DOI: https://doi.org/10.53350/pjmhs2022161149

ORIGINAL ARTICLE

Effects of Hand-Arm Bimanual Intensive Training on Fine Motor Skills in Patients of Chronic Stroke

AISHA MUNAWAR', PAKEEZA SEEMAL[2], HAMNA AFZAL[3], AMNA YASEEN[4], TOOBA ASHRAF[5], AYESHA AMJAD[6]
[1]*Senior Lecturer, Department of Allied Health Sciences, Superior University, Sargodha Pakistan.*
[2]*Senior Lecturer, College of Physiotherapy, Niazi Medical and Dental College, Sargodha Pakistan.*
[3]*Lecturer, Department of Physical therapy, University of South Asia, Lahore Pakistan.*
[4]*Lecturer, Riphah College of Rehabilitation and Allied Health Sciences, Riphah International University, Islamabad Pakistan.*
[5,6]*Lecturer, Department of Physical therapy, Sargodha Institute of Health Sciences, Sargodha Pakistan.*
[7]*Lecturer, Department of Physical therapy, Sargodha Institute of Health Sciences, Sargodha Pakistan.*
Correspondence to Dr. Pakeeza Seemal, Email: pakeezaseemal212@gmail.com, Phone number: 03137722275

ABSTRACT

Aim: To determine the effects of Hand-arm Bimanual Intensive Training on fine motor skills of chronic stroke patients.
Methods: A randomized control trail was conducted at District Head Quarter Hospital Sargodha. Twenty-eight stroke patients were randomized into 2 groups. All patients were examined by using Questionnaire of Disabilities of Arm, Shoulder, and Hand (DASH), Action Research Arm Test (ARAT) and Wolf Motor Function Test (WMFT). Control group was treated with Conventional Physical Therapy and experimental group with Hand Arm Bimanual Intensive Training. There were 3 sessions every week for a total of 12 sessions over the course of 4 weeks. At the beginning of the intervention, two weeks later, and four weeks later, all outcomes were evaluated. Data analysis was done with SPSS version 21.
Results: Intra group analysis showed statistically significant results ($p<0.001$) in each group after 4 weeks of treatment indicating improvement in Disabilities of Arm, Shoulder, and Hand (DASH), Action Research Arm Test (ARAT) and Wolf Motor Function Test (WMFT) of both groups. However, based on their mean differences, experimental group demonstrated greater progress across all outcome measures which is indicated through Inter group analysis that statistically significant difference was present between two groups in DASH, ARAT and WMFT with p-values 0.045, 0.046 and 0.043 respectively at end of treatment.
Practical implications: HABIT pays attention to bimanual training which is highly related to most ADL tasks so there is need to evaluate the effectiveness of HABIT-related interventions. This will help to promote improvements in upper extremity functions and to enhance the level of independence among stroke patients.
Conclusion: Study concluded that both conventional physical therapy and hand arm bimanual intensive training (HABIT) are helpful in improving upper extremity fine motor abilities in chronic stroke patients, but HABIT is more beneficial as compared to usual conventional and routine rehab treatments.
Keywords: HABIT, fine motor skills, physical therapy, upper extremity, stroke.

INTRODUCTION

The World Health Organization (WHO) first classified stroke as a neurological insufficiency of the cerebrovascular etiology in 1970. Stroke can persist for more than 24 hours, or it can result in the patient's death within or more than without a clear cause. Vascular insufficiency, subarachnoid hemorrhage, cerebral infection and/or intracerebral hemorrhage are some of the causes of stroke[1]. According to American Heart Association, on average after every 40 seconds, in the US has a stroke and approximately 795000 people each year experience a recurrent or new cases of stroke[2]. It has been reported that stroke is most prevalent and severe health related condition that can lead to the disability and even death in all over the world[3].

