Original Research Article

Effects of Bilateral Upper Extremity Exercises Training on Trunk Performance, Posture and Gait in Patients with Subacute Stroke: A Quasi Experimental Study

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Abstract

Background and objective: Stroke is one of the neurological disorders which is caused by disturbance in blood supply to the brainresulting in weakness in contralateral limbs and axial musculature. Stroke is the leading cause of physical impairment where the most prominent motor deficit is paresis of one side of body, which is contralateral to the event. This study was conducted with an aim to assess the effectiveness of bilateralupper extremity training on trunk performance, posture and gait in patients with subacute stroke.

Method: 30 subjects with subacute stroke were selected for the study. Subjects were treated for 3 days/week for 12 sessions with 45 minutes of task oriented, strengthening training and PNF technique for bilateral upper extremity along with conventional training. The rehabilitation protocol consists of bilateral functional exercises, activity of daily living goal, exercises in multiple movement games, strengtheningexercises for lower limb, controlled sitting training, sit to stand training, weight bearing and balance training

Conclusion: Significant improvement in all items of TIS, PASS and DGI were observed after intervention ($P< 0.001$). The study concluded that bilateral upper extremity training is more effective in improving trunkcontrol, posture and gait in subacute stroke patients.

Keywords: Stroke, Trunk Control, Bilateral upper extremity trainings, Posture, Gait

Introduction

Stroke was the second leading cause of death worldwide, according to the global burden of diseases (GBD) study in 1990.[1] During the past two decades, there is 26% increase in global deaths of stroke and stroke still remains the second leading cause of death worldwide.[1] The prevalence rate of stroke for total of urban and rural population, varied from 44.54 to 150/100000 where urban population prevalence rate was 45 to 487/100000 and rural population was 55 to

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388.4/100000.[2] Stroke is the leading cause of physical impairment where the most prominent motor deficit is paresis of one side of body, which is contralateral to the event.[2,3,4] Stroke is one of the chronic disorders and it can affect the arm-hand performance with the trunk performance permanently.[3,4,5,6,7]

During reaching or any activities requiring arm extension there is excessive compensatory trunk movements in patients resulting in the secondary complications including contractures, disuse of limbs, balance impairment, pain and more energy expenditure.[8] Problems of breathing, speech, balance, gait and arm and hand function is associated with poor trunk control. One can lose the ability to control trunk movements, sitting and standing balance with loss of selective trunk control.[9] One of the most important predictor of motor and functional recovery is sitting balance post stroke.[10] For coordinated movements of the extremities, balance and tasks performance, trunk control is a core component.[11,12] With the hand, trunk begins to move simultaneously or slightly before, when an individual try to reach object beyond its arm length. Impaired upper extremity control and coordination leads to excessive trunk movements.[13]Compensations between shoulder and upper trunk during arm movements is found to be slightly higher in stroke patients.[14]

A study indicated that trunk muscles are activated before movement of upper extremities.[15] Another study reported that limitation of compensatory trunk movement may be an essential element during task-related training of upper extremities particularly for chronic patients with hemiparesis and controlled movements of upper extremities activate trunk muscles.[16,17] It was also demonstrated that bilateral upper extremity training effectively reduces the trunk compensation.[18] A literature suggested that movement of upper extremities are associated with trunk muscle activity.[19]It has also been reported bilateral upper extremity exercise decrease the need of trunk involvement.[20]

Trunk rehabilitation has gained only a little attention despite the evidence of its importance in day-to-day activities. Some of the studies suggested that upper extremity function gets improved with trunk rehabilitation.[20] A literature concluded that trunk impairments and gait are positively correlated in stroke patients. This indicates the need for the early implementation of truncal rehabilitation for better rehabilitation outcomes.[21]Hence, this study was focused to assess the efficacy of bilateral upper extremity exercises training on trunk performance, posture and gait of patients with subacute stroke.

Materials and Methods

SOURCE OF DATA:

Subjects were obtained from R.V. College of Physiotherapy - OPD and other selected Neurological Rehabilitation centres and Physiotherapy Clinics across Bengaluru

METHOD OF COLLECTION OF DATA:

The data for the study was collected based on the following categories:

- **Study recruitments:** Subacute stroke patients selected from the study setting (14 days to 6 months)
- **Sampling Method:** Purposive sampling
- **Sample size:** Total sample size = 30

INCLUSION CRITERIA:

- Age group between 45 to 60 years
- Patients willing to participate as volunteers and sign the written informed consent
- Patients able to walk independently
- Patient able to remain in sitting position without support
- Fugl-Meyer Scale for Upper Extremity score above 19
- Ability to follow 2 step commands
- Patient with 4 and 5 grade in voluntary control grading

EXCLUSION CRITERIA:

- Any other neurological or rheumatic disorders
- Significant orthopedics or pain condition in upper extremity
- Any spinal or limb deformities
- Uncontrolled hypertension

- Skin rashes or allergy
- Evidence of neglect
- Patient with shoulder hand syndrome
- Patient with cognitive issues

PROCEDURE:

After obtaining an approval from the Institutional Ethics Committee (IEC) of R.V. College of Physiotherapy® subjects were selected according to inclusion and exclusion criteria of the study.Subjects who fulfill the inclusion and exclusion criteria were included in the study.

