

A Comparative Study Between Reversed Mirror Therapy Versus Graded Repetitive Arm Supplementary Program Exercise Along with Mirror Therapy for Sub-Acute Upper Limb Stroke

T. Anjali¹, R. Vishnupriya¹, D. Kannan², R. Ferdinand³, M.P. Thenmozhi⁴,
S. Kohilavani⁵, K. Anandhara⁶, S. Sathyapriya⁷

¹MPT student, ²Principal,
^{3,4,5,6,7}Professors. JKK Munirajah Medical Research Foundation, College of Physiotherapy, Komarapalayam,
The Tamil Nadu Dr. M.G.R. Medical University, Chennai.

Corresponding Author: T. Anjali

DOI: <https://doi.org/10.52403/ijhsr.20250955>

ABSTRACT

Background: "Stroke (CVA) is a sudden neurological deficit resulting from an interruption or significant reduction in cerebral blood flow, leading to localized brain tissue injury due to ischemia or hemorrhage. "The purpose of this study is to compare the effect of reversed mirror therapy versus graded repetitive arm supplementary program along with mirror therapy for improving grip strength and arm, hand functions.

Aim: The aim of the study is to compare the effect of reversed mirror therapy versus graded repetitive arm supplementary program along with mirror therapy for improving "Evaluation of arm and hand function alongside grip strength in subacute upper limb stroke" study Design: quasi experimental study.

Method: sampling of 30 subjects of age between 40-50 years of male were selected from the JKKMRF college of physiotherapy. Group A of 15 subjects receives reversed mirror therapy, and Group B receives graded repetitive arm supplementary program along with mirror therapy. The values of Pre and post interventions were assessed by hand grip strength test and Chedoke arm and hand activity inventory.

RESULT: Group A sub-acute stroke patients were included in the study and completed the 15 sessions of reversed mirror therapy with mirror therapy they were re-evaluated at four-month follow up "A two-tailed p-value of less than 0. 0001 suggests a statistically significant difference of high magnitude, based on conventional benchmarks. "

Conclusion: we conclude that the graded repetitive arm supplementary program with mirror therapy has a improvement of grip strength in hand, arm functions on sub-acute stroke.

Keywords: Reversed mirror therapy. Graded repetitive arm supplementary program, Mirror therapy, HAND grip strength test, Chedoke arm and hand activity inventory.

INTRODUCTION

A stroke is a series medical condition that occurs when the blood supply to a part of the brain is disrupted leading to a brain cell

damage or death. It is one of the leading causes of disability and mortality worldwide. ⁽¹⁾ with a various risk factor including high blood pressure, diabetes,

smoking and an unhealthy life style. Ischemic strokes are the result of a thrombus, embolism or conditions that produce a low systemic perfusion pressure. The resulting a lack of cerebral blood flow deprives the brain of needed oxygen and disrupts cellular metabolism, and it leads to injury and death of tissues. Hemorrhagic strokes, with abnormal bleeding into the extravascular areas of the brain, are the result of rupture of a cerebral vessel or trauma. ⁽²⁾ Major risk factors for stroke are hypertension, heart disease, disorders of heart rhythm, and diabetes mellitus. Intracranial hemorrhage is caused by rupture of a cerebral vessel with subsequent bleeding into the brain. Primary cerebral hemorrhage typically occurs in a small blood vessel weakened by atherosclerosis producing an aneurysm. ⁽³⁾ sub-arachnoid hemorrhage occurs from bleeding into the subarachnoid space typically from a saccular or berry aneurysm affecting primarily large blood vessels. Arteriovenous malformation is another congenital defect that can result in stroke. The abnormal vessels undergo progressive dilation with age and eventually bleed in 50% of cases. Sudden and severe cerebral bleeding can result in death within hours, because intracranial pressure raises rapidly and adjacent cortical tissues are compressed or displaced as in brainstem herniation.

REVERSED MIRROR THERAPY

Reversed mirror therapy is a therapeutic technique developed as an extension and alternative to traditional mirror therapy. It is primarily used in neuro rehabilitation for conditions like stroke, phantom limb pain, and motor function disorders. While traditional mirror therapy provides visual feedback from the unaffected limb to simulate movement in the impaired limb, reversed mirror therapy shifts the focus, it presents an image of the affected limb, often altered to appear as though it is functioning normally ⁽⁴⁾. This approach aims to re-engage the brains motor pathways and

enhance recovery, even in cases where movement is not physically possible.

