper and lower extremities
- Stretching exercises
- Strengthening exercises
- Proprioceptive Neuromuscular Facilitation (PNF) techniques
- Balance training
- Gait training
- Coordination exercises

Session structure

- ~10 minutes of warm-up exercises
- ~45–50 minutes of conventional exercises with intermittent rest breaks**.**

Experimental Group – mCIMT + Task-Oriented Training

Participants in the experimental group received:

1. **Modified Constraint-Induced Movement Therapy (mCIMT)**

- The unaffected upper limb was restrained during each therapy session using a towel, splint, or orthosis.
- Restraint was applied throughout the 1-hour training session to encourage active use of the affected limb.

2. **Task-Oriented Training (performed with the affected upper limb)**

Functional, goal-directed tasks included

- Lifting a glass of water to approximately 90° of shoulder flexion with elbow extended
- Moving five small crystals from a table into a box
- Wiping a table with a towel with elbow extended
- Grasping and releasing a 6 cm diameter tennis ball
- Combing hair

Session structure

- ~10 minutes of warm-up
- ~50 minutes of task-oriented activities with short rest (2–3 minutes) after every 15 minutes of practice.
- The total dose and frequency (1 hour/day, 5 days/week, 4 weeks) were matched to the control group.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using appropriate statistical software**.**

- Descriptive statistics: mean and standard deviation (SD)
- Within-group comparison (pre- vs post-intervention): paired t-test
- Between-group comparison (post-intervention scores): independent t-test
- A p-value < 0.05 was considered statistically significant.

Results

Baseline Characteristics

Twenty-eight sub-acute stroke patients (n = 28) were included and completed the study. They were divided equally into the experimental (n = 14) and control (n = 14) groups. The majority of participants were male, and most were in the age range 41–60 years. Baseline FMA-UE and *ARAT* scores were comparable between both groups, indicating homogeneity at the start of the study.

Age (Experimental Group)	Gender	FMA-UE PRE	FMA-UE POST	*ARAT* PRE	*ARAT* POST	Age (Control Group)	Gender	FMA-UE PRE	FMA-UE POST	*ARAT* PRE	*ARAT* POST
51	M	20	30	10	17	51	M	20	30	10	17
82	M	39	51	22	41	82	M	39	51	22	41
92	M	14	35	7	19	92	M	14	35	7	19
40	M	45	65	41	48	40	M	45	65	41	48
55	F	22	34	10	29	55	F	22	34	10	29
45	M	18	29	3	12	45	M	18	29	3	12
43	M	17	29	9	19	43	M	17	29	9	19
72	M	48	64	29	50	72	M	48	64	29	50
49	M	38	60	31	44	49	M	38	60	31	44
45	M	20	35	11	23	45	M	20	35	11	23
57	M	19	27	10	19	57	M	19	27	10	19
32	M	19	30	8	17	32	M	19	30	8	17
38	M	9	25	6	16	38	M	9	25	6	16
48	M	20	34	9	20	48	M	20	34	9	20

Within-Group Comparison

Experimental Group (mCIMT + TOT)

1. **Fma-Ue**

- **Pre:** 24.85 ± 12.21
- **Post:** 39.14 ± 14.33
- **Mean change:** 14.29
- **Paired t-test:** $t \approx 12.47$, $p < 0.001$

2. **ARAT**

- **Pre:** 14.71 ± 11.35
- **Post:** 26.71 ± 13.18
- **Mean change:** 12.00
- **Paired t-test:** $t \approx 9.93$, $p < 0.001$

The experimental group showed highly significant improvement in upper extremity motor recovery and functional performance.

Control Group (Conventional Therapy)

1. **fma-Ue**

- **Pre:** 22.07 ± 8.44
- **Post:** 23.92 ± 8.80
- **Mean change:** 1.86
- **Paired t-test:** $t \approx 4.76$, $p < 0.001$

2. **ARAT**

- **Pre:** 11.21 ± 5.64
- **Post:** 12.28 ± 6.29
- **Mean change:** 1.07
- **Paired t-test:** $t \approx 3.51$, $p = 0.004$

The control group also showed statistically significant but clinically small improvements.

Between-Group Comparison

Post-intervention scores were compared between the two groups.

1. **Fma-Ue (Post)**

- **Experimental:** 39.14 ± 14.33
- **Control:** 23.92 ± 8.80
- **Mean difference:** 16.04
- **Independent t-test:** $t \approx 3.11$, $df = 26$, $p < 0.05$

2. **ARAT (Post)**

- **Experimental:** 26.71 ± 13.18
- **Control:** 12.28 ± 6.29
- **Mean difference:** 14.21
- **Independent t-test:** $t \approx 3.08$, $df = 26$, $p < 0.05$

These findings indicate that the combination of mCIMT and Task-Oriented Training produced significantly greater improvement in upper extremity functional performance than conventional therapy alone.

Discussion

The present study demonstrated that combining Modified Constraint-Induced Movement Therapy with Task-Oriented Training resulted in significantly greater improvements in upper extremity motor recovery and functional task performance in sub-acute stroke patients compared to conventional physiotherapy.

