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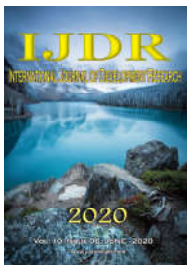

RESEARCH ARTICLE OPEN ACCESS

EFFECTS OF TASK-SPECIFIC REHABILITATION ON FUNCTIONS OF THE UPPER EXTREMITY IN CHRONIC STROKE

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ABSTRACT

Background and Purpose: Post stroke, many individuals have severely limited functional movement control due to chronic unilateral motor dysfunction in upper extremity. Study aims to evaluate the effectiveness of Task-specific rehabilitation on upper extremity function. For this, Bilateral Movement Training (BMT) was given to see its effects on upper extremity functions with a chronic stroke of more than 6 months and less than 2 years earlier. **Methods:** One hundred subjects, who were diagnosed as stroke by qualified Neurologists and Neurosurgeons were selected & given BMT, one session of 45 minutes/day for ninety days. At Day 0, Day 45, and Day 90 Fugl-Meyer Assessment of physical performance (FMAPP) & Stroke Rehabilitation Assessment of Movement (STREAM) used to assess upper extremity dysfunction in stroke. **Results:** Analysis of pre and post-study data tells that FMAPP & STREAM discovered substantial findings (P, 0.000). After rehabilitation treatment showed that BMT is better on both the scales. **Conclusions:** Findings of this trial provide important insights that task-specific rehabilitation in form of BMT has significant improvement in functions of upper extremity in chronic stroke subjects. It is recommended in future that similar study can be done for longer duration or with large sample size.

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INTRODUCTION

Brain attack or stroke or cerebrovascular accident is a clinical syndrome typified by rapidly developing signs of focal or global disturbance of cerebral functions, lasting more than 24 hours or leading to death, with no apparent causes other than of vascular origin. Depending on the location of the vascular defect(s) different functions are disturbed leading to temporary or permanent impairments, activity limitations, and participation restrictions. A cerebrovascular accident or stroke occurs when blood supply to part of the brain is interrupted, causing brain cells to die. This blood flow to the brain is decreased; oxygen and glucose cannot be distributed to the brain. Blood flow can be compromised by a variety of mechanisms. When these neurological deficits persist for at least 24 hours, termed as stroke. The brain is supplied by two vertebral arteries and two internal carotids. The four arteries anastomose on the inferior surface of the brain forms Circle of Willis (circulus arteriosus).

Clinically a variety of focal deficits are possible, including changes in the level of wakefulness and impairments of sensory, motor, cognitive, perceptual, and language functions. Motor deficits are characterized by paralysis (hemiplegia) or flaw (hemi paresis), normally on the side of the body opposite to side of the lesion. The term hemiplegia is used generically to refer to the wide variety of motor troubles that result from stroke. The location and extent of brain injury, the total of collateral blood flow, and acute care management set up the harshness of neurological deficits in a patient. Mutilation may decide instinctively as brain swelling subsides, generally within 3 weeks. Residual neurological impairments are those that persist longer than 3 weeks and may lead to everlasting disability. Complications owing to Stroke are loss of voluntary movement and immobility result in loss of range of motion (ROM) and contractures. Contracture can develop anywhere but are above all apparent in paretic limbs. Seizures and hydrocephalus are neurological complications.

Deep Vein Thrombosis impaired cardiac output, cardiac decompensation, severe rhythm disorders, decreased lung volume, decrease pulmonary perfusion, and vital capacity and altered chest wall function. Ischemic changes and succeeding necrosis of skin result in skin breakdown n decubitus ulcers are other complications. The present study was undertaken to ascertain the effects of Task-specific rehabilitation for functions of the upper extremity in chronic stroke subjects. For this purpose Bilateral Movement Training (BMT) given to the subjects with chronic stroke. The BMT is a task-specific rehabilitation method that has recently been investigated by Summers et al in the year 2007 and Syed et al in the year 2015 for its influence on upper extremity recovery in individuals post-stroke. BMT is thought to affect the hemi paretic upper extremity by a phenomenon referred to as cross-education, or the cross transfer effect. It has been argued that bilateral movements performed in synchrony can generate crossed facilitation between the non-paretic and paretic upper limbs.