Mirror Therapy

"Mirror Therapy (MT) uses a mirror to create a visual illusion of the impaired limb, allowing the brain to sense movement without experiencing pain. In this method, the affected limb is placed behind the mirror, and the movements of the unaffected limb are reflected, giving the appearance that both limbs are functioning normally. "

GRADED REPETITIVE ARM SUPPLEMENTARY PROGRAM (GRASP)

Grasp is a structured, task – oriented exercise program specifically designed to improve upper limb function in individuals recovering from stroke or other neurological impairments. Developed to be delivered either independently by the patient or under supervision, GRASP, focuses on repetitive, functional arm and hand movements that promote neuroplastic changes in the brain, leading to improved motor control and strength in the affected limb. ⁽⁵⁾

These techniques had been used for one hour per day and encourage the patient to use the stroke – affected arm and hand function as much as possible. It increases the potential for recovery of the hand and arm through the challenging repetitions of practice and encourage the use of stroke affected hand in everyday activities

The GRASP program components include a group of four sections;

Stretching

Arm strengthening

Hand strengthening

Coordination

Each one of the following exercises in the manual is graded to work with the participant one to determine which level is to start with each exercise. It is important of that the exercise is challenging, if the participant completes the exercise without making any error such as mishandling or dropping the object, that we have to make it more difficult. It is a worldwide technique

and standardized, it includes stretching, strengthening, and task oriented. These interventions are compared and calculated and shows the result of effective technique by using the appropriate scales.

MATERIALS & METHODS

The study was conducted at JKKMMRF College of Physiotherapy outpatient department. The patient was informed about that the whole protocol and treatment procedure. A written consent was obtained from their voluntary participation in this study. They were taken 30 patients with upper limb stroke patients were selected based on the inclusion and exclusion criteria and they were divided into two groups of Group A and Group B. Group A was with reversed mirror therapy with mirror therapy on upper limb stroke patients Hand grip strength test and Chedoke arm and hand inventory activity were used as outcome measures each patient was given a physiotherapy program for 4 months duration. The pre and post treatment values were measured before and after 4 months for comparison.

INCLUSION CRITERIA

Age between 40 to 50 years
Only male
Ischemic stroke
Frontal parietal, cortico-subcortical unilateral lesion assessed by CT
Acute phase of illness
CAHAI score ranges from below 30

EXCLUSION CRITERIA

History of subarachnoid haemorrhage
Unilateral spatial neglect
Psychiatric disorders
Recent Fracture
Auditory impairment
Balanced disorder
Shoulder dislocation
Reflex sympathetic dystrophy.

PROCEDURE

REVERSED MIRROR THERAPY

Reversed mirror therapy (RMT) is a variation of mirror therapy, often used for treating conditions like phantom limb pain, stroke – related motor deficits, or complex regional pain syndrome (CRPS). Unlike traditional mirror therapy, RMT focuses on using the affected limb to drive the visual illusion, often creating a sense of restored function or engagement.

INTERVENTION FOR GROUP-A;

Reversed mirror therapy

The patient was in sitting position with both arms on either side of a vertical mirror placed at your midline.

The mirror should reflect the affected limb.

Hide the unaffected limb behind the mirror, out of sight.

Slowly move the affected limb while watching its reflection.

Start with simple movements wrist flexion/extension, finger tapping, or opening and closing the hand.

Stop if pain increases. Modify tasks to stay within tolerance. It was given for 1-2 sessions per day, 15 -30 minutes each for 4-6 weeks.

Some reversed mirror therapy exercises are;

1. Finger Tapping
2. Wrist flexion/ extension
3. Object grasp and release
4. Waving or hand circles
5. Writing/ drawing practice.

INTERVENTION FOR GROUP B

Graded arm repetitive supplementary program (GRASP) is a structured based rehabilitation program designed to improve upper limb function especially in stroke patients with limited hand and arm use.

These techniques had been used for one hour per day and encourage the patient to use the stroke – affected arm and hand function as much as possible. It increases the potential for recovery of the hand and arm through the challenging repetitions of practice and encourage the use of stroke affected hand in everyday activities

The GRASP program components include a group of four sections;

Stretching
 Arm strengthening
 Hand strengthening
 Coordination

STRETCHING

Total arm stretch
 Shoulder shrug
 Hand and wrist stretch

ARM STRENGTHENING

Push ups
 Shoulder exercise; arm to the side, front
 Elbow exercise
 Wrist exercise
 Total arm stretch

HAND STRENGTHENING

Squeezing the ball

COORDINATION

Start the ball with rolling partner
 Open and close fingers
 Thumb opposition
 Lateral wrist bends
 Rotate wrist

REPETITIONS

Perform 10 repetitions, 10 sec of rest given in between each exercise done for 45 minutes per session.