The substantial improvement in FMA-UE and *ARAT* scores in the experimental group suggests that integrating repetitive, task-specific practice with use-dependent cortical reorganization (via mCIMT) provides a synergistic effect. mCIMT helps to overcome learned non-use by limiting compensatory reliance on the non-paretic limb and compelling use of the affected limb. Task-oriented training, meanwhile, enhances motor control through meaningful, goal-directed tasks that closely resemble daily activities.

These results are consistent with earlier studies:

- Kim and Chang reported that mCIMT improves upper extremity function and occupational performance in stroke patients.

- Atteya found that modified constraint-induced therapy could be efficacious for improving upper limb function in sub-acute stroke patients.
- Thant *et al*., Marryam and Umar, Park and Yoo, and Hussain *et al*. showed that Task-Oriented Training improves upper limb function, motor control, and quality of life in stroke survivors.

The control group exhibited modest improvements, most likely due to spontaneous recovery and the benefit of conventional therapy. However, the magnitude of change was markedly smaller than that observed in the experimental group, emphasizing the importance of structured, intensive, and functionally relevant training protocols.

The findings reinforce the neuroplasticity-based model of stroke recovery, which underscores the value of early, repetitive, and task-specific practice during the sub-acute phase. Combining mCIMT and TOT appears to be a clinically feasible and effective intervention strategy to optimize upper limb recovery.

Limitations

- Small sample size (n = 28), which may limit generalizability.
- Single-centre study, possibly introducing selection bias.
- The intervention period of 4 weeks may be insufficient to fully evaluate long-term retention of functional gains.
- Only two outcome measures (FMA-UE and *ARAT*) were used; additional measures such as ADL scales or quality-of-life questionnaires could provide a broader assessment.
- No follow-up assessment was conducted after completion of the intervention to determine the sustainability of improvements.

Future Scope

- Larger, multi-centre randomized controlled trials are needed to validate and generalize the findings.
- Long-term follow-up studies should assess the durability of functional and neuroplastic changes.
- Future research may investigate the optimal intensity, duration, and task complexity of combined mCIMT and TOT protocols.
- Exploring combinations with other techniques (e.g., mirror therapy, virtual reality, robotics, or neuromodulation) may further enhance outcomes.
- Integration of neuroimaging or electrophysiological methods could help clarify underlying mechanisms of recovery.

Conclusion

The present study concludes that Modified Constraint-Induced Movement Therapy combined with Task-Oriented Training is significantly more effective than conventional physiotherapy alone in improving upper extremity functional performance in sub-acute stroke patients. The combined approach enhances motor recovery, promotes active use of the paretic limb, and improves performance of functional tasks, making it a valuable strategy in stroke rehabilitation.

Conflict of Interest

The authors declare no conflict of interest.

References

1. Thant AA, Wanpen S, Nualnetr N, Puntumetakul R, Chatchawan U, Hla KM, Khin MT. Effects of task-oriented training on upper extremity functional performance in patients with sub-acute stroke: A randomized controlled trial. Journal of Physical Therapy Science,2019:31(1):82–87.
2. Marryam M, Umar M. Effectiveness of task-oriented training in improving upper limb function after stroke. Rawal Medical Journal,2017:42(3):341–343.
3. Hussain M, Fatima A, Ahmad A, Gilani SA. Effects of task-oriented rehabilitation of upper extremity after stroke: A systematic review. Journal of Pakistan Medical Association,2022:72(7):1406–1413.
4. Park J, Yoo C. Effects of task-oriented training on upper extremity function and performance of daily activities by chronic stroke patients. Journal of Physical Therapy Science,2015:27(8):2657–2659.
5. Alsubiheen AM, Choi W, Yu W, Lee H. The effect of task-oriented activities training on upper-limb function, daily activities, and quality of life in chronic stroke patients: A randomized controlled trial. International Journal of Environmental Research and Public Health,2022:19(21):14125.
6. Winstein CJ, Wolf SL, Dromerick AW, Lane CJ, Nelsen MA, Lewthwaite R, *et al*. Effect of a task-oriented rehabilitation program on upper extremity recovery following motor stroke. Journal of the American Medical Association,2016:315:(6):571–581.
7. Bosch J, O'Donnell MJ, Barreca S, Thabane L, Wishart L. Does task-oriented practice improve upper extremity motor recovery after stroke? A systematic review. ISRN Stroke, 2014, 1. Article ID 504910.
8. Yoo C, Park J. Impact of task-oriented training on hand function and activities of daily living after stroke. Journal of Physical Therapy Science,2015:27(8):2529–2531.
9. Firoozeh F, Dehkordi SN, Dadgoo M, Islam D, Habibi SA. The effects of task-oriented training combined with Bobath program and task-oriented training alone on upper-limb function in stroke patients. Functional Disability Journal,2019:2(1)20-20.
10. Bonifer NM, Anderson KM, Arciniegas DB. Constraint-induced movement therapy after stroke: Efficacy for patients with minimal upper-extremity motor ability. Archives of Physical Medicine and Rehabilitation,2005:86(9):1867–1873.
11. Kim JH, Chang MY. Effects of modified constraint-induced movement therapy on upper extremity function and occupational performance of stroke patients. Journal of Physical Therapy Science,2018:30(8):1092–1094.
12. Atteya AA. Effects of modified constraint-induced therapy on upper limb function in subacute stroke patients. Neurosciences Journal,2004:9(1):24–29.