Stroke is a neurological condition that can cause physical, interpersonal, cognitive, and other behavioral symptoms. About 87% strokes are due to ischemia or reduced blood flow while 13% are hemorrhagic in nature, of which 10% are primary hemorrhages while 3% are hemorrhages in subarachnoid region[4]. The major risk factor of stroke is hypertension and stress while other factors that causes risk include smoking, obesity, high cholesterol in blood, poor dietary intake, diabetes and other health issues[5]. Old age, male gender, positive family history of the associated diseases or the disorders like the kidney issues, the liver and gall bladder issues, any tumor that is untreatable and many other factors can complicate the signs and symptoms of stroke[6]. Most patients with stroke have long term impairment and almost 80% suffer from upper extremity disability. Gross and fine motor skills are completely lost or impaired[7]. Muscle tone is disturbed which adversely affects the functions of upper extremity in daily activities compromising the functional independence and quality of life[8].

Received on 13-06-2022
Accepted on 27-10-2022

Rehabilitation after stroke is an organized and well planned procedure to enhance the state of functioning of the patient and to make the patient able to return to active lifestyle as soon as possible[9]. As a motor rehabilitation technique, bilateral upper limb training involves patients performing motor activities with both upper limbs to enhance hemiplegic fine motor skills. Use of bilateral limbs cause synchronized movements; facilitating central distribution of neural networks[3]. This network facilitates motor cortical areas and cause spatiotemporal coupling of upper limb movements according to the existence of bilateral descending motor pathways. Therefore, bilateral arm training is more advantageous for proximal limb control[10]. Hand-Arm Bimanual Intensive Training (HABIT) programs involve symmetrical bilateral training, such as bilateral motor priming, robot assisted training , repetitive practice of functional tasks (bilateral isokinetic training) and BATRAC (bilateral arm training with rhythmic auditory cues). The majority of studies used a 15- to 2.25-hour daily, three to five day weekly and two to eight week training regimen[11].

A previous study stated that effectiveness of unilateral training was not more than bilateral training to improve dexterity functions of upper limb. But timings of intervention, nature of task, dose, and training intensity may have positive influence on results[12]. Different variety of tasks which include both unilateral and bilateral training programs were indicated in past studies for increasing the upper extremity's functional usage after a stroke[13]. It was also concluded previously that bilateral training with verbal feedback, special instructions, encouragement by therapist and task-oriented program are beneficial for motor-learning training in neurologically intact people[14]. Another study found that patients who were much more impaired experienced significant improvements with bilateral short-term training compared to unilateral training when performing similar tasks, and patients who were significantly more impaired experienced superior results with

bilateral long-term training[15]. It was also reported previously that bilateral arm training with auditory cues BATRAC, bilateral coupling training and EMG stimulation training provide significant results and movements incorporating central and peripheral input with bilateral training in activities of daily living might significantly improve upper extremity functions[16].

Although, various researches had shown effects of articular interventions on stroke but still there is lack of multi component studies focusing on fine motor skills. This study will determine the effects of HABIT on fine motor skills of upper extremity in chronic stroke patients which is not explored yet in Pakistan despite of its utmost significance.

MATERIALS AND METHODS

After receiving approval from the Riphah College of Rehabilitation and Allied Health Sciences Research Ethical Committee (RIPHAH/RCRS/REC/Letter-00668), a randomized control study was carried out. From March 2020 to August 2020, the study was carried out in the physiotherapy department of the District Head Quarter Hospital in Sargodha.

Both male and female patients between age 45-65 years[5], having chronic stroke (with onset more than 6 months ago), either new or recurrent case, and Modified Ashworth Scale 1, 1+ and 2 were included. Patients with other comorbidities like angina, cancer, pneumonia, cognition cognitive disabilities[6] and upper limb surgical interventions (carpel tunnel surgery, acute fracture) were excluded.

Sample size of 28 subjects was calculated by using Open-Epi. Mean and St. deviation of Disability of arm, shoulder, and hand questionnaire was taken from previous study[4]. After fully describing the study's objectives, willing participants were asked for their written, informed consent. The study's participant recruitment was done using a non-probability convenient sampling strategy, and the participant randomization was completed using the sealed envelope method.

