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Effectiveness of Bilateral Arm Training on Upper Extremity Function in Sub-Acute Stroke Patients: Pilot Study

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Abstract: ***Objective: To see the effect of bilateral arm training on the upper limb function. Subject and Method: 30 subjects diagnosed with sub-acute stroke were assigned to study. Intervention in form of Conventional & Bilateral arm training were given for 5 Days per week for four weeks. Upper extremity function test was evaluated by Fugl Meyer Assessment, Motor activity log scale and action research arm test pre-& post treatment. Relationship and responsiveness of all clinical test were performed by Wilcoxon signed ranks test and Mann-Whitney test respectively. Result: All correlations were significant at 95% C.I. at baseline as well as four-week time. There is increasing bilateral arm training function on upper limb while comparing to conventional therapy in four-week protocol. Conclusion: On the basis of present study, it can be concluded that Bilateral arm training can be beneficial in improving upper limb function in sub-acute stroke patient when it compares to the Conventional therapy by using the Fugl Meyer assessment scale, Motor activity log scale and action research arm test***

Keywords: Stroke, Bilateral arm training, Conventional therapy, Upper limb function

1. Introduction

The functional impairment of the upper limb is commonly seen in to the stroke and that affects about 85% of stroke survivors [(1)]. Stroke is a common, serious and disabling health-care problem in all the world [(2)] and stroke also a major cause of disability in adults so one direct common affection of stroke is the defeat of upper limb function. Whereas in stroke up to 83% of stroke survivors learn to walk again but It is estimated that only 5-20% of stroke survivors attain complete functional recovery of their affected upper limb and Approximately 70-80% of people who sustain a stroke have upper extremity impairments. Many of them do not recover in to the upper limb function, which can lead to difficulty in activity of daily living and to participate in community life [(3)].so that for rehabilitation of the stroke neuroplasticity is the basic appliance for improvements in functional outcome therefore one significant goal of rehabilitation of stroke patients is the effective use of neuroplasticity for functional recovery [(2)].

In stroke the most relevant body function affected that consciousness orientation and intellectual, temperature and personality, energy and drive, sleep, attention and memory, psychomotor and perceptual, cognitive and seeing, proprioception and touch, voice and articulation, ingestion, defecation, urinary and sexual problem, mobility and stability of joints, muscle power, tone and reflexes, muscle endurance, control of voluntary movement and gait pattern function and the most relevant activity affected communication, reading, writing, solving problem, undertake single or multiple task, transferring oneself, maintaining body position, walking, mobility, toileting, dressing, self-care, eating, drinking, preparation of meal, use of transportation, recreation and doing housework[(4)].

In to the counties there has been more than 100 per cent increase in incidence of stroke % ([(5)] and 87% of these deaths [(6)] occurred in low-income and middle-income countries including India from 1970-1979 to 2000-2008[(5)] and 35 million deaths attributable to chronic no communicable diseases that occurred worldwide in 2005 and stroke was responsible for 5.7 million deaths [(6)].

Bilateral arm training is a promising treatment approach [(7)] and also it is a potential therapeutic approach for the stroke rehabilitation [(8)] and that improves in the upper limb function after stroke. In this treatment method usually includes the repetitive practice of bilateral, symmetrical movement of whole-arm functional training, which frequently is supervised and mediated by therapist or robot. In to the therapist bilateral arm training studies showed that there is reducing upper limb impairments, enhancing motor function and increasing movement smoothness and force generation during reaching and this requires extensive therapist guidance for treatment delivery [(7)]. In this method recoveries of motor function after such training programs has been perceived and explain through some neural mechanisms including neural facilitation of ipsilateral tracts, cortical disinhibition, two level neural crosstalk and other central regulation of brain function [(8)] and there is also one study that suggest Simultaneous bilateral training involves the execution of identical activities with both arms simultaneously but independently and the beneficial effects of this bilateral training are assumed to arise from an interlimb coupling effect, in that movement of the non-paretic arm facilitates movements in the impaired limb. Cauraugh 2008 and stinear 2008 further propose that bilateral practice of synchronous movements with the paretic and non-paretic limbs permits activation of the intact

hemisphere to facilitate activation of the damaged hemisphere through enhanced interhemispheric inhibition [9].

