

Effectiveness of Bilateral Task-Oriented Exercises and Mirror Therapy to Improve Hand Function in Hemiparetic Stroke

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ABSTRACT

Background and Objectives: Stroke is a clinical syndrome consisting of rapidly developing clinical signs of focal disturbance of cerebral function lasting more than 24 hours or leading to death with no apparent cause other than a vascular origin." Some evidence-based studies proved that bilateral task-oriented exercise and Mirror therapy are effective in improving the hand function in hemiparetic stroke patient. But there is no comparative study of these two protocols. Hence the purpose of this study is to compare the effectiveness of bilateral task-oriented exercises and Mirror therapy in improving hand function in hemiparetic stroke patient.

Methods: A total of 67 subjects met selection criteria for the study among them 7 members are dropouts from group A and B and were divided into 2 groups, 30 members in group A (bilateral task-oriented exercises), 30 members in group B (Mirror therapy). Both groups performed intervention for 5 days per week, for 4 weeks. The outcomes were Fugl Meyer and Motor Activity Log for measuring functional disabilities.

Results: Paired "T" test was used to access the statistical significance within the groups. Statistical analysis between two groups using independent "t" test revealed that there is no significant difference between Bilateral task-oriented exercises and Mirror therapy groups.

Conclusion: In this study, 4 weeks of bilateral task-oriented exercises and Mirror therapy showed that both approaches are equally effective in improving hand function in hemiparetic stroke.

Key Words: Hemiparetic stroke, Bilateral task-oriented exercises, Mirror therapy, Motor activity log, Fugl Meyer.

INTRODUCTION

Stroke is described through the World Health Organization as "a medical syndrome which includes unexpectedly developing clinical signs of focal (or worldwide in case of coma) disturbance of cerebral function lasting more than 24 hours or leading to death without an obvious reason apart from a vascular origin." (1,2,3)

Stroke is the second leading cause of death worldwide (1-4), which may increase in future, as a result demographic transitions in population. The formation of ischemic cascade around the area effected in brain leads to neuronal death along with an irreversible loss of neural function.

Stroke is one of the main reasons of death and disability in India. In India 1.2% of overall deaths arise because of stroke (9,10). The Incidence of stroke ranged from 105 to 152/100,000 men and women according to year, and a incidence of stroke ranged from 44.29 to 559/100,000 people in specific elements of the use of a at some point of the beyond decade and through 2030 its far anticipated to grow as much as 98/10000(6,7). The envisioned occurrence rate of stroke range, 84-262/100,000 in rural and 334-424/100,000 in urban areas. The prevalence rate is 119-145/100,000 primarily based totally at the current

population primarily on the population-based studies⁽⁴⁾. After ischemic coronary heart disease, stroke is the most typical purpose of mortality global, having brought on round 5.7 million deaths in, of which greater than 80% took place in low and middle earnings countries (LMIC). In addition, estimates showed that there may be 62 million survivors of stroke global, many of whom are likely to be disabled, with up to a third living with severe disability⁽¹²⁾.

Strokes may be labeled into 3 foremost categories: ischemic, transient ischemic attack and hemorrhagic. Ischemic strokes are caused by interruption of the blood supply to the brain, at the same time as hemorrhagic strokes end result from the rupture of a blood vessel or a strange vascular structure⁽¹³⁾. About 87% of strokes are ischemic, the rest being hemorrhagic. Bleeding can increase interior regions of ischemia, a condition known as "hemorrhagic transformation." It is unknown what number of hemorrhagic strokes actually starts as ischemic strokes. Hemiplegia in stroke is attributable to the involvement of corticospinal system on the side opposite to paralysis leading to motor deficits.

Decreased paretic arm function due to inadequate muscle recruitment, spasticity in muscle, abnormal muscle tone, and uncoordinated response are important contributors to post stroke disability. The disability in daily life is of longer duration for paralysis of the upper extremity than of the lower extremity. It has been reported that up to 85% of stroke survivors experience hemiparesis and 55%-75% continue to have limitations in the upper extremity function⁽¹⁹⁾. Therefore, to improve the function of the affected upper extremity in stroke patients, it is necessary to maximize the opportunities in the usage of upper extremity bilateral activities have been discussed as measure to improve the body symmetry and to reduce abnormal muscle tone there by promoting voluntary movement of the affected upper extremity.

Thus far bilateral upper extremity coordination movements have been applied in the form of bilateral task-oriented exercises such as repetitive training tasks, grasping ability to hold objects with various sizes, shapes and weights⁽²⁸⁾.