However, stroke subjects may have complexity actively moving the paretic upper limb due to weakness, or other complicating factors like spasticity. BMT, uses the intact limb to promote the functional revival of the impaired limb through the facilitative coupling effects between the upper limbs identified in studies of interlimb coordination in healthy adults. The practice of bilateral symmetrical movements may allow the activation of the intact hemisphere to facilitate the activation of the damaged hemisphere leading to improved movement control of the impaired limb promoting neural plasticity.

Objectives: To evaluate the effectiveness of Task-specific rehabilitation in the form of Bilateral Movement Training (BMT) for functions of Upper extremity in Chronic Stroke.

MATERIALS AND METHODS

A case series study was conducted with multiple cross sectional follow up data collected from participants at Department of Physiotherapy (Pacific medical college and hospital), Centers of Physical medicine and rehabilitation in Udaipur and subjects from the nearby districts in south Rajasthan in the area of stroke rehabilitation, after approval of the Committee on Ethics and Research in Human Beings of Pacific Medical University. The present study was an attempt to improve upon established technique to see the effects of Task-specific rehabilitation on functions of the upper extremity in chronic stroke subjects. To find a solution for the problem statement this study was designed to assess the effectiveness of BMT on functions of the upper extremity in chronic stroke subjects. In the present study, convenient sampling method was used and a sample of 100 consecutive subjects was collected. All subjects were required to give written well-versed consent prior to participation in the study. All subjects were diagnosed and referred to as chronic stroke by Neurologists and Neurosurgeons based on baseline assessment (by the use of a primary assessment chart).

Subjects who had a stroke were included in the study if they meet the inclusion criteria. Inclusion criteria were chronic stroke due to arterial involvement in the brain, both types ischemic and hemorrhagic stroke was included, both genders were included, subjects who agreed to give written informed consent prior to the study, subjects who score 1 in upper extremity functions and hand movements within STREAM, subjects should have intact sensory and cognitive functions, subjects having a chronic stroke of time duration more than 6 months and less than 2 years, subjects between ages of 40 to 60 years and all subjects who understand my verbal instructions and were able to read and follow the chart of instructions and exercises provided by me. Exclusion criteria were subjects having diabetes, aphasia (impairment of language comprehension, formulation, and use), subjects who were psychologically unstable, subjects having surgical reconstruction of upper limb (nerve and muscle), subjects who had an open wound or unhealed scar of the upper limb, subjects who had any skin diseases or superficial skin infections, subjects who had seizures within the past 12 months, subjects who had cardiac pacemakers, subjects who had uncontrolled cardiac arrhythmias, subjects who had other central/peripheral neurological diseases other than stroke and subjects with an allergic reaction to any substance being applied to the skin.

Equipment used were Stroke Rehabilitation Assessment of Movement (STREAM), Fugl – Meyer Assessment of Physical Performance (FMA/FMAPP), Neurological Examination chart, Exercise Chart / Instruction Chart, one customized wooden block (length 30 cm, width 20 cm, height 10 cm and with 1 cm boundary of on the top and 1-inch partition in middle, approximately) and two customized wooden dowels (rectangle base: 11 x7.5 x3 cm, handle length: 14 cm, approximately). (Figure 1). One hundred consecutive subjects of stroke were chosen& treated with BMT each day for 90 days. This is built-in with the concurrent lifting of two customized wooden dowels, one in each hand, and placed them on predefined target on a customized wooden block. The total treatment time was 45 minutes per session. Participants were seated in front of a table on which a small customized wooden block was kept (length 30 cm, width 20 cm, height 10 cm and with 1 cm boundary of on the top and 1-inch partition in middle, approximately). The customized wooden block was kept at a distance so that each participant had to extend his/her impaired arm in order to reach the target area in the center of the customized wooden block (Figure 2). The task requires participants to concurrently lift two customized wooden dowels, one in each hand (rectangle base: 11×7.5×3 cm, vertical handle length: 14 cm, approximately) from the table and place it on a target located on the customized wooden block. Right alignment with the target(s) required a wrist extension(s) of approximately 35°. Participants with residual wrist and finger movement present were required to hold the dowel by closing their hands around its vertical handle. Each session began with two 'warm-up' reaching trials for both the unimpaired and impaired hand before four unilateral test trials were recorded. Participants then performed 50 training trials of the dowel placement task, with both impaired and unimpaired hand moving synchronously. Stroke Rehabilitation Assessment of Movement (STREAM) and Fugl-Meyer Assessment of Physical Performance (FMAPP) were used as primary outcome measures.