The Fugl Meyer assessment scale is a well-designed, comprehensive and efficient clinical investigation technique and it is widely used by therapist for estimate of the stroke-related motor impairment and the FMA was developed to measure sensorimotor stroke recovery based on Twitchell and Brunnstrom's concept of sequential stages of motor return in patient with stroke impairment thus FMA motor score included 33 items associated to movements of the proximal and distal part of the upper extremity and the total score range from 0 to 66 (10). The motor activity log measures the spontaneous use of the most affected upper limb with the amount of use and quality of movement scales during activities in real environments in individuals with chronic stroke impairments (11). The action research arm test is a very reliable, valid measure of arm motor status after stroke impairments and this test has established value for characterizing clinical state and for measuring spontaneous and therapy-included recovery. The action research arm test when performed in a standardized manner is a useful tool for assessment of arm motor deficits after stroke and this test evaluate 19 tests of arm motor function both distally and proximally and the maximum score is 57(12).

2. Aim of Study

To assess the effectiveness of Bilateral Arm Training to improve upper limb function.

3. Objective

To see the effect of bilateral arm training on the upper limb function.

4. Material and Method

The participant were selected using inclusion criteria:

1) Ability to extend at least 10° at the metacarpophalangeal and interphalangeal joint and 20° at the wrist.
2) CVA between 4 weeks and 6 Month prior to study enrollment.
3) A score of 70 or higher on the Modified Mini mental status examination.
4) Age between 23-81 years.
5) No excessive spasticity as defined by the score of 2 or higher on the Modified ashworth spasticity scale.
6) No excessive pain in the more affected upper limb as measured by the score of 4 or higher on the 10-point visual analog scale.

Exclusion criteria:

1) Uncontrolled hypertension (190/110 mm/g).
2) Significant orthopedic & pain condition.3) Excessive spasticity defined as a score of 3 or more on MAS.

5. Instruments

Instruments were applied due to their use in bilateral arm training work and responsiveness to motor change following force use. They were 1) the 66 points upper extremity section of the Fugl Meyer assessment motor recovery after stroke (fugl-meyer), which assesse impairment using a 3-point ordinal scale (anchored by 0=cannot per-form; 2= can perform fully). The Fugl-Meyer offers impressive test-retest reliability (total = 0.98–0.99; subtests = 0.87–1.00),28 interrater reliability, and construct validity.29 2) The Action Research Arm Test (ARA),30 a 19-item, 57-point test divided into 4 categories (grasp, grip, pinch, and gross movement), has each item graded on a 4- point ordinal scale (anchored by 0 = can perform no part of the test;3= performs test normally). The ARA has high intrarater (r = 0.99) and retest (r = 0.98) reliability and validity.30,31 3) The Motor Activity Log (MAL), a semi structured interview measuring how patients use their affected limbs for ADLs. Patients and caregivers individually rate how much and how well the patient used the affected arm for 30 ADLs during the past week using a 6-point Amount of Use scale and a 6-point Quality of Movement scale. Because caregivers/family members were overburdened or no caregiver was available, the MAL was only administered to patients.

6. Testing and Intervention

A multiple baseline, randomized, control pre-post design was applied. After screening and signing consent form the Fugl Meyer assessment, action research arm test and motor activity log scale were administered and then patient were randomly assigned in to the experimental and control group. The protocol given to the patient for 5 days per week for 4-week periods.

Experimental group:

- Lifting two cups
- Picking up two pegs
- Reaching forward or upward to move blocks
- Grasping and releasing 2 towels

Control group:

In this group there is given a conventional activity to the patients. The conventional rehabilitation was provided passive stretching within submaximal ranges of motion to inhibit spasticity, active-assisted movements, weight bearing for upper limb, activity of daily living and exercise to improve strength.

7. Results

All the two groups in the study were compared both the pretest and posttest. Regularity of the subtests was tested for all the outcome measures used. The characteristics of the subjects are untaken in Table 1.