Bilateral task-oriented exercises have been discussed has measures to improve the symmetry and to reduce abnormal muscle tone there by promoting voluntary movement of affected upper extremity⁽¹⁶⁻¹⁸⁾. Performing the bilateral task-oriented exercises, which supports the opinion that when both hands move simultaneously, instead of acting as a separate unit they act as a unit. which is perceived as a coordinated unit by the brain^(19,20).

Mirror therapy is a relatively new therapeutic intervention which is simple¹⁵, inexpensive and most significantly patient directed treatment that focuses on moving the unimpaired limb. It was first brought by Ramachandran and Roger Ramachandran¹⁶ to deal with phantom limb ache after amputation. It makes visual information to encourage patients to pay attention at the movements in their non-paretic limbs. Visual illusions make the patients feel as if their two hands are moving simultaneously and symmetrically⁽⁸⁻¹⁰⁾.

MATERIALS AND METHODS

The study was proposed to compare the effectiveness of bilateral task-oriented exercises and mirror therapy in hemiparetic stroke subjects.

SUBJECTS: Subjects are recruited from department of Physiotherapy, Neurology department, KIMS general hospital, Amalapuram.

METHOD OF DATA COLLECTION:

A total number of 67 patients both men and women of age between 30-80 years suffering with motor impairment due to stroke and who are willing to participate in the study were included as per the study criteria after obtaining the consent form and the patients. These 67 subjects were

allocated into two groups by convenience sampling.

GROUPS	NO.OF. SUBJECTS	TREATMENT
GROUP A	33	Bilateral-task oriented exercises
GROUP B	34	Mirror therapy

STUDY DESIGN: Quasi experimental study

STUDY DURATION: This study was conducted during the period between July 2020 to June 2021.

STUDY SAMPLE: convenient sampling

TREATMENT DURATION: 45mins per day, 5days per week for 4 weeks

ETHICAL CLEARANCE: Ethical clearance was taken from ethical committee of Konaseema Institute of Medical sciences and Research Foundation at Amalapuram

OUTCOME MEASURES:

- Fugl Meyer
- Motor activity log (MAL)

The Fugl Meyer was the most frequently used outcome measure applied in the studies. Motor activity is assessed by using Fugl Meyer assessment of upper extremity.

The upper-extremity MAL-14 is a structured interview that elicits information about 14 activities of daily living. Patients are asked to rate Quality of Movement (QOM) and Amount of Use (AOU) for assessing how well and how often they use their more impaired arm to complete each ADL. Both scales are anchored at 6 points 0-5.

MATERIALS: Cups, Towel, Table, Chair, Wooden box, Mirror, Glass.

INCLUSION CRITERIA:

- Ability to understand and perform the exercise as instructed by the therapist.
- Lack of excessive spasticity in the joints of the affected upper extremity.
- Upper extremity paresis with ability to extend the affected wrist and fingers to at least 15 degrees.
- Burn Strom stage 4
- Mini mental scale above 24

EXCLUSION CRITERIA:

- Patient with joint movement limitations in the healthy upper extremity.
- A visual field defects.
- Those who had previously undergone a rehabilitation program.
- Person with recurrent stroke

PROCEDURE

Total 67 stroke subjects were included in the study. Subjects who met the inclusion criteria were allocated into 2 groups, with 33 subjects in group A and 34 subjects in group B. Initially they were screened with Brunnstrom stage 4 for motor ability of upper extremity. After that the two groups follows two interventions of treatment one of the groups follows the bilateral-task oriented exercises and other group follows the mirror therapy during the period of the training was carried out for 45 minute per day for 5 days per week up to 4 weeks, the participants were instructed with oral explanations and guidance about the training by a therapist.

Bilateral task-oriented exercises with conventional physiotherapy in 4-week protocol according to the group they were allocated. Tasks selected because they can easily be implemented in bilateral-task oriented exercises and mirror therapy groups had the same amount of time in training, there were 5 functional tasks. All the members in this study participated in regular physiotherapy as per regular treatment followed in rehabilitation setting. (19,20)

Group A: Protocol for bilateral-task oriented exercises

Subjects were made to sit in a chair in front of a table of comfortable height and perform specific tasks. In this group the subjects were asked to perform tasks using both hands that is affected and the un affected upper extremities. So the main goal is to produce the movement by simple task-oriented exercises, by involving both the upper extremities, both arms are used simultaneously or alternately. Tasks include using a towel to sweep the table with both

hands together, staking the cups by using both the hands simultaneously, positioning the cup up right by using the both hands simultaneously, carrying a wooded block by using the both hands simultaneously and drinking water by lifting the glass. Conventional physiotherapy includes neurodevelopment facilitation techniques organized specifically for each patient, exercises include range of motion exercises, strengthening exercises, stretches. ⁽¹⁶⁻¹⁸⁾