Statistical Analysis: Using SPSS Window version 21.0, all analyses were obtained. Demographic data of subjects including age, gender, disease, duration, FMAPP, STREAM were summarized through percentages. Statistical analysis helps in determining the recovery of motor functions of upper extremity in chronic stroke subjects. An alpha-level of 0.05 was used to decide statistical significance.

Analysis of variance (ANOVA) with repetitive measures was performed to analyze the differences in the subjects with BMT for three different time durations (0 days, 45 days, and 90 days). Pair wise comparisons were checked applying adjustments through Bonferroni test. Furthermore, on sample't' test was applied for BMT in three different time durations. Comparing STREAM (test value = 20) and FMAPP (test value = 66) and sample mean.

RESULTS

This study designed to check the efficacy of task-specific rehabilitation to improve upper extremity functions during the rehabilitation period of the subjects post CVA. The present study comprises of 100 subjects who fulfilled the inclusion criteria for the study. All the 100 subjects who were included in the study were offered BMT for 90 days and then their post-therapy recovery was documented. The post-intervention recovery of upper extremity functions was objectively documented. The present study was undertaken to establish the outcome of BMT for functions of upper extremity in chronic stroke subjects. Data collected through the study showed significant improvement in the functions of upper extremity in all subjects with chronic stroke. Therefore, it can be concluded that BMT is advantageous for functions of upper extremity in chronic stroke subjects. One of the intentions of the study was the verification of the outcome after the application of BMT in chronic stroke subjects. The subjects were treated with BMT and consequences show a significant recovery of functions of upper limb when pre-test and post-test data were compared.

The main purpose of the study was to find out the effects of BMT on functions of upper extremity in chronic stroke. As indicated in Table No.3, the mean scores of STREAM for Upper Limb on 0 days was 8.81±0.761, the score ranges from minimum 7 to maximum 10, the skewness was found to be 0.056 and the kurtosis was found to be -0.721. The mean scores of STREAM for Upper Limb on 45 days were 10.80±0.778, the score ranges from minimum 9 to maximum 12, the skewness was found to be -0.026 and the kurtosis was found to be -0.625. The mean scores of STREAM for Upper Limb on 90 days were 13.82±0.770, the score ranges from minimum 12 to maximum 15, the skewness was found to be 0.052 and the kurtosis was found to be -0.774. (Figure No. 3)

As indicated in Table No.3 the mean scores of FMAPP for Upper Limb on 0 days were 22.22±2.360, the score ranges from minimum 17 to maximum 26, the skewness was found to be -0.316 and the kurtosis was found to be -0.864. The mean scores of FMAPP for Upper Limb on 45 days were 34.24±2.358, the score ranges from minimum 29 to maximum 38, the skewness was found to be -0.341 and the kurtosis was found to be -0.845. The mean scores of FMAPP for Upper Limb on 90 days were 46.22±2.368, the score ranges from minimum 41 to maximum 50, the skewness was found to be -0.319 and the kurtosis was found to be -0.888. (Figure No. 4)

Results from Repeated Measures ANOVA: The Repeated measures ANOVA for STREAM scores were applied and the results obtained are presented in Table 4.1. Table 4.1 and Table 4.2 indicates that the F- Value was found significant at 0.01 level ($p<0.01$). It indicates that there are significant differences between mean STREAM scores on 0 days, 45 days, and 90 days. Furthermore, the mean score indicates that there is a positive effect of the intervention on STREAM Scores. Tables 4.1, 4.2, 4.3 indicates that there are statistically significant differences in STREAM Scores in 0 to 45 days ($p<0.01$), 0 to 90 days ($p<0.01$), and 45 to 90 days ($p<0.01$).