Data was collected by using Disabilities of the arm, shoulder, and hand (DASH), Action Research Arm Test (ARAT) and Wolf motor function test (WMFT). DASH was used to assess the physical function of patients while performing certain upper limb activities interventions. [(17)] The WMFT quantifies upper extremity motor ability through timed and functional tasks[18]. ARAT was used to examine the client's capacity to handle objects that varied in size, shape, and weight in order to determine particular changes in motor function of a limb[19].

Control group was given conservative physical therapy including unilateral task-oriented activities reaching a glass for 10 minutes, using a zipper for 10 minutes, active ROM for 10 minutes and passive ROM 10 minute, with 5 minutes of break after 2 tasks[20]. Experimental group was treated by conventional physical therapy and HABIT. Hand-arm bi-manual intensive training exercises included activities such as weight and form grip items, put a towel, glass lift, tap the keyboard keys, ball catch, carry an item with you. Each exercise was performed for 8 minutes with 2 minutes of break in between[20].

It takes approximately 1 hour to complete this entire session. There were 3 sessions every week for a total of 12 sessions over the course of 4 week. One session lasted for 60 minutes. Before, during (2nd week), and following (4th week) treatment, evaluation was conducted.

Software called SPSS version 21 was used to conduct the statistical analysis. The Shapiro-Wilk test was used to ensure that the data was normal. Parametric tests of analysis were used, and a p-value of 0.05 was regarded as statistically significant. A general linear model repeated measure univariate analysis was utilized, with a group (conventional physical therapy vs HABIT) and time (baseline, during treatment, post treatment) as factor for analysis. Independent sample t-tests were used for intergroup analysis while Repeated Measure ANOVA was used for intragroup analysis.

RESULTS

In accordance with the requirements for eligibility, 36 participants were evaluated. 8 of them were turned away. Three of them did not meet the requirements for inclusion, and five of them declined to take part. The study involved 28 individuals. The results of this investigation indicate that adopting HABIT is more successful than traditional physical therapy in helping chronic stroke patients with their upper extremity fine motor abilities.

There was 6(42.85%) males and 8(57.14%) female patients in each group. Mean age of participants in Control Group was 55.29±4.46 while in Experimental group was 57.50±5.97 55. (Table 1) At the time of baseline, there was no statistically significant difference between the two groups for any of the measures, including ARAT, DASH, WMFT with p value> 0.05. In control group, 8(57.1%) patients were having ischemic and 6(42.9%) were suffering from hemorrhagic stroke. Whereas in experimental group, 6(42.9%) of ischemic and 8(57.1%) of hemorrhagic stroke were present. The percentage of monoplegia, hemiplegic, paraplegic and quadriplegic was 35.7%, 28.6%, 28.6%, 7.1% in control group while in experimental group it was 28.6%, 21.4%, 7.1%, and 42.9% (Table 2).

Intra group analysis showed statistically significant results (p<0.001) in each group after 4 weeks of treatment indicating improvement in all outcome measures of both groups (Table 3). Inter group analysis also indicated that statistically significant difference was present between two groups in DASH, ARAT and WMFT with p-values 0.045, 0.046, 0.043 and F-value 3.296, 3.052, 10.252 respectively at end of treatment. (Table 3)

Table 1: Descriptive statistics of age and gender among the groups.

Study Group		N	Mean± SD
Control Group	Age	14	55.29±4.46
	Gender	6 males 8 females	42.85% 57.14%
Experimental Group	Age	14	57.50±5.97
	Gender	6 males 8 females	42.85% 57.14%

Table 2: Descriptive statistics of type of stroke and area affected.

Study Variable		Control Group		Experimental Group	
		Frequency	Percentage	Frequency	Percentage
Type of stroke	Ischemic	8	57.1%	6	42.9%
	Hemorrhagic	6	42.9%	8	57.1%
Area affected	Monoplegia	5	35.7%	4	28.6%
	Hemiplegia	4	28.6%	3	21.4%
	Paraplegia	4	28.6%	1	7.1%
	Quadriplegia	1	7.1%	6	42.9%

Table 3: Within and between group comparison of DASH, ARAT and WMFT among the groups.

