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Original Article

A Comparative Analysis of Mirror Therapy and Motor Relearning Techniques for Enhancing Upper Limb Function in Stroke Recovery

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ABSTRACT

Background: Stroke commonly causes persistent upper limb motor impairment, limiting functional independence and daily activity performance. Rehabilitation strategies that promote neuroplasticity, task-specific practice, and motor relearning are essential for improving post-stroke arm and hand function. Objective: To compare the effects of mirror therapy, motor relearning programme, and conventional physiotherapy on upper limb functional recovery among post-stroke patients. Methods: A randomized controlled trial was conducted among 60 adult post-stroke patients aged 45–75 years with first-ever unilateral stroke and residual upper limb impairment. Participants were allocated equally into three groups: motor relearning programme, mirror therapy, and conventional physiotherapy. Interventions were delivered for 60 minutes per session, 5 days per week, for 8 weeks. Outcomes were assessed at baseline, week 4, and week 8 using the Fugl-Meyer Assessment Upper Extremity as the primary outcome, with Motor Assessment Scale and Chedoke Arm and Hand Activity Inventory as secondary outcomes. Results: All groups showed improvement after 8 weeks, but gains were greatest in the motor relearning programme group. FMA-UE increased by 12.9 points in the motor relearning programme group, compared with 8.8 points in the mirror therapy group and 4.0 points in the control group. MAS and CAHAI also improved most strongly with motor relearning programme, with gains of 12.2 and 15.6 points, respectively. Conclusion: Motor relearning programme produced greater improvement in upper limb motor recovery and functional activity performance than mirror therapy or conventional physiotherapy, while mirror therapy remained beneficial as an accessible adjunctive rehabilitation approach. Keywords: Stroke Rehabilitation; Upper Limb Function; Motor Relearning Programme; Mirror Therapy; Fugl-Meyer Assessment; Motor Recovery; Task-Oriented Training.

INTRODUCTION

Stroke remains one of the leading causes of long-term adult disability worldwide and is frequently associated with persistent upper limb motor impairment that limits independence, participation in daily activities, and overall quality of life (1). Motor deficits of the upper extremity may persist beyond the acute phase of recovery, particularly when voluntary control, coordination, dexterity, and functional hand use are affected, making restoration of arm and hand function a central priority in neurorehabilitation (2). Because spontaneous neurological recovery is often incomplete, rehabilitation strategies that actively promote neuroplasticity, motor relearning, sensory feedback, and task-specific practice are essential for improving functional outcomes after stroke (3).

Among contemporary rehabilitation approaches, mirror therapy and the motor relearning programme have gained clinical attention because both are designed to enhance motor recovery through mechanisms that extend beyond passive movement or impairment-focused exercise. Mirror therapy uses visual feedback from the non-paretic limb to create the illusion of movement in the affected limb, thereby stimulating sensorimotor networks, improving attention toward the paretic side, and potentially activating mirror neuron mechanisms involved in motor planning and relearning (4). Previous studies have reported that mirror therapy may improve upper limb motor performance, functional independence, and activities of daily living in individuals with subacute and chronic stroke, although treatment effects may vary according to stroke stage, task protocol, session duration, and baseline severity of impairment (5).

The motor relearning programme, in contrast, is based on principles of task-oriented training, motor control, and problem-solving during functional movement. It emphasizes repetitive practice of meaningful tasks such as reaching, grasping, object manipulation, and coordinated arm-hand use, with the goal of improving movement efficiency and transferring gains into real-world activities (6). This approach directly targets functional performance by encouraging active patient participation, feedback-driven correction of movement patterns, and progressive task difficulty, which may be particularly relevant for improving upper limb use in daily activities (7). Evidence supporting task-specific and motor learning-based rehabilitation suggests that structured, repetitive, goal-directed practice may produce clinically meaningful improvements in motor control and functional independence after stroke (8).

Although both mirror therapy and motor relearning programme are used in stroke rehabilitation, uncertainty remains regarding their relative effectiveness for improving upper limb function when delivered with comparable treatment intensity. Existing studies have often compared mirror therapy with conventional physiotherapy or evaluated task-oriented approaches separately, while fewer trials have directly contrasted mirror therapy with structured motor relearning using standardized upper limb outcomes such as the Fugl-Meyer Assessment Upper Extremity, Motor Assessment Scale, and Chedoke Arm and Hand Activity Inventory (9). This creates a clinically important knowledge gap because rehabilitation professionals require comparative evidence to determine which intervention should be prioritized when the therapeutic goal is maximal recovery of arm and hand function after stroke.