Table 1.

Age	Frequency	Percent
40 - 45 years	20	20.0
45 - 50 years	10	10.0
50 - 55 years	25	25.0
55 - 60 years	45	45.0
Total	100	100.0

Table 2.

Gender	Frequency	Percent
Male	75	75.0
Female	25	25.0
Total	100	100.0

Figure 1. Instrumentation for bilateral movement training (BMT)

Figure 2. Bilateral movement training (BMT) application

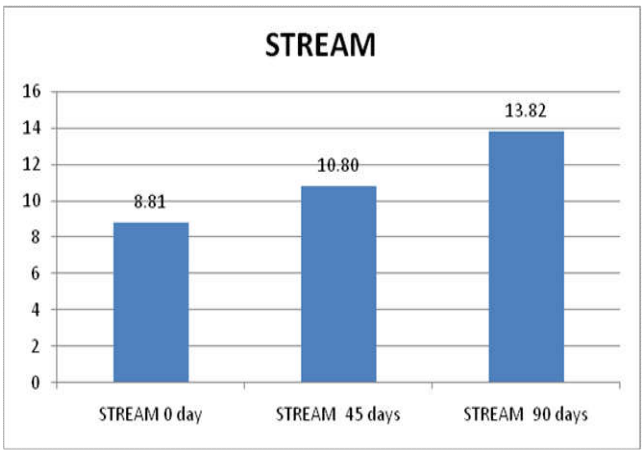

Figure 3. Mean value of subjects at day 0th, day 45th and day 90thon STREAM

Table 3. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
STREAM 0 day	100	7	10	08.81	0.761	0.056	-0.721
STREAM 45 days	100	9	12	10.80	0.778	-0.026	-0.625
STREAM 90 days	100	12	15	13.82	0.770	0.052	-0.774
FMAPP 0 day	100	17	26	22.22	2.360	-0.316	-0.864
FMAPP 45 days	100	29	38	34.24	2.358	-0.341	-0.845
FMAPP 90 days	100	41	50	46.22	2.368	-0.319	-0.888

Table 4.1

	Mean	Std. Deviation	N	Standard Error
STREAM 0 day	8.81	.761	100	0.076
STREAM 45 days	10.80	.778	100	0.078
STREAM 90 days	13.82	.770	100	0.077

Wikis Lamda value = 0.000 p<0.01 Mauchly's Test of Sphericity Mauchy's W = 0.758, chi Square = 27.210 p =0.000 (p<0.01)

Table 4.2. Tests of Between-Subjects Effects

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	37252.163	1	37252.163	21093.768	<0.001	.995
Error	174.837	99	1.766			

Table 4.3. Pair wise Comparison for STREAM Scores

(I) Time	(J) Time	Mean Difference (I-J)	Std. Error	Sig.[b]
0 days	45 days	-1.990*	.010	<0.001
	90 days	-5.010*	.010	<0.001
45 days	0 days	1.990*	.010	<0.001
	90 days	-3.020*	.014	<0.001
90 days	0 days	5.010*	.010	<0.001
	45 days	3.020*	.014	<0.001

* Significant Note: Adjustment is through Bonferroni

Table 4.4 One Sample't' test (test value = 20) for STREAM Scores

	Mean Difference	T	Df	Sig. (2tailed)
STREAM 0 day	11.190	146.970	99	<0.001
STREAM 45 days	9.200	118.176	99	<0.001
STREAM 90 days	6.180	80.217	99	<0.001

Table 5.1

	Mean	Std. Deviation	N	Std. Error
FMAPP 0 day	22.22	2.360	100	0.236
FMAPP 45 days	34.24	2.358	100	0.236
FMAPP 90 days	46.22	2.368	100	0.237