STATISTICAL ANALYSIS

Descriptive statistics for HAND GRIP STRENGTH TEST FOR GROUP A AND GROUP B

Group	Hand grip strength test	Mean	Standard deviation	Paired 't' value
Group A	Pre test	65. 8133	7. 7158	13. 2236
	Post test	92. 5607	13. 0669	
Group B	Pre test	66. 4933	7. 7936	12. 3808
	Post test	97. 7427	14. 7558	

Descriptive statistic for hand grip strength test in Group A shows that paired 't' test value of pre vs post-test values of group A was 13. 2236 at 0. 001% level which was greater than tabulated 't' value 2. 5. Group B shows that paired 't' values of pre and post-test values of group B was 12. 3808 at 0. 0001% level which was greater than tabulated t values 2. 5. this showed there is

significant difference between pre vs post test results of Group A and Group B for NPRS. This exposed that there was significant reduction in post-test mean values in response to NPRS in Group A and Group B.

RESULT HGST (POST TEST ANALYTICS)

Hand grip strength test	Mean	Mean difference	Standard deviation	Unpaired t- test
Group A	26. 7533	4. 4960	7. 8270	1. 3905
Group B	31. 2493		9. 7755	

The above table shows the post-test analysis result in HGST for Group A and B. The mean value of Group A is 26. 7533 which was lesser than Group B value of 31. 2493 and the unpaired 't' test value was 1. 3905 at 0. 0001 level, which was greater than tabulated 't' value. It

showed statistical significance difference between mean values of Group A and B.

DESCRIPTIVE STATISTICS FOR CHEDOKE ARM AND HAND ACTIVITY INVENTORY IN GROUP A AND GROUP B

Group	Chedoke arm and hand activity inventory	Mean	Standard deviation	Paired 't' value
Group A	Pre test	23. 27	5. 32	17. 7029
	Post test	43. 00	7. 58	
Group B	Pre test	24. 47	3. 18	48. 8501
	Post test	55. 53	3. 4	

Descriptive statistic for Chedoke arm and hand activity inventory in Group A shows that paired 't' test value of pre vs post-test values of group A was 17. 7029 at 0. 001% level which was greater than tabulated 't' value 2. 5. Group B shows that paired 't' values of pre and post-test values of group B was 48. 8501 at 0. 0001% level which was greater than tabulated t values 2. 5. this

showed there is significant difference between pre vs post test results of Group A and Group B for CAHAI. This exposed that there was significant reduction in post-test mean values in response to CAHAI in Group A and Group B.

RESULT - CAHAI SCORE (POST TEST ANALYTICS)

Chedoke Arm and Hand Activity Inventory	Mean	Mean difference	Standard deviation	Unpaired t- test
Group A	19. 73	11. 40	4. 32	8. 9505
Group B	31. 13			

The above table shows the post-test analysis result in CAHAI for Group A and B. The mean value of Group A is 19. 73 which was lesser than Group B value of 31. 13 and the unpaired 't' test value was 8. 9505 at 0. 0001 level, which was greater than tabulated 't' value. It showed statistical significance difference between mean values of

RESULT & DISCUSSION

The study was conducted for 4 months duration of intervention showed that Group B of those who received Graded repetitive arm supplementary program with mirror therapy has resulted an improvement in grip strength and arm, hand functions than Group A who received reversed mirror therapy.

The aim of the study was to compare the effectiveness of reversed mirror therapy versus graded repetitive arm supplementary program along with mirror therapy for improving grip strength and arm, hand functions.

The study sample comprised of 30 patients of which 15 group A and 15 group B The mean age of subjects was 40-50 years. Among 30 subjects,15 was treatment with reversed mirror therapy and 15 were treated with Graded repetitive arm supplementary program with mirror therapy. The pre and post-test values were assessed by HGST and CAHAI severity score in Group A and

Group B. ⁶ The paired t test value of HGST13. 22 and 12. 38 and CAHAI severity score is 17. 70 and 48. 85 respectively. The unpaired t test values for HGST 1. 3905 and CAHAI severity score is 8. 9505 respectively.

By analyzing the values of paired and unpaired t test results showed a statistically significant results comparing with the table value with 0. 05 level of significance of both groups between pretest vs post test results. The result obtained from statistical analysis indicates that there was a significant difference between two groups in showing improvement in upper limb sub-acute stroke. ⁷ The improvement of arm and hand functions was seen in all subjects received irrespective of the technique of the Graded repetitive arm supplementary program with mirror therapy.

By the result of alternate hypothesis is accepted and also there is significant difference between reversed mirror therapy versus Graded repetitive arm supplementary program with mirror therapy for the improvement of hand and arm functional movements. By analyzing the mean and standard deviation values of the result showed the subjects who received graded repetitive arm supplementary program with mirror therapy is found to be more effective in improving the arm and hand functions than reversed mirror therapy.