Therefore, this randomized controlled trial was designed to compare the effects of mirror therapy, motor relearning programme, and conventional physiotherapy on upper limb functional recovery among adult post-stroke patients with residual motor impairment. In PICO terms, the population comprised adults with post-stroke upper limb dysfunction; the interventions were mirror therapy and motor relearning programme; the comparator was conventional physiotherapy; and the outcomes were changes in motor impairment and functional upper limb performance measured using FMA-UE, MAS, and CAHAI scores. The study aimed to determine whether motor relearning programme produces greater improvement in upper limb function than mirror therapy and conventional physiotherapy after an 8-week rehabilitation period.

MATERIALS AND METHODS

A randomized controlled trial was conducted to compare the effects of motor relearning programme, mirror therapy, and conventional physiotherapy on upper limb functional recovery among adult post-stroke patients. The trial included 60 participants aged 45–75 years with first-ever unilateral stroke confirmed by neuroimaging, stroke onset within the previous 12 months, and residual upper limb motor impairment defined by a Fugl-Meyer Assessment Upper Extremity score between 20 and 45. Participants were recruited from a tertiary rehabilitation centre and were enrolled after screening for eligibility. Patients were excluded if they had severe cognitive impairment, defined as a Mini-Mental State Examination score below 20, severe spasticity with a Modified Ashworth Scale score greater than 3, or any additional neurological, musculoskeletal, or orthopedic condition that could independently affect upper limb function or interfere with participation in rehabilitation.

Eligible participants were randomly allocated into three equal groups of 20 participants each: the motor relearning programme group, the mirror therapy group, and the control group receiving conventional physiotherapy. Randomization was performed using computer-generated block allocation to maintain balanced group sizes throughout recruitment. Outcome assessment was performed by assessors who were blinded to group allocation. All participants received intervention for 8 weeks, and assessments were conducted at baseline, after 4 weeks, and after completion of the 8-week intervention period. The primary outcome was upper limb motor impairment measured using the Fugl-Meyer Assessment Upper Extremity. Secondary outcomes included functional motor performance assessed using the Motor Assessment Scale and arm-hand activity performance assessed using the Chedoke Arm and Hand Activity Inventory (9,10).

Participants assigned to the motor relearning programme received task-oriented, repetitive, and goal-directed upper limb training focused on functional movement recovery. Training activities included reaching, grasping, releasing, object manipulation, and task-specific arm-hand coordination exercises selected according to individual functional limitations and rehabilitation goals. Each session emphasized active practice, correction of inefficient movement strategies, feedback-guided motor control, and progressive task difficulty to promote carryover into daily activities. Sessions were delivered for 60 minutes per day, 5 days per week, for 8 consecutive weeks.

Participants assigned to the mirror therapy group received upper limb rehabilitation using visual feedback through a mirror positioned at the body midline. During therapy, participants performed repeated movements and functional tasks with the unaffected limb while viewing its mirror reflection, creating the visual illusion of movement in the paretic limb. The intervention included bilateral mirror-based tasks directed toward improving attention, movement planning, sensorimotor feedback, and paretic upper limb engagement. Treatment intensity was matched with the motor relearning programme group, with sessions lasting 60 minutes per day, 5 days per week, for 8 weeks (11).