Table 1: Characteristics of the subjects

Sr. No.	Characteristics	Bilateral Arm	Conventional Theory
1	No. of Subject	15	15
2	Age (In Year) (Mean ± SD)	51.58±8.67	50.70±13.93
3	Sex(M/F)	8/7	11/4

The ARA test scores displayed significant improvement on posttest (p=0.01). Post hoc analysis discovered that the post test score was significantly higher than the pretest score in

BAT group. The graphical demonstration is given in Figure 1.

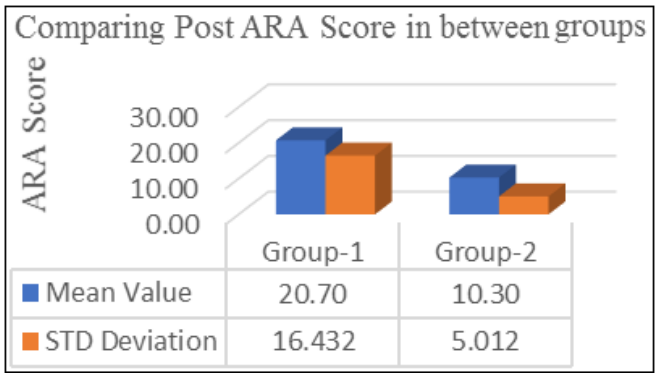

Figure 1: Comparing Post ARA Score in Between groups

The Fugl Meyer upper extremity motor performance section test scores exhibited significant improvements in Bilateral Arm Training group. Subjects in BAT group exhibited greater gains than the conventional therapy subjects. Post hoc analysis revealed that the post test score was higher than the pretest score. The graphical demonstration is given in Figure 2.

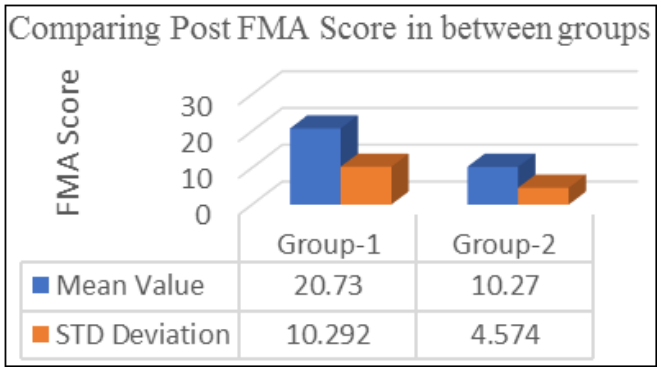

Figure 2: Comparing Post FMA Score in Between groups

The MAL test scores presented significant improvement on posttest. Post hoc analysis revealed that the post test score of Amount of use and Quality of movement are significantly higher than the pretest score in BAT group. The graphical demonstration is given in Figure 3 and Figure 4.

