

To Compare the Effectiveness of Bilateral Arm Training versus Unilateral Arm Training on Upper Limb Functions in Acute Stroke Patients

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ABSTRACT

The aim of the study was to find out the effectiveness of bilateral arm training over unilateral arm training on upper extremity functions among acute stroke patients. A total of 27 stroke patients participated in the study. Group A: 14 subjects received bilateral arm training of task related exercises, Group B: 13 subjects received unilateral arm training of task related exercises. Fugl Meyer assessment- upper limb component (FMA-UE) and Chedoke arm and hand activity inventory(CAHAI-13) was measured. The statistical analysis of all participants in group A and group B showed significant improvement in FMA-UE and CAHAI-13 scores. In FMA-UE the measure of mean difference of pre-test and post-test for both Group A and B were 15.14 and 11.30 respectively. The calculated 't' value using the paired test for group A and B were 11.96 and 6.11;(P<0.05). When comparing between the groups using independent 't' test, the FMA-UE scores showed mean difference of 3.78 and 't' value of 2.51 (P<0.05). In CAHAI-13 scores group A and B showed significant improvement with a mean difference of 10.57 and 7.61 respectively. The calculated 't' value using the paired test for group A and B were 13.27 and 8.12;(P<0.05). When comparing between the groups using independent 't' test, the CAHAI-13 scores showed mean difference of 3.03 and 't' value of 2.47(P<0.05). This study shows that the bilateral arm training of task related exercises is more effective in improving the upper limb functions than the unilateral arm training of task related exercises in acute stroke patients.

Keywords: Bilateral arm training, Unilateral arm training, Upper limb function, FuglMeyer Assessment, Chedoke Arm and Hand Activity Inventory, Stroke

INTRODUCTION

Stroke are currently the leading and long term cause of motor disabilities; The world health organization(WHO) define stroke as: "rapidly developing clinical signs of focal (at times global) disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than of vascular origin" (1)

Arm recovery after stroke is typically poor with 20% to 80% of patients showing incomplete recovery depending on initial impairment. (2) Various therapeutic interventions for improvement of the upper

limb focuses on the unilateral upper limb function. It is difficult for stroke patients to perform ADL requiring bilateral upper extremity use. So, have to improve the bilateral upper extremity function. It is difficult for stroke patients to perform ADL requiring bilateral upper extremity use. So, have to improve the bilateral upper extremity function. (3) Bilateral arm training incorporates task-oriented and motor relearning strategies including intense practice, intrinsic feedback, bimanual coordination, and goal-focused movements that improve upper extremity function.

A basic assumption of bilateral arm training is that symmetrical bilateral movements activate similar neural networks in both hemispheres when homologous muscles are simultaneously activated. Although the upper extremity is moved unilaterally, inhibition of the ipsilateral hemisphere and inter hemispheric inhibition occur to prevent mirror movement of the opposite upper extremity. When both upper extremities are moved for symmetrical task performance, intra-cortical inhibition is reduced and both hemispheres are activated. (4)

Treatment approaches which can facilitate this reorganization process by enhancing the cortical plasticity might have a very important role on improving the functional outcome following neuronal injury. In this aspect the role of bilateral arm training is well documented with published data but there are certain issues which still has to be clarified such as type of the bilateral arm training, selection of patients whether acute or chronic ,duration of treatment, nature of functional activities etc.

Thus it can be stated that studies are supporting bilateral arm training and some studies are challenging the concept of bilateral arm training .thus it can be generalized that the bilateral arm training can be grouped into 5 types. 1) repetitive reaching with hand fixed 2) isolated muscle repetitive task practice 3) whole arm functional task training 4) mirror therapy using bilateral training 5) involving device driven bilateral training (5)

Based on the above strategies, the researcher has taken the combination of whole arm functional task training and device driven bilateral training types. The usage of techniques that involve more functional activities can have a better outcome compared to the other strategies

Also it can be seen that the duration of the stroke is a very important variable which can have its effect in the outcome of bilateral arm training treatment sections. Studies in which bilateral arm training have been given to acute patients with post stroke

is comparatively very less in nature with respect to sub-acute and chronic patients with post stroke. (6)

Taking this aspect into consideration the researcher has formulated the study frame in acute case of patients with post stroke.