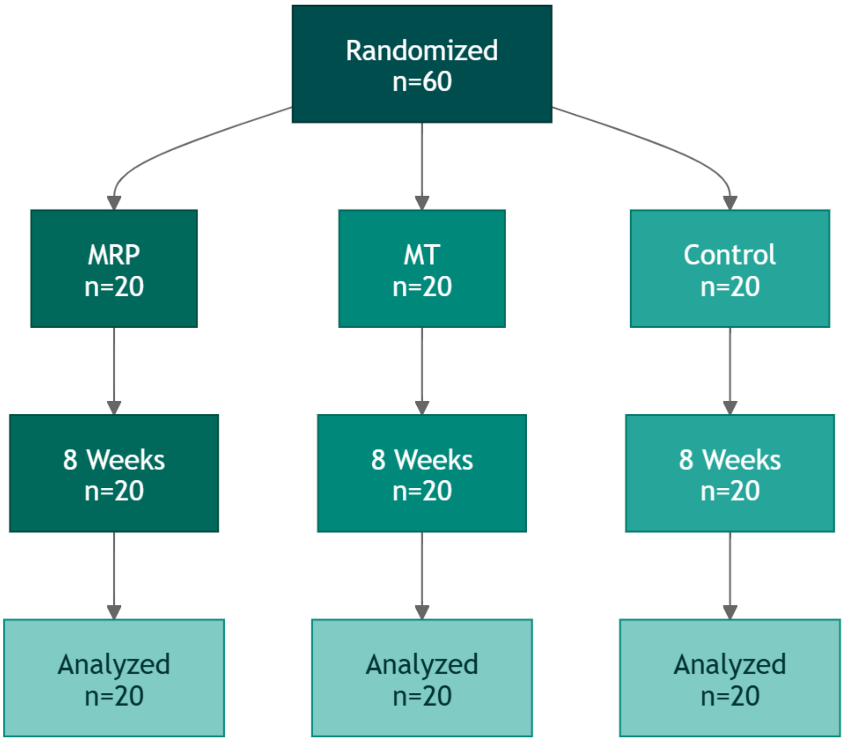

Figure 1 CONSORT Flowchart

Participants in the control group received conventional physiotherapy directed toward maintaining joint mobility, reducing secondary complications, and supporting general functional mobility. Conventional therapy included passive range-of-motion exercises, stretching, positioning, and functional mobility activities according to clinical need. The control intervention was delivered over the same 8-week study period to allow comparison with the active rehabilitation groups.

Data were collected using standardized clinical assessment tools at predefined time points. The Fugl-Meyer Assessment Upper Extremity was used as the primary measure because it evaluates motor impairment, coordination, and voluntary movement control of the affected upper limb after stroke. The Motor Assessment Scale was used to assess functional motor performance, and the Chedoke Arm and Hand Activity Inventory was used to evaluate the ability to perform bilateral upper limb activities relevant to daily function. Baseline demographic and clinical variables included age, sex, and time since stroke. Intervention effects were evaluated by comparing within-group changes over time and between-group differences across the three intervention arms.

To reduce measurement bias, outcome assessments were completed by blinded assessors using the same assessment schedule for all participants. Treatment intensity and duration were matched between the motor relearning programme and mirror therapy groups to reduce performance-related imbalance between active interventions. Eligibility criteria were applied before randomization to reduce clinical heterogeneity and to ensure that enrolled participants had measurable but not extreme upper limb impairment. Standardized outcome measures were used to improve consistency of measurement across assessment time points.

Data were analyzed using repeated-measures analysis of variance to examine changes in outcome scores over time within groups and differences in response patterns between groups. Post-hoc comparisons were performed using Bonferroni correction to control for multiple comparisons. Statistical significance was set at $p < 0.05$. Continuous variables were summarized as mean and standard deviation, while categorical variables were summarized as frequencies and percentages. Baseline characteristics were compared across groups to assess similarity before intervention. The main treatment effect was interpreted using change in Fugl-Meyer Assessment Upper Extremity scores from baseline to week 8, while secondary interpretation was based on changes in Motor Assessment Scale and Chedoke Arm and Hand Activity Inventory scores. The study was conducted in accordance with ethical principles for human participant research. Participants were enrolled after informed consent, and confidentiality of participant information was maintained throughout data collection, analysis, and reporting. Data were recorded using standardized assessment forms, checked for completeness before analysis, and entered consistently to support reproducibility and data integrity.

RESULTS

A total of 60 post-stroke participants were included and allocated equally into the motor relearning programme group, mirror therapy group, and control group, with 20 participants in each arm. Baseline demographic and clinical characteristics were comparable across the three groups. Mean age was 61.2 ± 8.9 years in the motor relearning programme group, 60.5 ± 9.3 years in the mirror therapy group, and 62.1 ± 7.4 years in the control group. The proportion of male participants was also balanced across groups, ranging from 50.0% to 60.0%. Mean time since stroke was similar, ranging from 5.8 ± 2.5 months to 6.4 ± 3.4 months. No statistically significant baseline differences were observed for age, sex distribution, or time since stroke.