Tasks [GROUP-A]

- Sweep with a towel on table
- Lifting a water glass to drink
- Staking cups
- Positioning the cup up right
- Carrying a wooded block

Group B: Protocol for mirror therapy:

The patients were seated on a chair with a table in front of them. The mirror was placed between the extremities and vertical to the table in front of them so that the non-paretic hand was reflected exercises were performed in seated position and make patient to do the following exercises wrist and fingers flexion, extension movements of wrist and fingers, pronation and supination of the forearm and wrist circumduction were performed sequentially these are the five sets of exercises each set is performed for 3 minutes and resting time of one minute was given after each set. ⁽¹⁴⁾

Conventional physiotherapy includes neurodevelopment facilitation techniques organized specifically for each patient, exercises include range of motion exercises, strengthening exercises, stretches. ⁽⁸⁻¹⁰⁾

The subjects in the mirror therapy group received treatment for 45 minutes. Mirror therapy for 15 minutes and 30 minutes for conventional physiotherapy for 5 days a week up to 4 weeks

Exercises [Group B]

- Flexion of wrist and fingers
- Extension of wrist and fingers
- Supination and pronation of the forearm
- Wrist circumduction

RESULTS

Statistical analysis was done using the statistical software SPSS 20.0 version for this purpose the data was entered into Microsoft Excel – 2007 spreadsheet, tabulated and subjected into statistical analysis.

Descriptive statistical data was presented in the form of mean [+/-] standard deviation, percentage (%) and also graphical representation. 60 subjects completed the entire study protocol of 4 weeks in the training session and 3 subjects were excluded from group A and 4 from group B.

To observe the treatment impact before and after the treatment in the groups, the analysis was carried out using statistical tests, for the outcome measures – Fugl Meyer assessment (upper extremity) and MAL. Within the group differences were checked with paired student-T test and between the group's differences are checked using unpaired student-T test.

MAL and Fugl-Meyer assessment of the upper extremity has shown differences in their pre-test and post-test values. But on comparing the means of both groups there was no difference, as both the interventions has improved the hand function in hemiparetic stroke.

Table – 1: Analysis of Pre and Post Interventions of Fugl Meyer and MAL (AOU & QOU) in BILATERAL TASK ORIENTED Group A

Outcomes		Mean	N	Std. Deviation	Std. Error Mean	p-value
Fugl Meyer (UE)	PRETEST	34.667	30	4.3056	0.8286	0.000*
	POSTTEST	54.444	30	4.2907	0.8257	
MAL (AOU)	PRETEST	1.713	30	0.3784	0.0728	0.000
	POSTTEST	2.903	30	0.2798	0.0538	
MAL (QOU)	PRETEST	1.839	30	0.4356	0.0838	0.000
	POSTTEST	3.187	30	0.3213	0.0618	

Result: the above table shows the significant improvement in Fugl Meyer and MAL (AOU & QOU) Assessment mean scores in Group A. (P-value - 0.000)

Table – 2: Analysis of Pre and Post Interventions of Fugl Meyer and MAL (AOU & QOU) in MIRROR THERAPY Group B

		Mean	N	Std. Deviation	Std. Error Mean	p-value
Fugl Meyer (UE)	PRETEST	34.308	30	4.1835	0.8205	0.000*
	POSTTEST	55.077	30	2.1526	0.4222	
MAL (AOU)	PRETEST	1.611	30	0.4277	0.0839	0.000
	POSTTEST	2.789	30	0.2395	0.047	
MAL (QOU)	PRETEST	1.786	30	0.5182	0.1016	0.000
	POSTTEST	3.025	30	0.2793	0.0548	

Result: the above table shows the significant improvement in Fugl Meyer and MAL (AOU & QOU) Assessment mean scores in Group B. (P-value - 0.000)

Table – 8: Analysis of Post test scores of Fugl Meyer and MAL (AOU & QOU) difference between Group A and Group B

OUTCOMES		N	Mean	Std. Deviation	Std. Error mean	P value
Fugl Meyer (UE)	POST-TEST GROUP-A	30	54.444	4.2907	0.8257	0.499
	POST-TEST GROUP-B	30	55.077	2.1526	0.4222	
MAL (AOU)	POST-TEST GROUP-A	30	2.903	0.2798	0.0538	0.117
	POST-TEST GROUP-B	30	2.789	0.2395	0.047	
MAL (QOU)	POST-TEST GROUP-A	30	3.187	0.3213	0.0618	0.057
	POST-TEST GROUP-B	30	3.025	0.2793	0.0548	

Result: the above table shows that there is no significant difference in Fugl Meyer and MAL (AOU & QOU) Assessment mean scores in Group A and group B. (P-value > 0.05)

DISCUSSION

Aim of the study was to compare the effects of bilateral task-oriented exercises and mirror therapy for improving the hand function in hemiparetic stroke. After the results my study accepted the null hypothesis as there was no significant difference between the groups.

