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# Comparative Effect of Mirror Therapy Versus Activity Based Mirror Therapy on The Upper Limb Motor Function in Chronic Stroke Survivors: An Experimental Study

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## ABSTRACT

Activity-based mirror therapy (ABMT), which combines purposeful, task-oriented movements with mirror feedback, may produce improved real-world motor outcomes. An Experimental study conducted to analyses the comparative effect of mirror therapy versus activity-based mirror therapy on the upper limb motor function in chronic stroke survivors. The 48 participants aged 20-85 years of age were randomly divided in two group, 24 in mirror therapy group (MT) and 24 in activity-based mirror therapy group (ABMT). Each intervention was conducted in 7 sessions per week, 25 mins per session for 25 days. The outcomes of the intervention were assessed using Motor Activity Log (MAL) and Modified Barthel Index (MBI). The t- value of MBI in group MT pre vs post analysis is –11.85 and the p-value is 0.0 whose interpretation is significant and the t- value of MBI in group ABMT pre vs post is -5.67 and p- value is 0.0 whose interpretation is significant. The t-value of MBI comparing both groups MT vs ABMT is 1.97 and p-value of MAL in MT vs ABMT is 0.055 whose interpretation is not significant. This research discovered that the mirror therapy and activity-based mirror therapy have a significant effect on upper limb motor function and ADL of chronic stroke survivors. Additionally, there is no comparative effect of mirror therapy versus activity-based mirror therapy on the upper limb motor function and ADL on chronic stroke survivors.

**KEY WORDS:** ACTIVITY-BASED MIRROR THERAPY, CHRONIC STROKE, MIRROR THERAPY, MOTOR ACTIVITY LOG, MODIFIED BARTHEL INDEX.

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## INTRODUCTION

The clinical condition known as stroke is defined by the sudden development of localized neurological symptoms that last for more than 24 hours. It can also be described as an acute neurological dysfunction that either persists beyond 24 hours or, in severe cases, leads to death within that time frame1.Stroke often occurs suddenly due to localized brain injury. In recent years, the incidence of both ischemic and hemorrhagic stroke in these countries has been reported as 85–94 per 100,000 people annually, with the rate being much higher (1151–1216 per 100,000) in individuals above 75 years of age [2].

In India, stroke incidence has varied from 105 to 152 per 100,000 people per year in different regions over the last two decades [3]. Metropolitan cities like Mumbai and Kolkata show higher cumulative rates compared to high-income countries (HICs). Mortality following stroke is also higher in India, with case fatality rates of 42% within one week in urban areas and 46% in rural areas [4].

Cerebrovascular accidents represent the predominant aetiology of chronic functional impairment in the adult population. Six months after the event, more than half of survivors continue to experience upper limb motor deficits. Successful rehabilitation requires repetitive, task-specific, and active practice. Nevertheless, interventions like constraint-induced movement therapy are suitable only for individuals who retain a certain degree of motor function5.

Research indicates that nearly 85% of stroke patients present with hemiparesis affecting either the upper or lower limbs. Among survivors, between 55% and 75% show reduced functional capacity in the upper limb, which can result in muscle weakness, stiffness, sensory loss, restricted joint movement, and decreased independence in activities of daily living [6]. Enhancing daily living skills and restore motor function, several rehabilitation methods are available, with mirror therapy (MT) being considered a simple and cost-efficient intervention [6].

In mirror therapy, the mirror provides visual feedback of normal movements from the unaffected limb, which activates brain regions associated with motor control, sensory integration, and pain modulation. This visual illusion helps retrain the nervous system and supports functional improvement7. TMAGUSN, a modified form of mirror therapy designed for unilateral spatial neglect, integrates task-based activities with visual magnification to address motor deficits in both upper and lower limbs. This approach improves visuo-tactile processing and involves multiple brain regions, including the motor, premotor, sensory, and cerebellar cortices, thereby promoting reorganization of impaired neural functions [5]. Mirror neurons are considered a vital component of this process, especially when task-specific exercises are included8.

