

Influence of Bilateral Upper Limb Training on Improving Motor Function in Hemiparetic Individuals

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ABSTRACT

Background: Delayed recovery of upper extremity hemiparesis in stroke survivors is the leading cause of functional disability. Variety of studies have been undertaken which mainly focuses on unilateral limb training. Bilateral training was necessary adjunct to unilateral training. So, there is need to train and assess the supportive role function.

Aim: To find out influence of Bilateral upper limb training on motor function in Hemiparetic individuals.

Method: 30 Patients with chronic stroke were randomly assigned for structured protocol for 4 weeks of training. Task were performed in 3 phases i) simultaneous activity ii) alternate activity of both upper limb iii) Home exercise programme including ADL's. The functional stage of each patient was measured by Brunnstrom Fugl-Meyer test assessment of motor function of upper extremity and motor activity log score.

Results: The Fugl-Meyer upper extremity motor function post-intervention score was significantly improving than pre-intervention score. ($P < 0.001$, $t = 8.809$). Motor activity log quality of movement and amount of use post-intervention scores for daily bilateral activities improved than pre-intervention score. ($P < 0.001$, $t = 10.383$, $t = 7.900$).

Conclusion: Bilateral upper limb training improved motor function in Hemiparetic individuals as well as it is effective in improving bilateral activities of daily living.

Keywords: stroke, bilateral upper limb training, Fugl-Meyer upper extremity score, Motor activity log.

INTRODUCTION

Chronic upper extremity Hemiparesis is leading cause of functional disability after Stroke.

Approximately 2/3 of stroke survivors have residual neurological deficits that persistently impairs functions.^(7,8) Specific dysfunctions due to upper extremity hemiparesis impairs performances of activities of daily living, which involves frequent use of upper limbs. For e.g. the activities which has completed within the first hour after waking up in morning such as putting paste on toothbrush, bathing, combing hair, buttoning clothes and using spoon as to stir coffee in cup or to eat breakfast as well as feeding, grooming, writing, self-care etc. which reduces functional independence, as many activities in daily life involves use of both upper limbs.

Variety of studies have been undertaken to improve motor function of upper extremity like MRP, CIMT, which mainly focuses on unilateral limb training. This study improves unilateral paretic limb function by giving bilateral upper limb training as the bilateral upper limb training was necessary adjunct to unilateral training because bilateral retraining was important and best served through bilateral training and not that of unilateral training and it also helps to regain unilateral skill.

In fact, only 5% adults regain full arm functional independence after stroke and 20% regain no functional use after

stroke⁽⁹⁾. Thus, present study intended that some alternative strategy was needed to reduce long-term disability and functional impairment due to upper extremity hemiparesis. Hence, it decided to work on Bilateral upper limb training to find out influence of it on motor function in Hemiparetic patient on improving motor function and functional ability of the paretic limbs along with non-paretic limb. In this therapy both the involved and non-involved upper limbs are forced to do repetitive movements in completing task in either symmetrical or alternating motions. Individual with stroke shows immediate coupling efforts when the upper limbs are moved together reinforcing benefits of bilateral practice for bilateral function. This learned non-use will exploited to produce possible training benefits to paretic limbs reaching abilities during bimanual reaching. Thus, Hemiparetic individual need to retrain bilateral skills and that is best achieved through bilateral training.

METHODS

- **Study type:** This study is experimental study
- **Study design:** Pre and Post-test treatment
- **Sample size:** Subjects(n=30) irrespective of age, sex, side affected, and artery involved as per inclusion and exclusion criteria
- **Sampling method:** Convenience sampling
- **Place of study:** OPD of Physiotherapy Krishna Institute of Medical sciences Deemed to be University, Karad.

MATERIAL USED:

- Peg board
- Ball and rings
- Notebooks
- Glass
- Skates
- Ruler and pen

INCLUSION CRITERIA:

- Both genders included.

- All the stroke patients irrespective of age, side affected, and artery involved
- Patients are according to Brunnstrom's stage 4 and above
- Patients having static balance and voluntary control
- Patients who can be able to follow simple commands.

EXCLUSION CRITERIA:

- Un-cooperative patients.
- Patients with higher cortical function deficit
- Patients having severe spasticity or contracture in elbow, wrist or in fingers.

OUTCOME MEASURES:

Brunnstrom- Fugl Meyer Test-assessment of motor function of upper extremity⁽¹⁾

Motor Activity Log score⁽³⁾

PROCEDURE

Post stroke patients under inclusion criteria were selected who were come in Krishna hospital Physiotherapy OPD.

- Detailed explanation of the study procedure had given to the patients in the language they understood and signed consent obtained from each of them.
- A general Neurological assessment of the patient was performed to obtain the thorough information about his or her present status.
- The motor function was assessed with use of Brunnstrom's Fugl Meyer upper extremity motor performance test of impairment and ADL assessed with Motor activity log questionnaire and score measured.
- After thorough assessment treatment was given as of structured treatment protocol, which include affected and non-affected arm, exercises simultaneously (symmetrical and asymmetrical activities of arm).

