

Comparison of Effects of Motor Relearning Programme and Mirror Therapy on Upper Extremity Functions in Post-Stroke Patients—A Randomized Control Trial

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ABSTRACT

Objective: To compare the effects of Motor Relearning Programme and Mirror Therapy on upper extremity functions in Post-Stroke patients.

Design: Parallel group, randomized controlled trial.

Settings: The present research investigation was carried out in the outpatient department (OPD) of the University College of Physiotherapy in Faridkot, as well as in the IPD and OPD of the Department of Neurology and Neurosurgery of Guru Gobind Singh Medical College and Hospital in Faridkot, Punjab.

Methods: A total of 45 post-stroke patients with upper limb disability were divided randomly into three equal groups comprises 15 patients each. Group A received Motor Relearning Programme (MRP) along with Conventional Physiotherapy (CPT), whereas Group B received Mirror Therapy (MT) along with CPT and Group C received CPT only. The total duration of intervention was 1 hour per session and frequency of 8 weeks, with 5 sessions per week.

Main Outcome Measures: The outcome measures included were Motor Assessment Scale (MAS), Chedoke Arm And Hand Activity Inventory Scale (CAHAI), Fugl Meyer Assessment of physical performance of Upper Extremity (FMA-UE) Scale.

Results: The present study revealed that all the parameters within the groups had significantly improved in the pre-intervention analysis. However, post-intervention scores of all the parameters of Group A revealed considerable high improvement at a significant level of ($p < 0.0001$) when compared to the other two groups i.e., Group B and Group C.

Conclusion: In light of the study's findings, it is concluded that the MRP along with CPT is more effective than MT along with CPT and CPT alone.

Keywords: Conventional Physiotherapy, Mirror Therapy, Motor Relearning Programme, Stroke.

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1. INTRODUCTION

The World Health Organisation (WHO) defined stroke in 1989 as “Cerebrovascular origin neurological impairment that lasts for more than 24 hours or is interrupted by death within 24 hours”. The number of stroke cases in India over the age of 20 is estimated to be 1 million, or 203 cases per 100,000 people [1]. Initial arm weakness affects about 85% of stroke patients and persists

in 55%–75% of them even three to six months after the stroke. However, only 5% to 20% of stroke patients have full restoration of their hemiparetic upper extremity [2]. The quality of life and independence in “basic” activities of daily living (washing, grooming, feeding, dressing, “instrumental” home/financial management, etc.) are significantly impacted by the loss of upper limb function independence [3]. Relearning motor skills is a necessary



part of recovering motor function after a stroke and neuroplasticity plays a role in this. In order to maximize upper extremity functions after a stroke, recent studies have focused on designing rehabilitation procedures that encourage such neuroplasticity [4].

Task-specific exercises are generally thought to have the greatest advantage for stroke patients because they are thought to promote neural plasticity. The MRP for stroke developed by Janet Carr and Roberta Shephard is an excellent example of this approach. The method includes multiple aspects of motor learning theory and provides beneficial recommendations for enhancing functional skills [5].

Mirror therapy is a form of rehabilitation strategy in which the reflection (visual input) of a moving unaffected limb creates an impression of motion in the affected limb [6]. The use of such mirror image illusions for the reduction of phantom limb pain was initially suggested by Ramachandran and Rogers-Ramachandran [7]. According to research, observing someone performing an activity causes activation of the same motor regions of the brain as doing the movement itself. Observed behaviours inspire desired actions, involving motor planning and execution. Furthermore, research suggests that observing the movements of sound, working limbs may help damaged motor cortex regions of the brain to recover [3].

The aim of conventional physiotherapy, which is also referred as “mobilisation and tactile stimulation,” is to give stroke victims who have severe paresis or paralysis sensory stimulation through their hands. The primary goal of the conventional physiotherapy treatment approach is to establish voluntary movement through therapist assisted motions that promotes and guide sensory information [8]. Several studies have examined the effects of MRP and MT on stroke patients, but very little has been established regarding the best ways to implement the various exercise techniques. According to our knowledge, this is the first randomized control trial which properly defined the exercise programme and evaluate the impact of MRP and MT on upper extremity functions in post-stroke patients.