Upper limb motor impairment improved progressively across the intervention period, with the greatest improvement observed in the motor relearning programme group. Baseline FMA-UE scores were comparable among the three groups, with means of 32.4 ± 5.1, 31.9 ± 4.8, and 32.8 ± 5.6 in the motor relearning programme, mirror therapy, and control groups, respectively. By week 4, the motor relearning programme group increased to 39.8 ± 4.3, compared with 36.1 ± 4.7 in the mirror therapy group and 34.0

± 5.2 in the control group. At week 8, the motor relearning programme group reached 45.3 ± 3.8, representing a mean gain of 12.9 points from baseline. The mirror therapy group improved by 8.8 points, reaching 40.7 ± 4.5, while the control group improved by 4.0 points, reaching 36.8 ± 5.0. Between-group differences were statistically significant at week 4 and week 8, with the strongest separation at week 8.

Table 1. Baseline Demographic and Clinical Characteristics of Participants

Variable	Motor Relearning Programme n=20	Mirror Therapy n=20	Control n=20	Test Statistic	p-value
Age, years, mean ± SD	61.2 ± 8.9	60.5 ± 9.3	62.1 ± 7.4	F=0.18	0.840
Male sex, n (%)	11 (55.0)	10 (50.0)	12 (60.0)	χ^2=0.40	0.817
Time since stroke, months, mean ± SD	6.1 ± 3.0	5.8 ± 2.5	6.4 ± 3.4	F=0.20	0.818

Table 2. Fugl-Meyer Assessment Upper Extremity Scores Across Time

Time Point	Motor Relearning Programme Mean ± SD	Mirror Therapy Mean ± SD	Control Mean ± SD	Overall Between-Group Test	p-value
Baseline	32.4 ± 5.1	31.9 ± 4.8	32.8 ± 5.6	F=0.15	0.860
Week 4	39.8 ± 4.3	36.1 ± 4.7	34.0 ± 5.2	F=7.65	0.001
Week 8	45.3 ± 3.8	40.7 ± 4.5	36.8 ± 5.0	F=18.20	<0.001
Change from baseline to week 8	+12.9	+8.8	+4.0	—	—

Pairwise comparison at week 8 showed that the motor relearning programme produced higher FMA-UE scores than mirror therapy and control treatment. The mean week-8 difference between motor relearning programme and mirror therapy was 4.6 points, while the difference between motor relearning programme and control was 8.5 points. Mirror therapy also showed a higher week-8 FMA-UE score than control, with a mean difference of 3.9 points.

Table 3. Week-8 Pairwise Comparison of FMA-UE Scores

Comparison	Mean Difference	95% CI	p-value
Motor Relearning Programme vs Mirror Therapy	4.6	1.93 to 7.27	0.001
Motor Relearning Programme vs Control	8.5	5.65 to 11.35	<0.001
Mirror Therapy vs Control	3.9	0.85 to 6.95	0.013

Secondary outcomes showed a similar pattern. MAS scores improved from 22.5 ± 4.9 to 34.7 ± 5.0 in the motor relearning programme group, representing a 12.2-point increase. The mirror therapy group improved from 21.9 ± 5.1 to 30.2 ± 5.3, with an 8.3-point increase, while the control group improved from 23.1 ± 4.7 to 26.5 ± 5.2, with a 3.4-point increase. The between-group difference at week 8 was statistically significant. CAHAI scores also improved most strongly in the motor relearning programme group, increasing from 43.8 ± 8.2 to 59.4 ± 7.8, a 15.6-point gain. The mirror therapy group improved by 8.7 points, and the control group improved by 2.7 points. Week-8 between-group differences were statistically significant for CAHAI as well.