Subjects were given treatment as in 3 phases including simple to complex activity using different tools, as well as task-oriented activities of daily living.

Phase 1: subjects were asked to perform movement by using both hands simultaneously in different weight bearing positions

Phase 2: subjects were asked to perform movement or task by using both hands but in alternate manner

Phase 3: subjects were given home protocol of complex day to day activities of daily living. Exercises given in all phases were bilateral PNF patterns, different activities using material like ball /peg board/ rings/ notebook/water glass etc. Given in different weight bearing positions. (11,12,13,1,2)

The therapist first assists the patient in learning the desired task. More specifically, critical task elements and successful goals and outcomes were identified. The desired task was demonstrated to patient, the patient then asked to begin practice. In each phase numbers of interrelated activities were there, practice of component parts may precede practice of whole task. Simple verbal commands were given for correction and guidance of different activities, simultaneous practices of similar movements on both the sides (Bimanual practice) have been shown to improve learning and promote integration of the two sides of the body.

As initial practice progresses, the patient were asked to self-examine his own performance and identify problems and thus he actively involved in developing problem-solving skills.

For improving performance and more importantly for better retention and adaptability patient were progress to slightly complex phase 2 in which patients were asked to perform alternate activity of both upper limbs (anti phase) reciprocal pattern of bilateral PNF, different reaching and lifting activities etc

Finally, in last phase for patients with more advanced recovery training strategies that focus on repetitive and intense use of task in daily activity was given for meaningful improvement in function. The therapist should continually

communicate support and give encouragement to the patient.

Dosage:

Each activity should be performed at least 10-15 times repeatedly (treatment time 45 minutes) varies from patient to patient as per condition and demand of patients; Duration of study: - 4 weeks; Intensity - 6days/week.

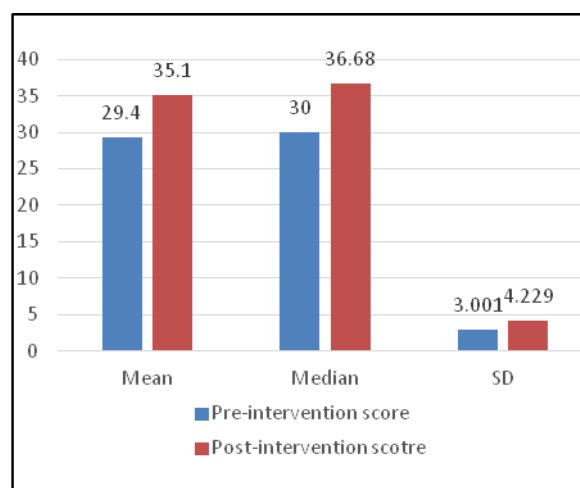
STATISTICAL ANALYSIS

The statistical analysis of the non-parametric data was done by using Wilcoxon matched –pairs signed rank ‘t’ test.

Wilcoxon matched - pairs signed rank ‘t’ test shows the correlation between pre-intervention and post-intervention score.

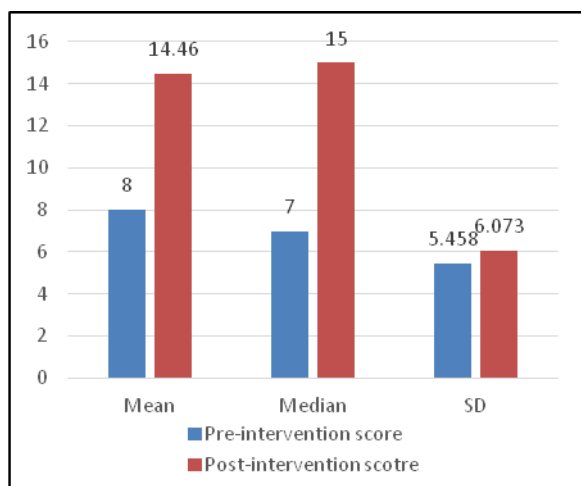
FUGL-MEYER UPPER EXTREMITY MOTOR FUNCTION TEST SCORE:

	FMUET Pre-intervention score	FMUET Post-intervention score
Mean	29.4	35.1
Median	30.00	36.68
SD	3.001	4.229