2. METHODS

2.1. Ethical Clearance

The Institutional ethical committee of University College of Physiotherapy at Baba Farid University of Health Sciences in Faridkot, Punjab, provided ethical clearance for the study.

2.1.1. Participants

A total of 45 patients, aged 40–65 years, both males and females diagnosed with ischemic and hemorrhagic stroke, with unilateral stroke, duration between 1 to 6 months, MMSE score >23 and Brunnstrom stage 4 and 5, were included in the study. Exclusion criteria was patients with visual and auditory deficits, patients with mental disability, patients with any musculoskeletal disorder, patients with more than one stroke incident, patients with any systematic disease (neoplasms, uncontrolled hypertension, high blood sugar level), patients who have already undergone any

neurosurgical interventions (craniotomy, epilepsy surgery, brain aneurysm surgery).

2.2. Study Procedures

Using a random number table, selected patients were randomly divided into three groups, Group A (n = 15), Group B (n = 15) and Group C (n = 15). Group A was the experimental group where motor relearning programme along with conventional physiotherapy was given to all the patients for 8 weeks with 5 sessions per week for 1 hr/day. Group B was also the experimental group in which mirror therapy along with conventional physiotherapy was given to all the patients for 8 weeks with 5 sessions per week for 1 hr/day. Group C constituted control group in which only conventional physiotherapy was given to all the patients for 8 weeks with 5 sessions per week for 1 hr/day. Patients in all the three groups were assessed at three intervals. Baseline assessment before the administration of physiotherapy intervention, 2nd assessment after 4 weeks of baseline assessment and final 3rd assessment after 8 weeks of baseline assessment.

3. INTERVENTION

3.1. Group A—Experimental Group

Motor Relearning Programme [9]

3.1.1. Analysis of Motor Performance

Reaching actions are significantly impacted by the weakness of the glenohumeral joint's abductors, flexors, external rotators and supinators while the ability to manipulate objects is impacted by weak wrist extensors, finger and thumb flexors, extensors abductors and adductors.

3.1.2. Observational Analysis

Therapists must rely on their own visual observations of motor performance as part of daily motor training in order to conduct analysis and serve as a guide for intervention.

3.1.3. Focusing Attention

Determining what the patient should pay attention to throughout practise is significant. Verbal instruction and live video illustration are two methods for focusing attention.

3.1.4. Soft Tissue Stretching

To reduce muscle stiffness before exercise and as needed throughout, quick passive stretches are performed right before and during the exercise session. Active stretching occurs with active exercise.

3.1.5. Training

3.1.5.1. Active Exercises

Sitting Position: Lifting and lowering a glass held by the palm and fingers while keeping one arm on the table. Placing the glass to the left and right by flexing and extending the wrist, lifting it off the table with the forearm in mid-rotation. Tapping the tabletop with all of your fingers. Supinating while holding a ruler and placing the ruler's end on a surface. Transfer the cup you are holding, which is full

of water, to your other hand, and set it where you would like it to be. While holding the forearm in the middle of its rotation, slide the glass forward in a different direction to touch the targets. With the elbow extended and flexed, slide the glass backwards and forwards until it touches the target. When the shoulder is at 90 degrees of flexion, it can reach and point within a controlled range above that angle, and its forward and sideways range gradually expands. Putting the forearm on the lap while shrugging the shoulders. Lifting hands to comb hair.

3.1.5.2. *Reaching and Balancing Practice*

Exercises performed while sitting on a stool include reaching forward, sideways, or backward to pick up an object, moving it to another location (such as the floor), picking it up again, reaching as far as you can in one direction, then setting it down.