Task-based mirror therapy (TBMT) has also been shown to support upper limb recovery in stroke patients. Nevertheless, findings remain inconsistent. Antoniotti et al. reported no significant difference between real and sham MT in patients during the early phase of stroke. Since cortical and subcortical neuroplasticity are deeply linked with motor skill learning, the extent of recovery may vary depending on lesion severity [9]. Hence, mirror therapy yields heterogeneous results regarding upper extremity functional recovery in hemiplegic populations10. Therefore, the purpose of the present study is to analyse the comparative effect of mirror therapy versus activity-based mirror therapy on the upper limb motor function in chronic stroke survivors.

## MATERIAL AND METHODS

An Experimental study conducted to analyses the comparative effect of mirror therapy versus activity-based mirror therapy on the upper limb motor function in chronic stroke survivors. This study was reviewed and approved by the Institutional Ethical Committee of Santosh College of Occupational Therapy (Ref No.-SCOT/NOV-24/ECNeuro-10) and data was collected from Indian Neurorehab and Physio Centre, Kavi Nagar, Ghaziabad. 48 participants were screened through Fugl-Meyer Assessment and Brunnstrom Recovery Stages then randomly assigned to one of two groups: group A- Mirror therapy (MT) and group B- Activity based mirror therapy (ABMT) group. Using Cochran's formula with a 95% confidence level and 5% margin of error, the minimum sample size was calculated to be approximately 24 participants per group.

All participants received the intervention for 25 days, one session per day for 25 minutes, 7 days in a week. Exercises programs in MT group consisted of finger up/down, wrist up/down, finger stretches and close, palm up and down, fist open and closed and thumb extension 'thumbs up"[7]. Exercises program in ABNT group included elbow flexion using a spongy ball, elbow extension and ulnar deviation using of water bottle, radial deviation using a duster, wrist flexion with chopstick, wrist extension using a cup, extension for fingers using the wooden blocks, abduction and adduction of all fingers using the cubes6.

**Outcome Measurements:** The following outcome measurements were taken at baseline and again after 25 days of intervention program. The assessment tools included the Modified Barthel Index (MBI), an enhanced 0–100-point scoring structure with five-tier rating methodology, providing increased assessment precision and improved reliability for monitoring functional advancement11. The Motor Activity Log (MAL) to assess how often (amount of use, AoU) and how well (quality of movement, QoM) they can use the affected hand in 30 daily activities [12].

## RESULTS

A total of 48 participants were included in the study through a random sampling method. There were fifteen males and nine females in MT group and eighteen males and 6 female in the ABMT group. The results were presented in two phases: Pretest and Posttest assessments, and the significance of the MT group and ABMT group was determined using MBI and MAL Outcome measures. In phase one, the pretest assessment of the MBI and MAL administered to the participants before providing intervention and in second phase the posttest assessment of the MBI and MAL was re-administered after twenty-five days. The analysis of data gives the following tables showing demographic characteristics and test results.

**Table 1. Baseline characteristic**

| Outcome Measure | MT | | | | ABMT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | | (SD) | | Mean | | (SD) | | | |
| | Pre test | Post test | Pre test | Post test | Pre test | Post test | Pre test | Post test | T | P |
| Motor Activity Log | 2.86 | 4.38 | 1.1 | 1.25 | 3.06 | 3.97 | 0.99 | 1.27 | -0.661 | 0.512 |
| Modified Barthel Index | 40.71 | 50.79 | 9.87 | 10.15 | 37.51 | 44.5 | 12.12 | 11.9 | 0.94 | 0.352 |

EG: experimental group, CG: Control group, SD: Standard deviation

**Table 2. Result of baseline and post test scores of the outcome measures in MT and ABMT group**

| Outcome measure | MT | | ABMT | |
|---|---|---|---|---|
| | T | P | T | P |
| Motor Activity Log | -11.17 | 0.0 | -5.75 | 0.0 |
| Modified Barthel Index | -11.85 | 0.0 | -5.67 | 0.0 |

**Table 3. Result of post data analysis of the outcome measures, MT vs ABMT group**

| Outcome measure | t-value | p-value |
|---|---|---|
| Barthal Index | 1.97 | 0.055 |
| MAL | 1.11 | 0.273 |

## DISCUSSION

The present study's findings reveal that both mirror-based therapeutic interventions (MT) and its activity-integrated variant (ABMT) successfully facilitate upper extremity functional restoration and independence in daily activities among chronic stroke patients. Participants receiving MT treatment exhibited measurable progress across multiple evaluation instruments, notably the Motor Activity Log (MAL) and Modified Barthel Index (MBI).