Informed consent was taken from the subjects and the procedure of the study was explained to them. A detailed neurological examination was performed.

Pre-test

Subjects were screened for hand function by Fugl-Meyer Scale for Upper Extremity

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Pre-assessment of outcome measures (TIS, PASS and DGI) was done by a researcher.

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Subjects were treated for 3 days/week for 12 sessions with 45 minutes of task oriented, strengthening training and PNF technique for bilateral upper extremity along with conventional training. The rehabilitation protocol consists of bilateral functional exercises, activity of daily living goal, exercises in multiple movement games, strengthening exercises for lower limb, controlled sitting training, sit to stand training, weight bearing and balance training.

↓

All activities were performed with increasing the difficulty levels and with progression in range of motion according to patient capacity followed by exercise performance feedback and was supported byverbal instruction like reach and point to the target and touch the target etc. for most of the task (shown in table below), subject initially performed few repetitions and then gradually increases this to N no. of sets.

↓

Each exercise was designed based on timing and spatial coordination.

Post-test- At the end of 4 weeks, the researcher re-evaluated the outcome measures (TIS, PASS and DGI).

Task training	Strengthening training	Conventional training
Pushing and pulling with both arm	Carrying an object	Bridging exercise
Wipe table with both arm	Repetition of active and passive bilateral forearm supination and pronation	Lower limb strengthening
Bilateral reaching and placing object	Same movement with resistance	Controlled sitting training
Elbow extension duringreach	Repetition of wrist flexion and extension	Sit to stand
Bilateral Grip object of different size and shape (volleyball, rectangular box,)	Same movement with resistance	Range of motion exercisesfor lower limb
Drinking water from abottle	Bilateral isometric hand grip force training	Balance and gait training

STATISTICAL ANALYSIS:

The data collected for this study was analyzed statistically in the following 2 ways:

1. **Descriptive statistics:** All the categorical variables were presented in a tabular form, the result was expressed in frequency tables, percentage wherever necessary. The quantitative variables were described by means of descriptive statistics like Mean, Median, SD or interquartile range with standard error of mean and 95% confidence interval for mean. Wherever necessary the result was presented graphically.

2. **Inferential statistics**: The difference in the mean scores from pre-test to post-test between the outcome measures scale (TIS, PASS and DGI) was assessed by using paired t-test or Wilcoxon signed rank test, subject to verification of normality assumption. Results was considered significant whenever P≤0.001.

Results

Table No. 1: Age wise distribution of subjects

Age (yrs.)	Frequency	Percent
46 - 55	11	36.7
56 - 60	19	63.3
Total	30	100.0

In the present study, it was observed that, out of 30 subjects studied, 11 (36.7%) were in age group 46 to55 and 19 (63.3%) were in age group 56 to 60.

Table No. 2: Gender wise distribution of subjects

Gender	Frequency	Percent
Male	16	53.3
Female	14	46.7
Total	30	100.0

Out of 30 subjects 16 were male and 14 were female. The proportion of male subjects was 53.3% andfemale subjects was 46.7%.

Table No. 3: Distribution of subjects by affected side

Affected side	Frequency	Percent
Right	22	73.3
Left	8	26.7
Total	30	100.0

In the present study it was observed that, out of 30 subjects, 22 (73.3%) were right side hemiparesis and8 (26.7%) were left side hemiparesis.

Table No. 4: Trunk Impairment Scale (TIS)

Trunk impairment scale (TIS)	Pre-test		Post-test		t - value	P-value
	Mean	SD	Mean	SD		
Static sitting balance (SSB)	4.57	1.30	6.27	0.58	8.323	< 0.001
Dynamic sitting balance (DSB)	5.10	1.47	9.27	1.31	14.082	< 0.001
Coordination	2.40	1.16	5.17	0.95	13.350	< 0.001
Total score	12.07	2.97	20.83	2.45	20.880	< 0.001

- In the present study, the mean ± SD of static sitting balance pre-test was 4.57 ± 1.30 and for post-test it was 6.27 ± 0.58. Here, the difference in mean is found to be statistically significant (t-value =8.323, p < 0.001).
- The mean ± SD of dynamic sitting balance pre-test was 5.10 ± 1.47 and post-test it was 9.27 ± 1.31. Here, the difference in mean is found to be statistically significant (t-value =14.082,p<0.001)
- The mean ± SD of coordination pre-test was 2.40 ± 1.16 and post-test it was 5.17 ± 0.95. Here, the difference in mean is found to be statistically significant (t-value= 13.350, p< 0.001)
- The mean ± SD of total score of Trunk Impairment Scale (TIS) pre-test was 12.07± 2.97 and post-test was 20.83 ± 2.45. There is a significant difference of t-value= 20.880 (p<0.001). Thisshows that there is a significant improvement for trunk impairment score.