While consideration of improving quality of life in patients with upper limb sub-acute stroke patients the study shows that there was effective and good improvement. A study conducted by Harris, Eng, Miller and Dawson. et. al. ,2009 validate a randomized controlled trial to evaluate the effectiveness of the Graded repetitive arm supplementary program (GRASP) in improving arm functioning during in patients with stroke rehabilitation. These findings suggests that the GRASP is an effective, low cost and feasibility intervention for enhancing upper limb recovery in stroke patients.

A study conducted by Luigi, Tesio, Antonio, Caronni et al., (2023) This study compares MIT and REMIT on post stroke upper limb recovery to gain clues on the mechanism of action of mirror therapies. The result of the study was both MIT and REMIT can improve upper limb dexterity in hemiparesis after stroke⁶

"Reversed Mirror Therapy (REMIT) is believed to engage distinct neural mechanisms by providing a visual representation of movement that opposes the actual motor output. This contradictory feedback may stimulate cortical reorganization, enhance sensorimotor integration, and promote adaptive neuroplasticity in individuals with impaired upper limb function, particularly after stroke⁶. By challenging the brain's internal representation of movement, REMIT may also improve motor control and proprioceptive accuracy. "

"The combination of Graded Repetitive Arm Supplementary Program (GRASP) with Mirror Therapy facilitates motor recovery through repeated task-specific upper limb activities that enhance neural plasticity. This approach promotes cortical reorganization by engaging both sensory and motor pathways. While GRASP emphasizes functional strengthening and repetitive use of the affected limb, mirror therapy provides visual feedback that activates mirror neurons and enhances bilateral motor network activation.

Together, they support improved motor control, coordination, and sensorimotor integration in individuals with upper limb deficits, particularly post-stroke⁸

Therefore, graded repetitive arm supplementary program with mirror therapy is more effective in improving the arm and hand functions of upper limb sub-acute stroke.

CONCLUSION

We conclude that the graded repetitive arm supplementary program with mirror therapy has an improvement of grip strength in hand, arm functions on sub-acute stroke.

Declaration by Authors

Ethical Approval: Approved

Acknowledgement: None

Source of Funding: None

Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Feigin, V. L., Brainin, M., Norrving, B., Gorelick, P. B., Dichgans, M., Wang, W & Pandian, J. (2022). World Stroke Organization (WSO): Global stroke fact sheet 2022. *International Journal of Stroke*,
2. Powers, W. J., Rabinstein, A. A., Ackerson, T., Adeoye, O. M., Bambakidis, N. C., Becker, K., & Tirschwell, D. L. (2019). 2018 Guidelines for the early management of patients with acute ischemic stroke: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*,
3. Sutherland, G. R., & Auer, R. N. (2006). Primary intracerebral hemorrhage: Pathophysiology, epidemiology, and management. *Journal of Clinical Neuroscience*, 13(5), 511–517. Review article summarizing how chronic hypertension and small vessel disease—particularly Charcot–Bouchar microaneurysms—lead to spontaneous intracerebral hemorrhage.
4. Brunetti, L., Tesio, L., Frey, V., et al. (2024). Reversed Mirror Therapy (REMIT) after stroke—A proof-of-concept study of

- upper-limb motor recovery. *Brain Sciences*, 13(6), 847.
5. Harris, J. E., Eng, J. J., Miller, W. C., & Dawson, A. S. (2009). A self-administered Graded Repetitive Arm Supplementary Program (GRASP) improves arm function during inpatient stroke rehabilitation: A multi-site randomized controlled trial. *Stroke*, 40(6), 2123–2128.
 6. Tesio L, Caronni A, Russo C, Felisari G, Banco E, Simone A, Scarano S, Bolognini N. Reversed Mirror Therapy (REMIT) after Stroke-A Proof-of-Concept Study. *Brain Sci.* 2023 May 24;13(6):847. doi: 10.3390/brainsci13060847. PMID: 37371327; PMCID: PMC10296617.
 7. Kwakkel, G., Kollen, B. J., & Wagenaar, R. C. (2002). Therapy impact on functional recovery in stroke rehabilitation: A critical review of the literature. *Physiotherapy*, 88(4), 171–185.
 8. Jaafar, N., Hassan, A., Ali, M., et al. (2021). Mirror therapy rehabilitation in stroke: A scoping review of upper limb recovery and brain activities. *Brain Sciences*, 11(7), 928.
- How to cite this article: T. Anjali, R. Vishnupriya, D. Kannan, R. Ferdinand, M.P. Thenmozhi, S. Kohilavani et al. A comparative study between reversed mirror therapy versus graded repetitive arm supplementary program exercise along with mirror therapy for sub-acute upper limb stroke. *Int J Health Sci Res.* 2025; 15(9):487-493. DOI: [10.52403/ijhsr.20250955](https://doi.org/10.52403/ijhsr.20250955)