Wikis Lamda value = 0.000 p<0.01 Mauchly's Test of Sphericity Mauchy's W = 0.742, chi Square = 29.190 p =0.000 (p<0.01)

Table 5.2 Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	351439.413	1	351439.413	21070.360	<0.001	.995
Error	1651.253	99	16.679			

Table 5.3 Pair wise comparisons for FMAPP Scores

(I) Time	(J) Time	Mean Difference (I-J)	Std. Error	Sig.
0 days	45 days	-12.020*	.020	<0.001
	90 days	-24.000*	.028	<0.001
45 days	0 days	12.020*	.020	<0.001
	90 days	-11.980*	.020	<0.001
90 days	0 days	24.000*	.028	<0.001
	45 days	11.980*	.020	<0.001

* Significant Note: Adjustment is through Bonferroni

Table 5.4. One Sample't' test (test value = 66) for FMAPP Scores

	Mean Difference	T	df	Sig. (2tailed)
FMAPP 0 day	43.780	185.547	99	<0.001
FMAPP 45 days	31.760	134.717	99	<0.001
FMAPP 90 days	19.780	83.529	99	<0.001

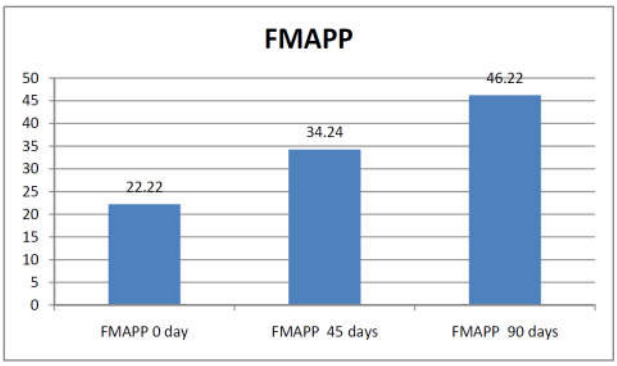

Figure 4. Mean value of subjects at day 0th, day 45th and day 90th on FMAPP

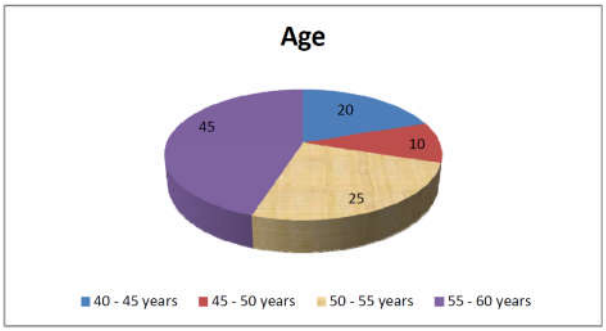

Figure 5. Age wise distribution of all 100 subjects

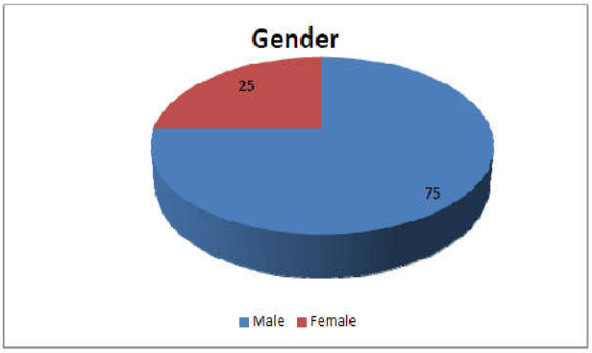

Figure 6. Gender wise distribution of all 100 subjects

The Repeated measures ANOVA for FMAPP scores were applied and the results obtained are presented in Table 5.1. Table 5.1 and Table 5.2 indicates that the F- Value was found significant at 0.01 level ($p<0.01$). It indicates that there are significant differences between mean FMAPP scores on 0 days, 45 days, and 90 days. Furthermore, the mean score indicates that there is a positive effect of the intervention on FMAPP Scores. Tables 5.1, 5.2, 5.3 indicate that there are significant differences in FMAPP Scores in 0 to 45 days ($p<0.01$), 0 to 90 days ($p<0.01$), and 45 to 90 days ($p<0.01$). These consequences revealed that subjects treated with BMT had significant recovery of functions of upper extremity in chronic stroke. Furthermore, the main objective of the study is to evaluate the effectiveness of BMT for functions of upper extremity in chronic stroke subjects. The functional revival of upper extremity was recorded by FMAPP and STREAM scales. Difference in the pre-test and post-test values of both group verified recovery from baseline to 90 days in upper extremity motor function. Analysis of variance (ANOVA) with repetitive measure was performed to analyze the differences in the subjects with BMT.

DISCUSSION

The objective of this study was to evaluate the effectiveness of BMT for functions of upper extremity in chronic stroke subjects in the clinical situation where subjects present with a shortfall in motor function. Consequences indicate that subjects improved appreciably over time ($p<0.001$) within-group analysis. This proves that BMT was helpful over time for motor recovery of upper extremity in chronic stroke subjects. More fascinatingly discussing intergroup analysis on day 0 and day 90, there was significant dissimilarity between pretest (day 0) and posttest (day 90) over time ($p<0.001$) which indicates that subjects improved in both FMAPP and STREAM. Overall motor recovery and motor behavior were improved with mean value± SD