Outcome variable	Pre-treatment (mean±S.D)	During Treatment (mean±S.D)	Post-treatment (mean±S.D)	P-value (within each group)	P-value (between two groups)	F value
DASH (Control Group)	60.93±16.29	55.00±13.29	48.00±13.00	≤0.001	0.045	3.296
Experimental Group	65.50±17.57	50.57±15.64	42.79±15.33	≤0.001		

ARAT(Control Group)	24.64±3.71	28.57±2.65	38.14±5.31	≤0.001	0.046	3.052
Experimental Group	23.00±4.40	35.29±3.42	42.93±4.01	≤0.001		
WMFT (Control Group)	21.07±6.56	34.86±5.36	54.93±8.37	≤0.001	0.043	10.252
Experimental Group	20.14±4.55	38.71±4.68	58.43±8.02	≤0.001		

DISCUSSION

Study was conducted to determine the effects of Hand-arm Bimanual Intensive Training on fine motor skills of upper extremity in chronic stroke patients.

Present study results for within-group analysis using repeated measure ANOVA indicated significant improvement in functional status of patients in each group. Previous studies also report improvement of motor and movement deficits in stroke patients after rehabilitation by using conventional physical therapy which favors current study results[9].

One of previous studies aimed to determine the effects of HABIT on upper extremity in hemiplegic cerebral palsy patients, reported significant results of HABIT on improving fine motor skills of upper limb[21]. This support results of current study which indicated positive outcomes of HABIT for enhancing fine motor skills of chronic stroke patients.

The beneficial effects of HABIT on upper extremity fine motor skills are also supported by another research which was conducted to compare the motor functional performances of Bilateral Upper Limb Training and Unilateral Upper Limb Training people with stroke. Study reported marked improvement of fine motor skills with bilateral upper limb training[22] which support significant results of HABIT in present study.

Current study indicated a significant difference between the two groups for all outcome measures. Compared to the conventional physical treatment group, there is more progress in the HABIT group in terms of DASH, ARAT and WMFT. This is in concurrence with previous study results which aimed to evaluate the effectiveness of HABIT by contrast with the conventional rehabilitative program (CRP) for motor functional regeneration of the upper endpoints in patients with acute stroke. Both groups demonstrated substantial statistical changes from baseline to post-treatment review of all indicators (FMA, ARAT, AMP, CMCT and RMT), with substantial changes in all measurement scales in the first week of intervention. After 1week ARAT, CMCT and RMT were recorded on the plateau for the HABIT and CRP classes, but no further changes were found in CRP group. Whereas, after two weeks, FMA and ARAT scores increased substantially in the HABIT group[23]. These results emphasize beneficial effects of HABIT for regaining motor skills of upper extremity as reported in current study.

CONCLUSION

Study concluded that both conventional physical therapy and hand arm bimanual intensive training (HABIT) are useful in improving fine motor skills of upper extremity among chronic stroke patients, but HABIT is more beneficial as compared to usual conventional and routine rehab treatments.

Conflict of interest: The study has no conflict of interest declared by any author.