3.1.5.3. *Manipulation and Dexterity Practice*

Exercises on a pegboard, hand-cupping exercises to practise opposing the radial and ulnar sides of the hand, scooping coins off a tabletop into the palm of the opposite hand, picking up a glass of water and drinking it and tapping exercises to quickly touch the tips of each finger to the thumb are among the best methods to strengthen your hands.

3.1.5.4. *Bimanual Practice*

Bimanual training should begin as soon as the patient is able to control basic motions with the damaged limb; exercises include holding objects between the ring and little fingers and palm while trying to remove them with the opposite hand. Holding the spoon and transferring the liquid to the mouth are activities involved in spoon-drinking. Practise moving your hand while preventing spillage.

3.1.5.5. *Strength Training*

Without increasing spasticity, strength training may enhance muscle power. The progression of elastic band exercises involves switching to a different coloured band. Examples include gripping activities utilising a spring-resisted gripping device, elastic band exercises, hand weight exercises, and utilising progressively larger objects when performing reaching, lifting, and manipulating tasks.

3.1.6. *Feedback*

The feedback learners get regarding the way they do an action is a crucial component of skill development. There are two main types of feedback: extrinsic feedback, which provides knowledge of the action's outcomes and knowledge of the performance itself and intrinsic feedback, which is the naturally occurring sensory feedback (visual, proprioceptive, and tactile) occurring as part of the activity.

3.1.7. *Transfer of Learning*

Facilitating the patient transfer training (learning) from the practise environment (the rehabilitation setting) to other surroundings is one of the main goals of the therapist's role as facilitator and instructor.

3.2. *Group B–Experimental Group* *Mirror Therapy [10]*

3.2.1. *Positioning of Arm*

In mirror box therapy, the patient sits near to a table that featured a vertically positioned square box mirror that was 35 cm in length and 35 cm in width. The paretic hand was placed in front of the reflecting side of the mirror with the involved hand behind it on the non-reflective side. The patient was instructed to try to make the identical motions with the paretic hand while moving the non-paretic hand during the session. Bimodal visuomotor neurons known as mirror neurons are active during action execution, mental stimulation (imagination), and action observation.

3.2.2. *Practice of Movements*

The exercises included writing or drawing circles, squeezing a ball, utilising all the fingers to oppose one another, reaching, gripping, lifting, placing things, counting with fingers, opening and closing of the hands and forearm supination and pronation.

3.3. *Group C–Control Group [10]*

3.3.1. *Upper Extremity*

3.3.1.1. *Theraband Exercises*

Exercises for range of motion for joints with no or minimal active movements, weight bearing activities, dumbbell/wrist cuff weight exercises, elbow/wrist flexion and extension and weight bearing activities for the upper extremities are all examples of exercises for the joints. (progressed by increasing the weight and extending the number of repetitions of sets from two sets of ten to three sets of fifteen).

3.3.1.2. *Hand Activities Exercises and Functional Training*

Hand muscle strengthening: Exercises using putty and grippers that involved pinching, gripping and finger extension improved by increasing the resistance of the putty and grippers and extending the amount of repetitions from two sets of ten to three sets of fifteen.

Functional activities: playing cards, reaching tasks, picking up objects of all sizes and shapes, and fine motor activities.

3.3.2. *Lower Extremity*

Cardiorespiratory fitness and mobility, brisk walking.

Sit to stand: progressed by reducing the chair's height and alternate stepping onto low risers progressed by raising the steppers' height and reducing the arm support.

Mobility and balance: tandem walking, walking through a course of obstacles, sudden stops and turns while walking, walking on different surfaces (carpet, foam), standing on a wobble board, standing with one foot in front of the other and kicking a ball with either foot are all examples of walking in various directions.

Lower extremity muscle strength: partial squats, progressed by raising movement intensity, toe raises, progressed by changing from bilateral to unilateral rises on either leg and repetitions, progressed by moving from two sets of ten to three sets of fifteen.