Table 4. Secondary Outcome Measures at Baseline and Week 8

Outcome	Time Point	Motor Relearning Programme Mean ± SD	Mirror Therapy Mean ± SD	Control Mean ± SD	Overall Between-Group Test	p-value
MAS	Baseline	22.5 ± 4.9	21.9 ± 5.1	23.1 ± 4.7	F=0.30	0.742
MAS	Week 8	34.7 ± 5.0	30.2 ± 5.3	26.5 ± 5.2	F=12.63	<0.001
MAS	Change from baseline to week 8	+12.2	+8.3	+3.4	—	—
CAHAI	Baseline	43.8 ± 8.2	42.9 ± 7.9	44.5 ± 8.5	F=0.19	0.827
CAHAI	Week 8	59.4 ± 7.8	51.6 ± 8.3	47.2 ± 8.9	F=10.96	<0.001
CAHAI	Change from baseline to week 8	+15.6	+8.7	+2.7	—	—

At week 8, pairwise comparisons for secondary outcomes further supported the superiority of the motor relearning programme. For MAS, the motor relearning programme group scored 4.5 points higher than the mirror therapy group and 8.2 points higher than the control group. Mirror therapy also exceeded control by 3.7 points. For CAHAI, the motor relearning programme group scored 7.8 points higher than mirror therapy and 12.2 points higher than control. The difference between mirror therapy and control for CAHAI was 4.4 points but did not reach statistical significance.

Table 5. Week-8 Pairwise Comparisons of Secondary Outcomes

Outcome	Comparison	Mean Difference	95% CI	p-value
MAS	Motor Relearning Programme vs Mirror Therapy	4.5	1.20 to 7.80	0.009
MAS	Motor Relearning Programme vs Control	8.2	4.93 to 11.47	<0.001
MAS	Mirror Therapy vs Control	3.7	0.34 to 7.06	0.032
CAHAI	Motor Relearning Programme vs Mirror Therapy	7.8	2.64 to 12.96	0.004
CAHAI	Motor Relearning Programme vs Control	12.2	6.84 to 17.56	<0.001
CAHAI	Mirror Therapy vs Control	4.4	-1.11 to 9.91	0.114

Overall, the results demonstrated consistent improvement in upper limb impairment and functional performance across the intervention period, with the largest gains observed in the motor relearning programme group. Mirror therapy also produced meaningful improvements compared with baseline and generally performed better than conventional physiotherapy, particularly for FMA-UE and MAS outcomes. The strongest treatment separation was observed at week 8, where the motor relearning programme showed the highest scores across FMA-UE, MAS, and CAHAI, indicating greater improvement in motor recovery and functional upper limb use.

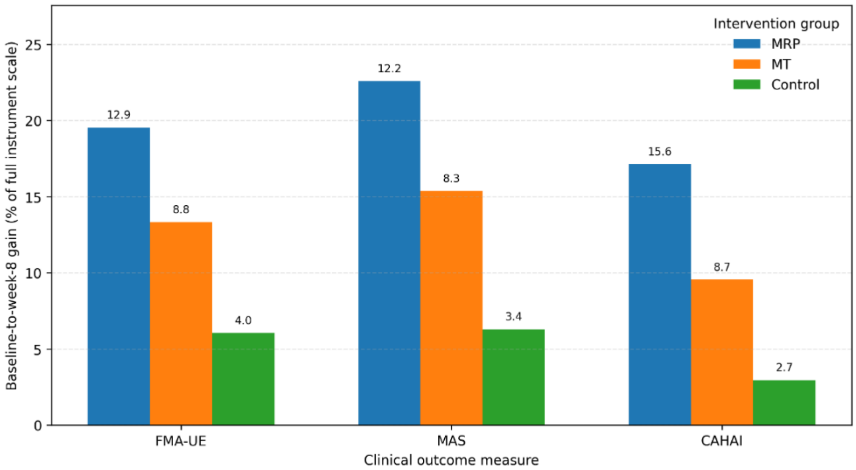

Figure 1. Normalized Upper Limb Recovery Gradient After 8 Weeks

The normalized recovery profile showed the strongest and most consistent functional gain in the motor relearning programme group across all three outcome domains, with baseline-to-week-8 improvements of 12.9 points on FMA-UE, 12.2 points on MAS, and 15.6 points on CAHAI, corresponding to approximately 19.5%, 22.6%, and 17.1% of each instrument's full scale, respectively. Mirror therapy demonstrated moderate improvement, with gains of 8.8 points on FMA-UE, 8.3 points on MAS, and 8.7 points on CAHAI, while the control group showed smaller gains of 4.0, 3.4, and 2.7 points, respectively. The widest comparative separation was observed for CAHAI, where the motor relearning programme exceeded mirror therapy by 6.9 points and control by 12.9 points, suggesting a stronger translation of task-oriented motor practice into functional arm-hand activity performance.