of 22.22±2.360 on day 0th, 34.24±2.358 on Day 45th and 46.22±2.368 on day 90th on Fugl-Meyer Assessment of Physical Performance (FMAPP) ($p<0.001$). Overall coordination, functional mobility skills and range of motion were enhanced with mean value ± SD of 8.81 ± 0.761 on Day 0th, 10.80 ± 0.778 on Day 45th and 13.82 ± 0.770 on Day 90th on Stroke Rehabilitation Assessment of Movement (STREAM) ($p<0.001$). This indicated that on both measuring tools there was an important advance of $p<0.001$ throughout study. Indeed these values concur with other studies on motor recovery of upper extremity treatments. This indicated that on both measuring tools there was an important advance of P=0.000 throughout study.

Indeed these values concur with other studies on motor recovery of upper extremity treatments. Here BMT works to get improved motor functions of upper limb through following mechanisms to affect the hemi paretic upper extremity by a phenomenon referred to as cross-education, or the cross transfer effect. It has been argued that bilateral movements performed in synchrony can generate crossed facilitation between the non-paretic and paretic upper limbs. BMT, uses the intact limb to promote functional revival of the impaired limb through the facilitative coupling effects among the upper limbs recognized in studies of interlimb coordination in healthy adults. The practice of bilateral symmetrical movements may allow the activation of the intact hemisphere to facilitate the activation of the damaged hemisphere leading to improved movement control of the impaired limb promoting neural plasticity. In present study BMT has given to chronic stroke subjects for motor recovery of upper limb.

For this study purpose, 100 consecutive subjects were included in this study. During this study, the minimum and maximum age criteria are ranging from 40 years to 60 years of age for all the 100 subjects. When we see a distribution of all 100 subjects according to their age as seen in Table No. 1, it has been seen that there were 20 subjects between the ages of 40-45 years. There were 10 subjects between ages of 45-50 years. There were 25 subjects between ages of 50-55 years. There were 45 subjects between ages of 55-60 years (Figure No.5). When we analyzed age of all subjectsaccording to their age in this study it had been seen that there were 15 male subjects and 5 female subjects between age of 40 to 45 years, 8 male subjects and 2 female subjects between age of 45 to 50 years, 17 male subjects and 8 female subjects between age of 50 to 55 years and 37 male subjects and 8 female subjects between 55 to 60 years. So as seen in Table No. 2, there were 75 % male and 25 % female subjects were there inthis study (Figure No.6)

Conclusion

Significant changes seen in functions of upper extremity in chronic stroke were observed during the study, thus the implementation of Task-specific rehabilitation plays a vital role in improving functions of upper extremity during the rehabilitation period of the patient's post CVA and it is recommended.

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