TABLE I: DEMOGRAPHIC INFORMATION OF PATIENTS

Demographic details	Age		
	Group A	Group B	Group C
Mean	54.13	54	53.93
S.D	7.79	6.75	6.65
Number	15	15	15
Male	10	9	11
Female	5	6	4

Group C received the above conventional physiotherapy exercises along with 15 minutes of warm up and 15 minutes of cool-down phase.

4. OUTCOME MEASURES

Motor function was measured using Motor Assessment Scale (MAS), functional ability was analyzed using Chedoke Arm and Hand Activity Inventory (CAHAI) scale, sensorimotor impairment was examined using Fugl Meyer Upper Extremity Scale (FMA-UE), cognition was

assessed using Mini Mental State Examination (MMSE), recovery of upper extremity movement was assessed using brunnstrom recovery stage of upper extremity.

5. DATA ANALYSIS

Data was analysed by using SPSS Version 20. Dependent t-test and Repeated Anova test were used to determine the comparison of effects of motor relearning programme and mirror therapy on upper extremity functions in post-stroke patients. Out of 45 patients, 30 were males and 15 were females. The overall mean age was 54.13 ± 7.79 , 54 ± 6.75 , 53.93 ± 6.65 (as shown in Table I).

6. RESULTS

6.1. Flow of Participants Through the Study

45 patients met the criteria for eligibility out of the 70 patients who were screened for the study; 12 patients withdrew from the study due to losing interest in participation, All the selected patients were randomised into