DISCUSSION

The present study compared the effects of motor relearning programme, mirror therapy, and conventional physiotherapy on upper limb functional recovery among post-stroke patients over an 8-week intervention period. The findings demonstrated improvement across all treatment arms, but the magnitude of recovery was greatest in the motor relearning programme group. FMA-UE scores increased from 32.4 ± 5.1 at baseline to 45.3 ± 3.8 at week 8 in the motor relearning programme group, compared with an increase from 31.9 ± 4.8 to 40.7 ± 4.5 in the mirror therapy group and from 32.8 ± 5.6 to 36.8 ± 5.0 in the control group. This pattern indicates that while both active rehabilitation approaches improved upper limb motor impairment, task-oriented motor relearning produced the largest functional gain. The superiority of the motor relearning programme was also reflected in secondary outcomes, where MAS improved by 12.2 points and CAHAI by 15.6 points, compared with 8.3 and 8.7 points after mirror therapy and 3.4 and 2.7 points after conventional physiotherapy, respectively (12).

The greater improvement observed with the motor relearning programme may be explained by its direct emphasis on active, repetitive, task-specific practice. Stroke recovery depends not only on impairment reduction but also on the relearning of coordinated movement strategies that can be transferred into daily activities. The motor relearning programme uses goal-directed tasks such as reaching, grasping, releasing, and object manipulation, which closely resemble functional movements required for independent living. This task specificity may explain why the motor relearning programme produced larger gains in CAHAI, an activity-based measure of arm and hand function, than mirror therapy and conventional physiotherapy. These findings are consistent with previous evidence indicating that motor learning-based and task-oriented interventions can enhance upper limb function by promoting repeated voluntary activation, feedback-guided correction, and functional carryover after stroke (13,14).

Mirror therapy also produced clinically meaningful improvement compared with conventional physiotherapy, particularly in FMA-UE and MAS scores. The mirror therapy group improved by 8.8 points on FMA-UE and 8.3 points on MAS over 8 weeks, suggesting that visual feedback and movement illusion may facilitate motor recovery in patients with residual upper limb impairment. The therapeutic mechanism of mirror therapy is commonly attributed to enhanced visual-motor feedback, increased attention toward the paretic limb, activation of sensorimotor cortical networks, and possible engagement of the mirror neuron system. By creating the perception of normal movement in the affected limb, mirror therapy may reduce learned non-use and support early motor planning, especially in patients who have difficulty generating sufficient voluntary movement. These findings align with previous randomized trials and reviews reporting beneficial effects of mirror therapy on upper limb motor performance and functional independence after stroke (15,16).

Although mirror therapy improved outcomes, its effect was smaller than that of the motor relearning programme across all measured domains. This difference may reflect the fact that mirror therapy primarily provides augmented visual feedback, whereas the motor relearning programme requires repeated active practice of functional tasks involving problem-solving, postural control, coordination, and performance refinement (17). Visual illusion alone may stimulate motor networks, but it may not provide the same degree of task-specific loading, graded difficulty, or real-world movement practice as motor relearning. The larger improvement in CAHAI in the motor relearning programme group supports this interpretation, as CAHAI reflects functional use of the arm and hand in bilateral activities rather than isolated impairment change alone. Therefore, mirror therapy may be best interpreted as a useful adjunctive intervention rather than a replacement for intensive task-oriented rehabilitation (18,19).

The control group also demonstrated modest improvement over the study period, with FMA-UE increasing by 4.0 points, MAS by 3.4 points, and CAHAI by 2.7 points. This improvement may be related to the effects of conventional physiotherapy, spontaneous neurological recovery, repeated clinical contact, and general mobility training. However, the smaller magnitude of change in the control group suggests that conventional therapy focused mainly on passive range of motion, stretching, positioning, and general functional mobility may be less effective for upper limb recovery when compared with interventions that directly target active motor control and functional arm-hand use. This supports the clinical need to incorporate structured, upper limb-specific rehabilitation strategies into post-stroke treatment plans (20,21).