REFERENCES

1. Benjamin EJ, Virani SS, Callaway CW, Chamberlain AM, Chang AR, Cheng S, et al. Heart disease and stroke statistics—2018 update: a report from the American Heart Association. Circulation. 2018;137(12):e67-e492.
2. Kwakkel G, Kollen BJ, Wagenaar RC. Therapy impact on functional recovery in stroke rehabilitation: a critical review of the literature. Physiotherapy. 1999;85(7):377-91.
3. Morris JH, van Wijck F, Joice S, Ogston SA, Cole I, MacWalter RS. A comparison of bilateral and unilateral upper-limb task training in early poststroke rehabilitation: a randomized controlled trial. Archives of physical medicine and rehabilitation. 2008;89(7):1237-45.
4. Taylor RA, Sansing LH. Microglial responses after ischemic stroke and intracerebral hemorrhage. Clinical and Developmental Immunology. 2013;2013.
5. Izzy S, Rubin DB, Ahmed FS, Akbik F, Renault S, Sylvester KW, et al. Cerebrovascular accidents during mechanical circulatory support: new predictors of ischemic and hemorrhagic strokes and outcome. Stroke. 2018;49(5):1197-203.
6. Costa TFd, Gomes TM, Viana LRdC, Martins KP, Costa KNdFM. Stroke: patient characteristics and quality of life of caregivers. Revista brasileira de enfermagem. 2016;69:933-9.
7. Vilela P. Acute stroke differential diagnosis: stroke mimics. European journal of radiology. 2017;96:133-44.
8. Winstein CJ, Stein J, Arena R, Bates B, Cherney LR, Cramer SC, et al. Guidelines for adult stroke rehabilitation and recovery: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2016;47(6):e98-e169.
9. Hugues A, Di Marco J, Janiaud P, Xue Y, Pires J, Khademi H, et al. Efficiency of physical therapy on postural imbalance after stroke: study protocol for a systematic review and meta-analysis. BMJ open. 2017;7(1):e013348.
10. Waller SM, Liu W, Whitall J. Temporal and spatial control following bilateral versus unilateral training. Human movement science. 2008;27(5):749-58.
11. Tijs E, Matyas TA. Bilateral training does not facilitate performance of copying tasks in poststroke hemiplegia. Neurorehabilitation and neural repair. 2006;20(4):473-83.
12. Stoykov ME, Lewis GN, Corcos DM. Comparison of bilateral and unilateral training for upper extremity hemiparesis in stroke. Neurorehabilitation and neural repair. 2009;23(9):945-53.
13. Waller SM, Whitall J. Bilateral arm training: why and who benefits? NeuroRehabilitation. 2008;23(1):29-41.
14. Whitall J, Waller SM, Sorkin JD, Forrester LW, Macko RF, Hanley DF, et al. Bilateral and unilateral arm training improve motor function through differing neuroplastic mechanisms: a single-blinded randomized controlled trial. Neurorehabilitation and neural repair. 2011;25(2):118-29.
15. Cauraugh JH, Lodha N, Naik SK, Summers JJ. Bilateral movement training and stroke motor recovery progress: a structured review and meta-analysis. Human movement science. 2010;29(5):853-70.
16. Whitall J, Savin Jr DN, Harris-Love M, Waller SM. Psychometric properties of a modified Wolf Motor Function test for people with mild and moderate upper-extremity hemiparesis. Archives of physical medicine and rehabilitation. 2006;87(5):656-60.
17. Amarenco P. Underlying pathology of stroke of unknown cause (cryptogenic stroke). Cerebrovascular diseases. 2009;27(Suppl. 1):97-103.
18. Salbach NM, Mayo NE, Robichaud-Ekstrand S, Hanley JA, Richards CL, Wood-Dauphinee S. The effect of a task-oriented walking intervention on improving balance self-efficacy poststroke: A randomized, controlled trial. Journal of the American Geriatrics Society. 2005;53(4):576-82.
19. Winstein CJ, Stein J, Arena R, Bates B, Cherney LR, Cramer SC, et al. Guidelines for adult stroke rehabilitation and recovery: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2016;47(6):e98-e169.
20. Fisicaro F, Lanza G, Grasso AA, Pennisi G, Bella R, Paulus W, et al. Repetitive transcranial magnetic stimulation in stroke rehabilitation: review of the current evidence and pitfalls. Therapeutic advances in neurological disorders. 2019;12:1756286419878317.
21. Abd El Wahab M, Hamed NE. Effect of hand-arm bimanual intensive therapy on fine-motor performance in children with hemiplegic cerebral palsy. Egyptian Journal of Medical Human Genetics. 2015;16(1):55-9.
22. Chen P-m, Kwong PW, Lai CK, Ng SS. Comparison of bilateral and unilateral upper limb training in people with stroke: A systematic review and meta-analysis. PloS one. 2019;14(5):e0216357.
23. Meng G, Meng X, Tan Y, Yu J, Jin A, Zhao Y, et al. Short-term efficacy of hand-arm bimanual intensive training on upper arm function in acute stroke patients: a randomized controlled trial. Frontiers in neurology. 2018;8:726.

DOI: https://doi.org/10.53350/pjmhs2022161149

ORIGINAL ARTICLE