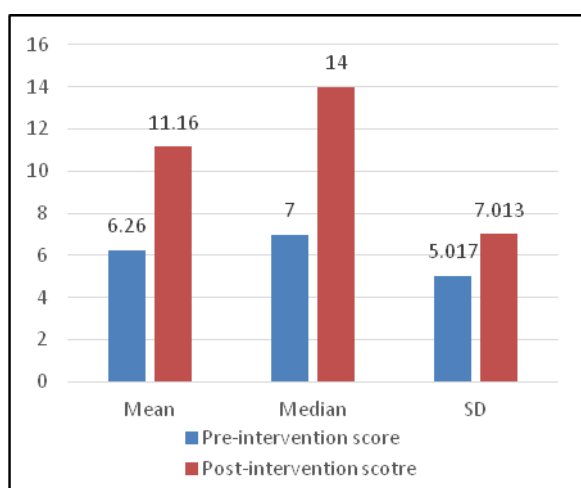
MOTOR ACTIVITY LOG-AMOUNT OF USE ADL SCORE:

	Motor activity log Pre-intervention score (AOU)	Motor activity log Post-intervention score (AOU)
Mean	8	14.46
Median	7	15
SD	5.458	6.073



MOTOR ACTIVITY LOG-QUALITY OF MOVEMENT SCORE:

	Motor activity log score Pre-intervention score (QOM)	Motor activity log Post-intervention score(QOM)
Mean	6.26	11.16
Median	7	14
SD	5.017	7.013



DISCUSSION

Stroke is the leading cause of death and long-term disabilities, so interventions on stroke rehabilitation mainly focuses on improving functions by decreasing the level of impairments and disabilities. The recovery of upper extremity uses in patients with Hemiparesis had been a long-standing struggle for therapists and patients alike. It was reported that upper limb Hemiparesis represents dominant function limitation in as much as 80% of patients with acute stroke. (14,15) Traditional therapeutic approach interventions were results in

continued impairment in 50-90% of patients, particularly after stroke. (9,16,17) Many studies were undertaken to improve motor function of upper extremity like; MRP, CIMT, which mainly focused on unilateral limb training in hemiparetic patients. Very few studies were undertaken to improve bilateral functions of upper limb. Again, for bilateral training most of studies were done by using either tailor made machine or robotic devices which was bit costly to conduct the study, in present study tailor made exercise protocol was given intended as plus point to patient as well for performing relatable, repetitive, and intense practice at home.

Performing same activity may be boring for them so in present study different activities in different phases were helpful to active participation of patient and it was also boosting their confidence as well.

There was Neurophysiological basis for bilateral training found in Neurophysiology Literature, (4,5,6) which suggests that it improves unilateral paretic limb motor function. One mechanism was transcallosal pathway, which shows that during unilateral activity there was interhemispheric inhibition. When bilateral training was given, it was seen that there was increased facilitation of both the hemisphere. Thus, bilateral training resulted in reduced ICI (Intracranial inhibition) and increased ICF (Intracranial facilitation) in both hemispheres, while unilateral training produced increased ICF and reduced ICI only in contralateral hemisphere. Thus, the present study aimed to investigate influence of bilateral upper limb training on improving motor function in Hemiparetic individuals.

It was concluded with 30 samples including 16 males and 14 females with mean age group 56.76 years. Patients included in this study were according to Brunnstrom's stage 4 and above. Patients treated according to exercise protocol and in given dosage for 24 days. Preintervention and Post-intervention score measured with Brunnstrom's Fugl Meyer Upper extremity

motor Function Test. Paired 't' test was used to evaluate the improvement in outcome measure. The Brunnstrom's Fugl Meyer Upper extremity Motor Function Test scores of the total 30 samples improved with mean of 35.1 with SD 4.229. Thus, post therapy results indicated statistically significant influence of training on motor function improvement.

Out of 30 patients, 16 were male with mean age of 57.68 years with SD 6.426 and 14 were female patients having mean age 55.71 years with SD 6.855. Total number of 30 patients, 17 were right side affected, and 13 were left side affected. Out of 16 male 10 were right side affected and 6 were left side affected. In 14 included female 7 were right side affected and 7 were left side affected. As the training approach was bilateral, that is simultaneous or alternate activity of both the extremities there was no impact of dominance or side affected of the Hemiparetic patients. For example, when bimanual movements were initiated simultaneously, the arms act as a unit that supersedes individual arm action (18,19) indicating that both arms were strongly linked as a coordinated unit in the brain. Thus, both the right and left side affected patients show positive results over motor function.

Thus, bilateral training has influence on improving motor function of Hemiparetic patients due to two main reasons, which signalled that bilateral training was a good idea to incorporate in stroke rehabilitation. First, individual with stroke needs to retrain bilateral skills and was best achieved through bilateral training. Secondly, practicing bilateral activities may also have positive effect on unilateral skills based on Neurophysiological mechanism.

CONCLUSION

Based on statistical analysis and interpretation it concludes that there is significant influence of bilateral upper limb training for improving motor function and ADL in Hemiparetic individuals. Further in future the study can continue individual

component of upper limb as well as lower limb instead of whole limb training by using tailor made machine.

- **Conflict of Interest:** None
- **Ethical Clearance:** Taken from Institutional ethical committee
- **Source of funding:** Krishna Institute of Medical Sciences Deemed University, Karad, Maharashtra, India.

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