The comparative pattern across outcomes provides important clinical insight. The motor relearning programme showed the largest normalized recovery across FMA-UE, MAS, and CAHAI, indicating that its benefits were not limited to impairment-level improvement but extended to functional performance and activity-based hand use. The strongest separation between groups was observed in CAHAI, where the motor relearning programme exceeded mirror therapy by 7.8 points and control by 12.2 points at week 8. This suggests that task-oriented practice may have a stronger effect on clinically meaningful activity performance than interventions relying primarily on sensory-motor feedback or passive therapeutic components. For rehabilitation practice, these findings support prioritizing motor relearning when the treatment objective is restoration of active upper limb use in daily tasks.

The findings are also relevant for individualized rehabilitation planning. Mirror therapy remains a practical and low-cost intervention that may be particularly useful for patients with limited active movement, poor confidence in using the paretic limb, or early-stage motor impairment where visual feedback can enhance engagement. In contrast, patients who can participate in repetitive functional practice may benefit more from a motor relearning approach because it challenges voluntary control, movement sequencing, and task completion. A combined model may therefore be clinically appropriate, where mirror therapy is used to facilitate early activation and attention to the affected limb, followed by progressive motor relearning to consolidate functional recovery. Such integration may maximize neuroplastic stimulation while improving real-world task performance.

The study has several limitations that should be considered when interpreting the findings. The intervention period was limited to 8 weeks, and no long-term follow-up was included to determine whether treatment gains were maintained after completion of supervised therapy. The sample size was relatively small, with 20 participants in each group, which may limit precision of between-group estimates and subgroup interpretation. The study included participants within 12 months after stroke, and recovery trajectories may differ between acute, subacute, and chronic phases. In addition, the intervention was delivered in a rehabilitation setting, so results may not fully generalize to home-based or community-based rehabilitation environments. The analysis focused on clinical outcome scores and did not include neurophysiological or imaging markers that could clarify mechanisms of recovery.

Despite these limitations, the study provides useful comparative evidence for upper limb rehabilitation after stroke. The consistent direction of improvement across FMA-UE, MAS, and CAHAI strengthens the interpretation that motor relearning programme produced broader recovery than mirror therapy or conventional physiotherapy. The use of impairment-based and activity-based measures allowed assessment of both motor recovery and functional task performance, which is important because improvements in clinical impairment scores do not always translate into meaningful gains in daily activities. The findings support the clinical value of task-oriented, repetitive, and feedback-guided upper limb rehabilitation and suggest that mirror therapy may be most useful as an adjunctive strategy within a broader rehabilitation programme.

Overall, the results indicate that both motor relearning programme and mirror therapy are beneficial for upper limb recovery after stroke, but the motor relearning programme produced greater improvement across motor impairment, functional motor performance, and arm-hand activity outcomes. These findings reinforce the importance of active, task-specific rehabilitation for restoring upper limb function and suggest that rehabilitation protocols should emphasize progressive motor relearning when patients are able to participate in functional practice. Mirror therapy remains a valuable, accessible, and clinically feasible intervention, particularly for enhancing visual-motor engagement, but its greatest value may lie in combination with structured task-oriented training rather than as a stand-alone alternative.

CONCLUSION

In conclusion, both motor relearning programme and mirror therapy improved upper limb motor recovery among post-stroke patients after 8 weeks of rehabilitation; however, the motor relearning programme produced greater gains across impairment-based, functional motor, and activity-based outcomes. Improvements in FMA-UE, MAS, and CAHAI scores were consistently highest in the motor relearning programme group, indicating that repetitive, task-oriented, and goal-directed upper limb practice may be more effective than visual feedback-based therapy or conventional physiotherapy alone for enhancing functional arm and hand recovery. Mirror therapy also demonstrated meaningful benefit and remains a practical, low-cost rehabilitation option, particularly for patients who require visual-motor facilitation or have limited capacity for intensive task practice. These findings support the prioritization of structured motor relearning strategies in post-stroke upper limb rehabilitation, while also suggesting that mirror therapy may be valuable as an adjunct within individualized, function-focused rehabilitation programmes.

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