Thus the need of the study is justified by taking acute patients and conducting an experimental study using bilateral arm training. Hence the researcher is trying to find out the effect of bilateral arm training in improving the upper extremity function among the individuals with acute stroke.

METHODOLOGY

Participants: A total of 27 acute stroke patients participated in the study and divided into two groups, Group A and Group B, Convenience sampling used, Participants were recruited from the Stroke Rehabilitation Centre, Department of Physical medicine and Rehabilitation and Department of Neurology in PSG IMS&R Hospitals, Coimbatore. Stroke Patients were included if they met the following criteria: (1) Hemiparetic patients with 40-65 years of age. (2) MCA ischemic infarct with less than 4 weeks of onset. (3) Fugl Meyer assessment upper extremity score between of 19 – 40. (4) Ability to participate in 45 minutes physiotherapy session. (5) Mini mental state examination score > 24. (6) Modified Ashworth scale score \leq 2 in all upper limb muscles. (7) Medically stable patients and Participants were excluded if they have (1) Perceptual disorder, (2) Recurrent stroke, (3) Symptomatic cardiac failure, (4) Shoulder dislocation, (5) Uncorrectable vision problems, (6) Patients with other neurological disorder/musculoskeletal problems (7) Patients who are not able to follow the commands. The study was approved by the Institutional Human Ethics Committee, PSG Institute of Medical Sciences and Research. All the participants signed written informed consent prior to participation. Treatments received by participants are Group A: 14

subjects received bilateral arm training of task related exercises and Group B: 13 subjects received unilateral arm training of task related exercises.

Outcome measures: This is a Pre-test and Post-test, comparative study design. We measured participants' motor function with Fugl Meyer assessment- upper extremity component (FMA-UE) and functional outcome with Chedoke arm and hand activity inventory (CAHAI-13)

Intervention:

Bilateral Arm Training Activities: Wipe a table with arms using symmetrically, bilateral reaching and placing objects. Moving 2 identical small or medium-sized grocery objects from table to shelf with both hands, Bilateral elbow extension during horizontal reach, Grasp an empty glass take to mouth and return to starting position with both hands, Cups stacking using both hands and Bilateral in-phase cycling for 10 minutes.

Unilateral arm training: Wipe a table with a towel using the affected arm, reaching and placing objects. Moving small and medium-sized grocery items from table to shelf using only affected arm, Elbow extension during horizontal reach, Grasp an empty glass, take to mouth and return to starting position with affected hand, Cup stacking using one hand and One arm cycling for 10 minutes. Intensity & progression (Group A& Group B): Each activity has 15 repetition first week, 30 repetition second week with 2 sets, 45 repetition third week with 3 sets. 2- 5 minute rest period between each task

Statistical analysis: Data collected from subjects were analyzed using paired't' test to measure changes between pretest and posttest values of outcome measures within the group. Independent 't' test was used to measure changes between the groups.

RESULTS

This study is important because a total of 27 MCA stroke patients separated into two groups were age group of 45 -65 years participated in the study. The upper extremity functions were assessed in acute stroke patients using Chedoke arm and hand activity inventory (CAHAI-13) and Fugl-Meyer assessment- upper extremity component (FMA-UE). One group received bilateral arm training and other group received unilateral arm training for 3weeks.

All patients in group A and B showed significant improvement in Fugl-Meyer assessment- upper extremity component (FMA-UE) and Chedoke arm and hand activity inventory (CAHAI-13). In FMA-UE the measure of mean difference of pre-test and post-test for both Group A and B were 15.14 and 11.30 respectively. The calculated 't' value using the paired test for group A and B were 11.96 and 6.11;(P<0.05). When comparing between the groups using independent 't' test, the FMA-UE scores showed mean difference of 3.78 and 't' value of 2.51 (P<0.05). In CAHAI-13 scores group A and B showed significant improvement with a mean difference of 10.57 and 7.61 respectively. The calculated 't' value using the paired test for group A and B were 13.27 and 8.12;(P<0.05). When comparing between the groups using independent 't' test, the CAHAI-13 scores showed mean difference of 3.03 and 't' value of 2.47(P<0.05).