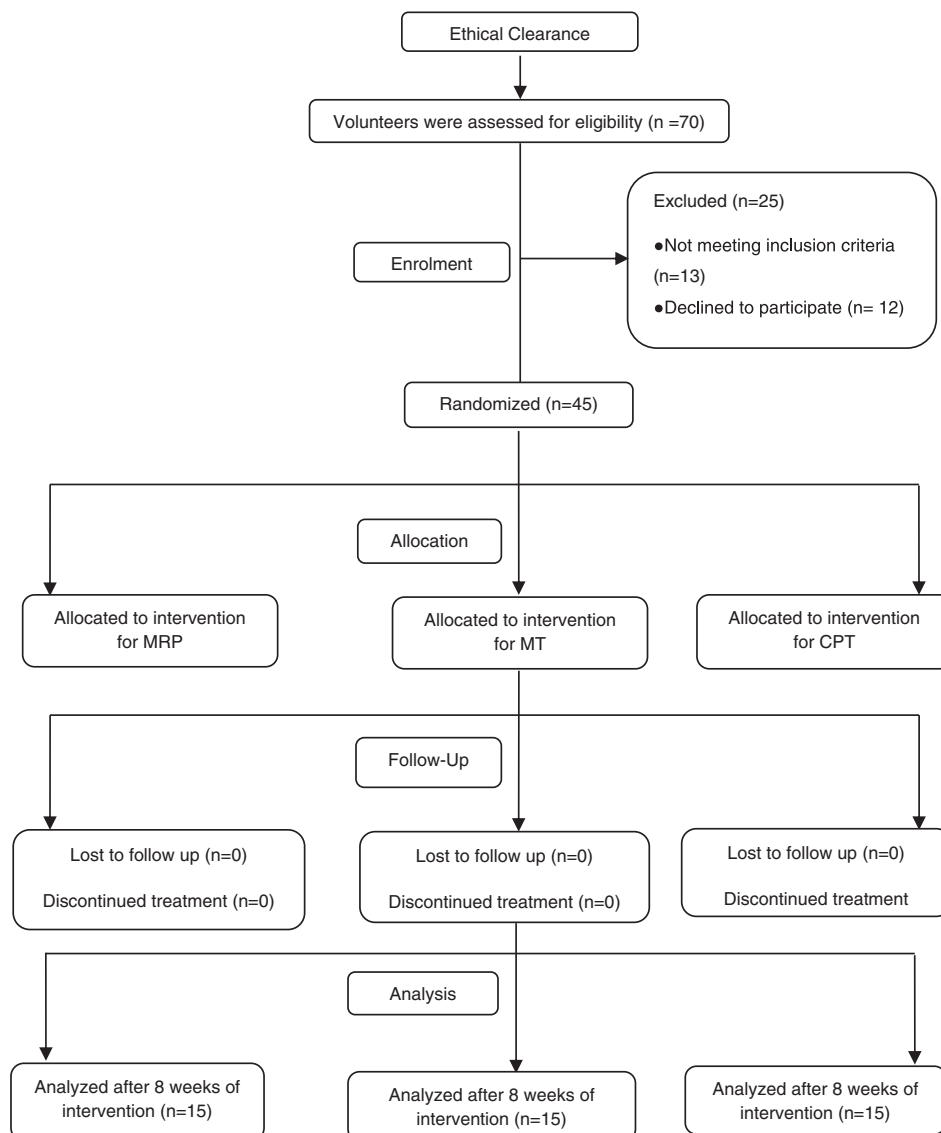


Fig. 1. Consort flow diagram.

TABLE II: DATA ANALYSIS BETWEEN THE GROUP A, GROUP B AND GROUP C

Outcome Measures	Group A (MRP + CPT)				Group B (MT + CPT)				Group C (CPT)			
	Mean \pm SD	Mean \pm SD	Mean \pm SD	p-value	Mean \pm SD	Mean \pm SD	Mean \pm SD	p-value	Mean \pm SD	Mean \pm SD	Mean \pm SD	p-value
	0 th week	4 th week	8 th week		0 th week	4 th week	8 th week		0 th week	4 th week	8 th week	
MAS	6.6 \pm 0.507	10.467 \pm 0.516	13.667 \pm 0.487	<0.0001	6.47 \pm 0.516	8.6 \pm 0.507	10.533 \pm 0.516	<0.0001	6.47 \pm 0.516	7.6 \pm 0.507	8.8 \pm 0.667	<0.0001
CAHAI	26.07 \pm 0.704	48.33 \pm 1.345	69.0 \pm 1.0	<0.0001	26.13 \pm 0.639	40.27 \pm 1.032	54.93 \pm 0.883	<0.0001	26.2 \pm 0.676	37.0 \pm 0.926	46.27 \pm 1.334	<0.0001
FMA-UE	57.8 \pm 1.521	75.4 \pm 1.639	92.93 \pm 1.437	<0.0001	58.33 \pm 1.345	70.07 \pm 1.624	81.93 \pm 1.579	<0.0001	58.2 \pm 1.521	68.13 \pm 1.577	78.07 \pm 1.579	<0.0001

three groups: 15 in the experimental Group A, 15 in the experimental Group B and 15 in the control Group C (as shown in Fig. 1).

6.2. Primary Outcomes

In all the three groups, there were significant differences between pre-treatment and post-treatment mean scores of all the parameters ($p < 0.0001$) (as shown in Table II). However the mean scores of Group A improved significantly more as compared to Group B and Group C (as shown in Table III).

7. DISCUSSION

Patients with stroke have to deal not only with pain, neurological impairment, functional independence, disability, deprived motor function but also with psychological distress, anxiety and depression. The purpose of the present research is to educate and retrain functional abilities, particularly upper limb skills to improve the quality of life of stroke survivors as optimal functional recovery is the ultimate goal of stroke rehabilitation.

A literature search revealed very few research evaluating MRP with MT. In one such study, MRP and MT's effects on stroke patients were examined by Rehani *et al.* [3]. The sample size for earlier study was 12, whereas the sample size of the current study was 45. The earlier study's findings did not support the findings of the present investigation since they were unable to show that one treatment was more beneficial than the other and the findings were not statistically significant ($p > 0.005$). This may be due to the trial's inadequate sample size as well as the fact that the treatments were only used for a brief period of time [3].