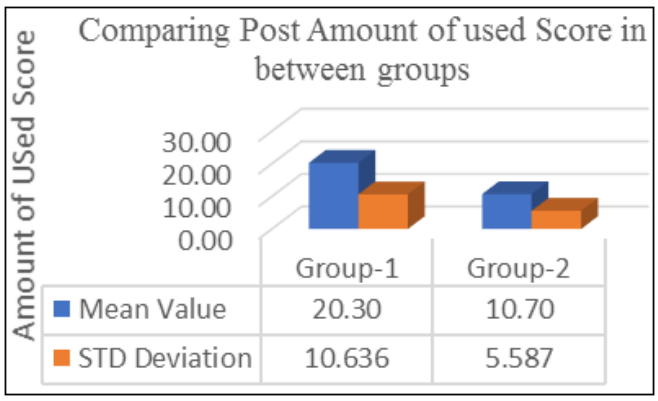

Figure 3: Comparing Post Amount of Used Score in Between groups

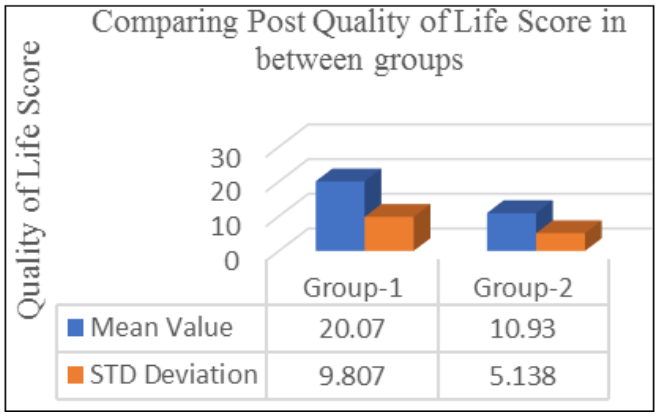

Figure 4: Comparing Post Quality of life Score in Between groups

BAT group showed greater improvements than conventional therapy group in the amount of use and quality of movements of the affected arm during performance of daily activities. The descriptive and inferential statistics are given in Table 2.

Table 2: Characteristics of the subjects

Descriptive AB		
Outcome measure	BAT Group	Conventional Group
ARA(m) S.D.	37.00 16.432	16.53 5.012
FMA(m) S.D.	22.93 10.292	12.73 4.574
AOU(m) S.D.	27.13 10.636	16.07 5.587
QOM(m) S.D.	24.80 9.807	14.60 5.138

8. Discussion

Here randomized control pilot study shows that implementation of bilateral arm training is useful in the sub-acute stage. Patient interviews throughout the protocol also revealed high satisfaction with bilateral arm training parameters. The result of the study provides experimental data addressing the changes that occurred in both motor and functional performance and quality of movement in patient with stroke following participation in 4-week bilateral arm training relative to conventional therapy. The Fugl Meyer assessment, motor activity log scale in quality of movement and amount of use and action research arm test which showed greater improvement in bilateral arm training group while compared to the conventional group.

In this study we establish, 4 week of BAT showed improvement in measures of motor impairment and functional use in patient with sub-acute upper extremity hemiparesis. This recommends that forced use in a repetitive manner, bilaterally can improve motor ability and functional use of upper extremity in sub-acute hemiparetic stroke patients. In our research the BAT group showed improved performance in FMA, MAL and ARAT while comparing with the control group. There was a significant difference in bilateral arm training and conventional therapy between group A and group B although the experimental group indicated better mean values and the standard deviation. There were Only few researchers that planned the effects of

the BAT without robot assistance on motor control, motor impairment and functional abilities. However, these previous studies involved very low intensity of training (e.g., 30 minutes per sessions). The present study used a more intensive BAT program (i.e., 1 hour per day) for comparison with a control intervention. The results are consistent in a part with the a priori hypotheses that patients with BAT would have better motor control, show less motor impairments and obtained a greater gain in functional abilities than the control group. The BAT group showed a greater efficiency of reaching in the temporal and spatial aspects during both the unilateral and bilateral tasks. The BAT group also showed better control strategy than the control group in bilateral task [(13)].

Only BAT produced significantly better motor improvement in the proximal UL than control intervention. Simultaneous activation of both hands may reduce intracortical inhibition and increase intracortical facilitation in both hemispheres and may therefore cause an additional facilitation in the affected hemisphere compared to activation of the affected hand alone. McCombe Waller and Whitall proposed that this speculated neural effect for the affected hemisphere may have positive aftereffects for unilateral paretic movement and improvement motor skills. In summary, BAT demonstrated greater improvements in motor capacity of UL than control intervention. In the other study, Richards et al employed robot-assisted BAT and Lewis and Byblow employed only 3 treatment activities for bilateral practice. Their treatment protocols were different from us that involved no robotic bilateral training with a variety of functional activities [(14)].

Other studies by Senesac et al. conducted study on whether bilateral arm training with rhythmic auditory cueing (BATRAC) helped the recovery of motor functions the affected upper extremity and whether the effects of the recovery of motor functions would be transmitted to the performance of new tasks. The subject underwent BATRAC for a total of 8 items in 2 weeks and the effect of the training were evaluated using similar task and new task. Although the maximum speed increase in both tasks, the training did not affect exercise time, speed up area or acceleration. With regards to such results, the researcher presented a stated opinion that if the repetitive bilateral training was composed of significant movement related to the patient's daily living activities, the training should have shown positive effect on the recovery of the patient's motor function.