TABLE 1: General characteristics of stroke participants

	Experimental group (n=14) n (%)	Control group (n=13) n(%)
Gender	Male 13(92.8%) Female 1(7.1%)	Male 7(53.8%) Female 6(46.1%)
Age (years)	51.92±8.25	54.07±7.55
Post Stroke Day	9.42±5.34	8.46±2.53
Side	Right – 8(57.1%) Left – 6(42.8%)	Right – 8(61.5%) Left – 5(38.4%)
MMSE	27.71±0.91;24	27.15± 1.67;24.
FMA-UE	30.57±5.89	31.61±4.71
CAHAI-13	28.78±8.55	36.92±9.46

Data given as mean ±standard deviation; median

TABLE2: Mean, Mean difference, Standard Deviation and Paired 't' test values of Fuglmeier assessment of Groups A&B.

Groups (FMA-UE)	Mean	Mean Difference	Standard Deviation	't' Value	'p' Value
Group A					
Pre-test	30.57	15.14	4.74	11.96	P<0.05
Post-test	45.71				
Group B					
Pre-test	31.62	11.30	6.66	6.11	P<0.05
Post-test	42.92				

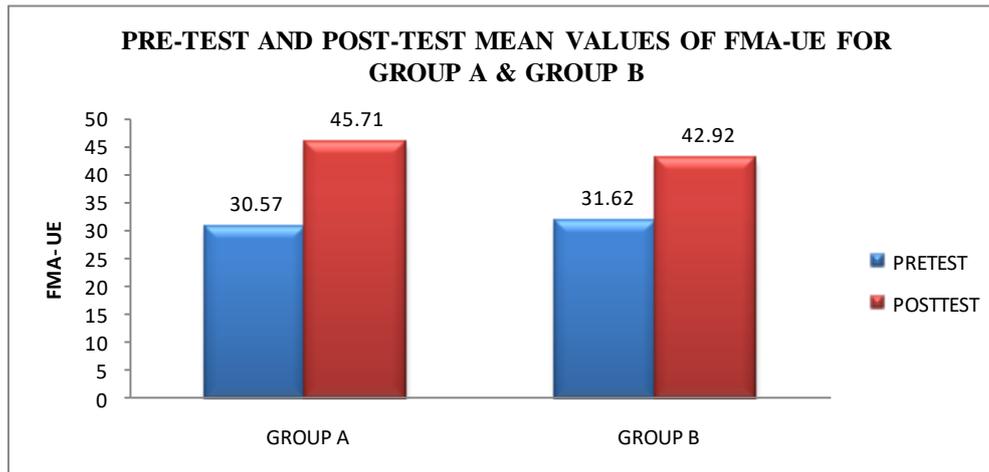


Figure1: Mean values of Pre-test and Post-test values of FMA-UE between Group A and Group B

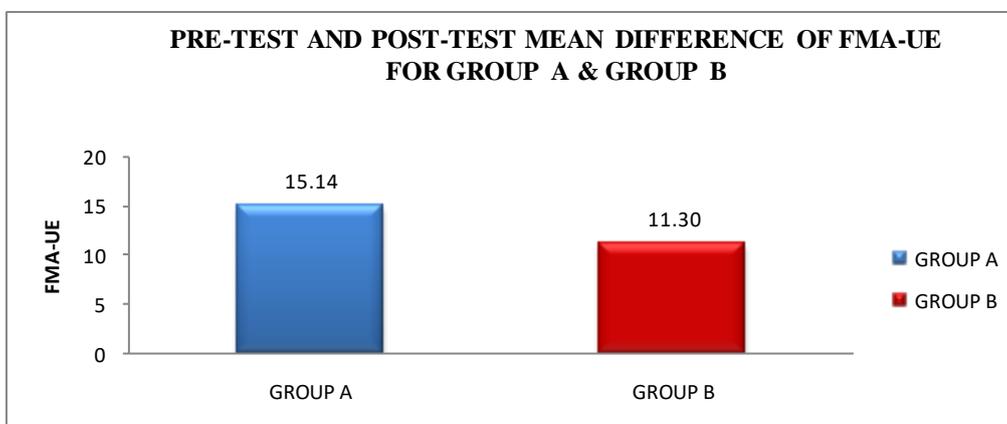


Figure2: Mean difference of Pre-test and Post-test values of FMA-UE between Group A and Group B

TABLE 3: Mean, Mean difference, Standard Deviation and Paired ‘t’ test values of Chedoke arm and hand activity inventory (CAHAI-13) of groups A&B.