The ABMT treatment group similarly achieved considerable advancement in MAL and MBI performance metrics. These outcomes substantiate the therapeutic value of both mirror-based approaches in promoting motor skill recovery and enhancing functional independence in this clinical population. Comparative statistical analysis, however, revealed no meaningful differences between treatment groups regarding MAL and MBI performance, suggesting equivalent therapeutic efficacy between MT and ABMT for upper extremity rehabilitation and daily living skill improvement, with neither intervention demonstrating clear superiority.

Statistical examination of MAL outcomes revealed pre-treatment baselines of 2.86 (MT participants) and 3.06 (ABMT participants), with subsequent post-treatment elevations to 4.38 and 3.97 respectively. Parallel MBI statistical assessment indicated initial measurements of 40.71 (MT group) and 37.71 (ABMT group), advancing to post-therapeutic benchmarks of 50.79 and 44.5 correspondingly. These quantitative findings demonstrate decreased distributional variability, reflecting more homogeneous therapeutic gains in upper extremity motor functioning and daily living activity performance across chronic stroke rehabilitation participants.

Statistical variability analysis revealed pre-therapeutic MAL distribution parameters of 1.1 (MT participants) and 0.99 (ABMT participants), while pre-therapeutic Barthel index distribution coefficients measured 9.87 (MT participants) and 12.12 (ABMT participants). Post-therapeutic variability assessment demonstrated MAL distribution parameters of 1.25 (MT participants) and 1.27 (ABMT participants), with corresponding Barthel index distribution coefficients of 10.15 (MT participants) and 11.9 (ABMT participants).

This decreased statistical dispersion underscores more concentrated distributional clustering following therapeutic implementation, substantiating that both conventional mirror therapy and activity-incorporated mirror therapy methodologies promote upper extremity motor restoration

and activities of daily living enhancement within chronic stroke therapeutic populations [13].

The result of our study is similar to the study done by Kamal Narayan Arya et al. in 2015 analyzed the clinical benefits of task-specific mirror therapy for upper extremity motor rehabilitation in stroke survivor cohorts6. Experimental participants performed targeted activities utilizing mirror apparatus technology, where unaffected extremity movements were visually mirrored to replicate affected-side motor patterns, while control participants received conventional motor rehabilitation protocols.

These findings indicate TBMT may facilitate wrist and hand motor restoration among post-stroke hemiparesis populations, establishing its effectiveness as an adjunctive therapy to standard stroke rehabilitation protocols [14], [15] examined the clinical impact of task-specific activities of daily living training on upper limb motor function, functional independence, and life quality measures in chronic post-stroke populations. Research results revealed that hemiplegic-side MFT scores and bilateral BBT performance showed statistically significant improvements in the task-oriented ADL group, though no significant group-time interactions emerged for unaffected-side MFT, functional independence, or quality of life variables.

This study has a few limitations. First, the small sample size may limit the generalizability of the findings. The intervention duration may have been insufficient to assess the long-term or cumulative benefits of mirror therapy or activity-based mirror therapy on upper limb rehabilitation. The lack of long-term follow-up made it difficult to establish whether either intervention produced lasting improvements or delayed effects. Future studies could include a larger and more diverse sample to improve the generalizability of the findings. Incorporate follow-up evaluations (for 3 or 6 months) to assess the long-term effectiveness and retention of therapy improvements.

## CONCLUSION

This controlled trial confirms the therapeutic efficacy of two mirror-based rehabilitation approaches—conventional mirror therapy (MT) and activity-based mirror therapy (ABMT)—in improving upper limb function and independence in chronic stroke patients. Both MT and ABMT led to significant improvements in Motor Activity Log (MAL) and Modified Barthel Index (MBI) scores. These findings support the clinical utility of mirror-based therapies in promoting motor recovery and functional independence. Comparative analysis of MAL and MBI outcomes revealed no statistically significant differences between groups, indicating that both MT and ABMT offer comparable therapeutic benefits without a clear advantage of one over the other.

**Ethical Clearance**
SCOT/NOV-24/ECNeuro-10,9/11/2024.

**Conflict of interest statement -** NONE.

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**Data availability-** The data associated with the paper are not publicly available but are available from the corresponding author on reasonable request.

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