Based on the results of this study, it can be seen that bilateral upper extremity training are more effective in improving upper extremity functions and daily living activities in stroke patients compared to the conventional therapy intervention.

9. Conclusion

On the basis of present study, it can be concluded that bilateral arm training can be beneficial in improving upper limb function in sub-acute stroke patients when it compared to the conventional therapy by using the Fugl Meyer assessment scale, Motor activity log scale and Action research arm test.

References

[1] Invernizzi M, Negrini S, Carda S, Lanzotti L, Cisari C, Baricich A. The value of adding mirror therapy for upper limb motor recovery of subacute stroke patients: a randomized controlled trial. Eur J Phys Rehabil Med. 2013 Jun 1;49(3):311-7.
[2] Chang WH, Kim YH. Robot-assisted therapy in stroke rehabilitation. Journal of stroke. 2013 Sep;15(3):174.
[3] Khandare SS, Singaravelan RM, Khatri SM. Comparison of task specific exercises and mirror therapy to improve upper limb function in subacute stroke patients. IOSR Journal of Dental and Medical Sciences. 2013 May;7(1):05-14.
[4] Langhorne P, Bernhardt J, Kwakkel G. Stroke rehabilitation. The Lancet. 2011 May 14; 377(9778):1693-702.
[5] Kamalakannan S, Gudlavalleti AS, Gudlavalleti VS, Goenka S, Kuper H. Incidence & prevalence of stroke in India: A systematic review. The Indian journal of medical research. 2017 Aug;146(2):175.
[6] Sridharan SE, Unnikrishnan JP, Sukumaran S, Sylaja PN, Nayak SD, Sarma PS, Radhakrishnan K. Incidence, types, risk factors, and outcome of stroke in a developing country: the Trivandrum Stroke Registry. Stroke. 2009 Apr 1;40(4):1212-8.
[7] Wu CY, Yang CL, Chuang LL, Lin KC, Chen HC, Chen MD, Huang WC. Effect of therapist-based versus robot-assisted bilateral arm training on motor control, functional performance, and quality of life after chronic stroke: a clinical trial.
[8] Wu FC, Lin YT, Kuo TS, Luh JJ, Lai JS. Clinical effects of combined bilateral arm training with functional electrical stimulation in patients with stroke. In2011 IEEE International Conference on Rehabilitation Robotics 2011 Jun 29 (pp. 1-7). IEEE.
[9] Coupar F, Pollock A, Van Wijck F, Morris J, Langhorne P. Simultaneous bilateral training for improving arm function after stroke. Cochrane Database of Systematic Reviews. 2010(4).
[10] Rabadi MH, Rabadi FM. Comparison of the action research arm test and the Fugl-Meyer assessment as measures of upper-extremity motor weakness after stroke. Archives of physical medicine and rehabilitation. 2006 Jul 1; 87(7):962-6.
[11] Pereira ND, Ovando AC, Michaelsen SM, Anjos SM, Lima RC, Nascimento LR, Teixeira-Salmela LF. Motor Activity Log-Brazil: reliability and relationships with motor impairments in individuals with chronic stroke. Arquivos de neuro-psiquiatria. 2012 Mar;70(3):196-201.
[12] Yozbatiran N, Der-Yeghiaian L, Cramer SC. A standardized approach to performing the action research arm test. Neurorehabilitation and neural repair. 2008 Jan; 22(1):78-90.
[13] Lin KC, Chen YA, Chen CL, Wu CY, Chang YF. The effects of bilateral arm training on motor control and functional performance in chronic stroke: a randomized controlled study. Neurorehabilitation and neural repair. 2010 Jan;24(1):42-51.
[14] Lin KC, Chang YF, Wu CY, Chen YA. Effects of constraint-induced therapy versus bilateral arm training on motor performance, daily functions, and quality of

life in stroke survivors. Neurorehabilitation and neural repair. 2009 Jun; 23(5):441-8.

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