The findings of the present study complement the study results of Kaur *et al.* [9] who did a randomized control trial on 30 patients with sub acute and chronic stroke with impaired hand functions. The experimental group received both Mirror therapy and conventional physiotherapy, while the control group only received conventional physiotherapy. For four weeks, each group received therapy for five days a week. This study found that increasing hand function in stroke patients using mirror therapy in addition to conventional physiotherapy was much more successful than using conventional physiotherapy alone [9].

Our findings have been supported by a study of Singh *et al.* [10] who examined MRP and Bobath therapy in rehabilitation of hemiplegic patients. The study was evaluated on 30 stroke patients. Both therapies were observed for 6 weeks, and it was concluded that MRP was considerably superior than Bobath therapy in reducing functional disability and improving functional mobility in hemiplegic patients [10].

The motor relearning programme developed by Carr and Shepherd is the foundation for the current research. The results of this clinical experiment suggest that both "sequential" and "function-based" training are essential for accelerating patients' functional recovery after stroke. We therefore reject the null hypothesis that there will be no significant effect of MRP on functional impairment in the upper extremity among post-stroke patients and accept the alternative hypothesis that there will be a significant effect of the Motor Relearning Programme on functional impairment in the upper extremity among post-stroke patients based on the results obtained in the study. So, it is concluded that MRP when combined with conventional physiotherapy, improves upper extremity functions in post-stroke patients and can be used in physiotherapy settings

TABLE III: DATA ANALYSIS WITHIN THE GROUP A, GROUP B AND GROUP C

Outcome Measures	Group A (MRP + CPT)				Group B (MT + CPT)				Group C (CPT)			
	Mean \pm SD	Mean \pm SD	Mean \pm SD	p-value	Mean \pm SD	Mean \pm SD	Mean \pm SD	p-value	Mean \pm SD	Mean \pm SD	Mean \pm SD	p-value
	0 th week	4 th week	8 th week		0 th week	4 th week	4 th week		0 th week	4 th week	8 th week	
MAS	6.6 \pm 0.507	10.467 \pm 0.516	13.667 \pm 0.488	<0.0001	6.47 \pm 0.516	8.60 \pm 0.507	10.533 \pm 0.516	<0.0001	6.47 \pm 0.516	7.60 \pm 0.507	8.8 \pm 0.676	<0.0001
CAHAI	26.07 \pm 0.704	48.33 \pm 1.345	69.0 \pm 1.0	<0.0001	26.13 \pm 0.639	40.267 \pm 1.0328	54.933 \pm 0.884	<0.0001	26.2 \pm 0.676	37 \pm 0.926,	46.267 \pm 1.334	<0.0001
FMA-UE	57.8 \pm 1.521	75.4 \pm 1.638	92.93 \pm 1.438	<0.0001	58.33 \pm 1.345	70.07 \pm 1.624	81.93 \pm 1.579	<0.0001	58.2 \pm 1.521	78.07 \pm 1.579	78.07 \pm 1.579	<0.0001

and community-based rehabilitation as an early intervention to enhance functioning in daily living activities.

8. CONCLUSION

According to the findings of this study, the Motor Relearning Programme is more effective in improving upper extremity motor function, functional ability and sensorimotor impairment in post-stroke patients. Improvement was highly significant after 8 weeks of treatment with Motor Relearning Programme along with Conventional Physiotherapy.

9. LIMITATION OF THE STUDY

1. A gender discrepancy has been noted in the data collection in the present study, males were more dominant than females.
2. The study considered age as limitation by selecting age group 45–60 years.

10. FUTURE SCOPE

1. Studies including patients from both rural and urban background should included.
2. Also there is need for a research which includes an equal percentage of males and females participants to compare gender based differences in patients with stroke.
3. The age of stroke patients in inclusion criteria can be less than 40 years.

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CONFLICT OF INTEREST

Authors declare that there is no conflict of interest.

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