A total of 67 subjects were included in the study with 7 dropouts three from bilateral task-oriented group due to Covid and not interested in study and four from mirror therapy two was due to Covid and others due to spontaneous recovery. In this study subjects were treated with advanced therapy and conventional therapy. Statically “P” value is less than 0.5 it has showed a significant difference for pre and post treatment in both mirror therapy and bilateral task-oriented exercises quality of the moments has also been taken through MAL. Motor activity is assessed with Fugl Myer^(27,28).

Brunner et al conducted study on subacute stroke patients with impaired hand function with CIMT and bilateral task-oriented exercises and the study concluded that bilateral task-oriented training is effective in improving hand function⁽²¹⁾. Mechanism of bilateral training focus on proximal control recruits’ additional neural pathways such as uncrossed corticospinal or bilateral sub cortical pathways such as rubro spinal that are then available to support the

crossed corticospinal pathways needed to accomplish unilateral distal hand function (17-19).

Bilateral sequential training ultimately increased the ipsi lesional cortical involvement in the control of the contralateral hand. bilateral upper extremity exercises which support the opinion that when both hands move simultaneously instead of acting as separate units, they act as single unit which is perceived as a coordinated unit by the brain⁽²⁸⁾. The study also found that when homologous muscle groups on the left and right sides are activated simultaneously by symmetrical bilateral exercises, the neural networks in the two cerebral hemispheres that are involved in upper extremity movement on both sides are similarly activated⁽²⁴⁾

Yavuzer et al conducted study on subacute stroke patients with impaired hand function with mirror therapy and the study concluded that mirror therapy is effective in improving hand function, multiple mirror therapy sessions improve laterality index of the primary motor, pre motor and supplementary motor areas of the ipsi lesional hemisphere. The visual illusions are activated in the frontal lobe of the cerebral hemisphere and this activation function as the basis of a neurological mechanism for including brain plasticity⁽⁸⁾ Mirror neurons, a set of cells in the pre motor cortex and inferior parietal lobule get stimulated during

observation as well as performing a motor act. Observation of the movements through mirror therapy may activate mirror neurons that further include the closely associated affected motor cortex these neurons exhibit plasticity⁽⁹⁻¹⁰⁾. By doing the multiple mirror therapy sessions it increases callosal communication from the damaged to undamaged brain also occurs balancing the inter hemispheric inhibition⁽³⁰⁾. The visual perception of movement activates the occipital area on the lesioned side. After receiving visuo-motor messages, the primary somato sensory cortex on the lesioned side excites immediately while the pre motor cortex activates later following many mirror therapy sessions. It increases excitability of corticospinal pathways corresponding to the affected body side⁽³³⁾

From above the reviews these are underlying mechanism of the bilateral task-oriented exercises and mirror therapy. As the participants in both groups were advised every day to use their arms in their daily activities. Regardless of the technique used, the important thing in the rehabilitation period is to provide patients with frequent and continuous chances to use the affected arm in their activities. In both types of training patients must use their most affected arm, both induce plastic changes in the central nervous system. Both the approaches were equally effective in improving the hand function in hemiparetic stroke.

Limitations of the Study: Limitations of the study includes very less sample size and lack of long-term follow-up.

Recommendations for further study: Further studies are required to asses with control group and with long term follow-ups.

CONCLUSION

This study concluded that both bilateral task-oriented exercises and mirror therapy are equally effective. So bilateral task training is not superior to mirror

therapy in improving hand function in hemiparetic stroke.

Acknowledgement: None

Conflict of Interest: None

Source of Funding: None

Ethical Approval: Approved

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- How to cite this article: Margrett M, B N Raju, Chakravarthi A et.al. Effectiveness of bilateral task-oriented exercises and mirror therapy to improve hand function in hemiparetic stroke. *International Journal of Research and Review.* 2021; 8(10): 366-373. DOI: <https://doi.org/10.52403/ijrr.20211049>