Groups (CAHAI-13)	Mean	Mean Difference	Standard Deviation	‘t’ Value	‘p’ Value
Group A					
Pre-test	28.79	10.57	2.98	13.27	P<0.05
Post-test	39.36				
Group B					
Pre-test	36.92	7.61	3.38	8.12	P<0.05
Post-test	44.54				

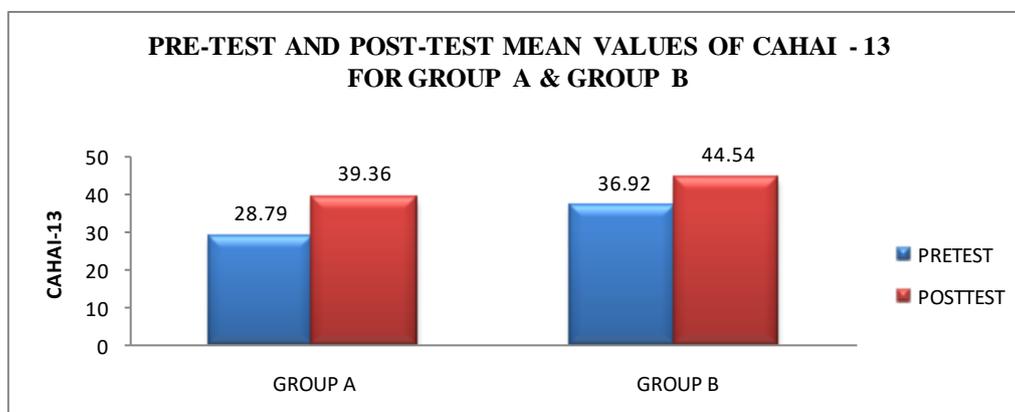


FIGURE 3: Mean Values of Pre-test and Post-test values of CAHAI-13 between Group A and Group B

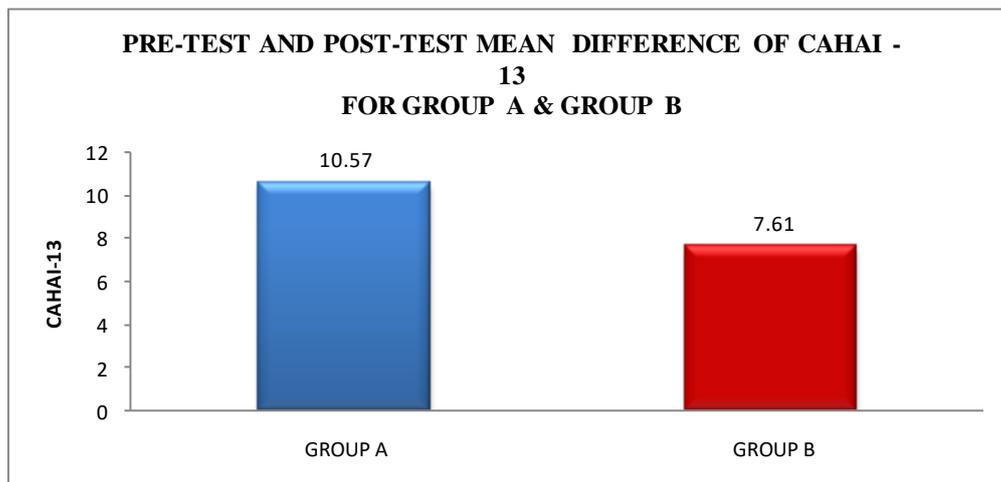


FIGURE 4: Mean Difference of Pre-test and Post-test values of CAHAI-13 between Group A and Group B

TABLE 4: INDEPENDENT 't' TEST VALUES

Outcome Measures	Mean Difference	Standard Deviation	't' value	'p' value
Fugl- Meyer assessment upper extremity(FMA-UE)	3.780	3.882	2.515	P<0.05
Chedoke arm and hand activity inventory(CAHAI-13)	3.033	3.181	2.477	P<0.05

The Independent 't' test was performed between Group A and Group B to analyze the significance of bilateral arm training and unilateral arm training Exercises on improving upper limb functions among hemiparetic acute-stroke patients.

The Fugl-Meyer assessment- upper extremity (FMA-UE), between the group were calculated using independent 't' test ,the obtained 't' value is 2.515 which was greater than that of table value of 2.060 at P<0.05.The Chedoke arm & hand activity inventory (CAHAI-13)between the groups were calculated the 't' value was 2.477 which was greater than the table value of 2.060 at P<0.05. Therefore the results of these statistical analysis showed that the Bilateral arm training technique is effective than the unilateral arm training exercises on improving upper limb functions among hemiparetic acute-stroke patients.

DISCUSSION

In this study, Both groups showing improvement in both outcome measures, even though the age of patient, pre morbid condition, initial level of impairment may contribute to this.

Nature of treatment strategies which applied by researcher is task related functional

training that is important aspect to consider and showing improvement in both groups but the bilateral training group have better improvement than unilateral training group.

Benefit of bilateral arm training are explain by following reasons, Stroke appears to alter normal transcallosal inhibition, resulting in increased intact hemisphere excitability during hemiparetic arm movement that may be inhibitory in nature, thus suppressing output from the damaged hemisphere. Depending on the lesion site and size, this overactivation appears transient, and more normal contralateral activation patterns resume over time. Identical motor commands generated in each hemisphere during bilateral movement may modulate transcallosal inhibition, balancing stroke-related interhemispheric overactivity and facilitating output from the damaged hemisphere as well as from normally inhibited ipsilateral pathways of the undamaged hemisphere to augment movement of the paretic arm

Whatever the physiology behind this, the bilateral arm training is effective in acute stage, when it was combined in manner of task related functional activity, which get maximum benefit while comparing to movement alone, here researcher frame

intervention like swipe with help of clothes, taking grocery objects and keep over height, arranging the cups, so the real functional objects and task performing are enhance the efficient, smooth and coordinated movement in persons with impaired arm after post stroke. (7)

Some studies with bilateral arm training showed improvement in proximal part of the upper limb than the distal part. The reason behind this was explained in terms of activities given to the patient which concentrate on the function of proximal areas of upper limb than distal part. But in this study it is noticed that both proximal and distal part of the affected limb showed an almost similar improvement needed for ADL activities.

In this study, only the functional aspect of upper extremity exercises was evaluated, and the performance of the exercises was not evaluated kinematically. In future studies, the functional aspect of upper extremity exercises and the kinematic and qualitative aspects of the exercises as well as the recovery in terms of neurophysiology should be evaluated.

Here Chedoke arm and hand activity inventory (CAHAI-13) used to evaluate the upper limb functions, this scale sub tasks involves all activities doing in bilateral hand use, and examining together as function. (8) Suggesting that want to evaluate bilateral function separately using other tools like Wolf motor function test, Jebson-taylor hand function test.

So, the result of the present study suggest that upper limb functional recovery in acute stroke patients can be improved significantly by bilateral arm training exercises. Limitations of this study are Experiment was done during spontaneous recovery period that might influence the results and Convenience sampling was used. Suggestions for future research are Follow up has to be done to identify the effect of therapy on long term. Then, Future study should consider large sample and randomized control trail and Motor threshold using mapping studies should be

performed to determine the response of bilateral arm training.

CONCLUSION

This study reveals that the bilateral arm training technique is more effective in improving the upper limb functions than the unilateral arm training in acute stroke patients. Treatment also adherent to ADL activities. Hence bilateral arm training can supplement to regular rehabilitation programme to improve upper limb function. This study concludes that “There was statistically significant improvement in upper limb functions following bilateral arm training than the unilateral arm training in acute stroke patients”.

Abbreviations

BAT	-	Bilateral arm training
MMSE	-	Mini Mental Status Examination
UAT	-	Unilateral arm training
FMA	-	Fugl Meyer Assessment
CAHAI	-	Chedoke Arm and Hand Activity Inventory
MCA	-	Middle Cerebral Artery
ROM	-	Range Of Motion

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