Table No. 5: Postural Assessment Scale for Stroke patients (PASS)

Postural assessmentscale for stroke patient (PASS)	Pre-test		Post-test		t - value	P - value
	Mean	SD	Mean	SD		
Maintaining posture (MP)	10.53	2.33	13.77	1.01	10.753	< 0.001
Changing a posture (CP)	16.67	2.70	20.43	0.86	9.344	< 0.001
Total Score	27.20	4.51	34.30	1.76	11.843	< 0.001

- In the present study, the mean ± SD of Maintaining Posture pre-test was 10.53 ± 2.33 and for post-test it was 13.77 ±1.01. Here, the difference in mean is found to be statistically significant (t-value =10.753, p < 0.001). This shows that there is a significant improvement in maintainingthe posture.
- The mean ± SD of Changing a Posture pre-test was 16.67 ± 2.70 and for post-test it was 20.43 ±
- 0.86. Here, the difference in mean is found to be statistically significant (t-value =9.344, p <0.001). This shows that there is a significant improvement in Changing the Posture.
- The mean ± SD of total score of PASS pre-test was 27.20± 4.51 and post-test was 34.30 ± 1.76. There is a significant difference of t-value= 11.843 (p<0.001). This shows that there is a significant improvement in PASS score.

Table 6: Dynamic Gait Index (DGI)

Dynamic Gait Index (DGI)	Mean	SD	t - value	P - value
Pre-test score	14.50	3.893	11.986	< 0.001
Post-test score	20.27	2.638		

- In the present study the mean ± SD of total score of Dynamic Gait Index (DGI) pre-test was 14.50± 3.893 and post-test was 20.27 ± 2.638. There is a significant difference of t-value= 11.986 (p<0.001). This shows that there is a significant improvement for DGI score.

Discussion

The present study was conducted to assess the effectiveness of bilateral upper extremity training on trunk performance, posture and gait in patients with subacute stroke in the age group between 45 and 60 with FMUE score above 19. A total of 30 subjects had participated in this study after signing the informed consent form. Outcome measures were recorded pre- and post- interventions.

After stroke, the sensorimotor impairment of trunk interferes with daily living affecting the functional performance of the individual. Trunk control is the ability of the trunk muscles to maintain the body upright, perform different movements like bending forward, backward and sideways, rotation of trunk, adjust the weight shifts and maintain the center of mass of the body during postural adjustments withinthe base of support.[22] The present study shows a significant improvement in trunk impairment scale score with significant difference of t-value= 20.880 (p<0.001).

Several studies have reported the weakness of trunk flexor-extensor and bilateral trunk rotators muscles with either left or right side body weakness in stroke survivors when compared to the age of healthy matched control.[23] Even pelvic alignment which is the major component for standing, walking and maintaining the posture is not normal after stroke and is influenced by poor trunk control.[24] The present study shows a significant improvement in PASS score with significant difference of t-value= 11.843 (p<0.001).

A study was conducted to examine the relation between upper extremity function and trunk control, balance and functional mobility in individuals with chronic stroke where upper extremity function was evaluated with upper extremity sub scale of the STREAM scale and trunk control, balance and functional mobility by TIS, BBS and TUG respectively. As a result, a relation was detected between upper extremity function, trunk control and balance highlighting the importance of focusing on upper extremity to improve trunk control, posture and balance in stroke survivors.[25]

In the present study there was significant improvement in all items of TIS, PASS and DGI were observed after intervention (P< 0.001). Another study has suggested that individuals with better upper extremity function has better balance, mobility and trunk control. Hence, it is important to focus on upper extremity as well as trunk control to improve balance and mobility in rehabilitation of stroke patients.[25] In the present study, there is a significant difference of t-value= 11.986 (p<0.001) of DGI score.

LIMITATIONS:

- The sample size was small.
- Study focused on only pre- and post-assessment variables documentation.
- A present study lacked with follow up interval.

RECOMMENDATION:

- Large sample size with more than 6 weeks of interventions with regular follow-ups can be performed.

Conclusion

The objective of the study was to assess the effectiveness of bilateral upper extremity training on trunk performance, posture and gait in patients with subacute stroke. The results of the present study states that the bilateral upper extremity training can be included with conventional training in the treatment protocol for subjects with subacute stroke with impaired trunk performance, posture and gait. Hence, it can be concluded that bilateral upper extremity training along with conventional therapy can provide more stability, improve the gait pattern, prevent fall and help with ADL activities in patients with subacute stroke.

Ethical Clearance: Approval was obtained from the Institutional Ethics Committee (IEC) of RV College of Physiotherapy®.(RVCP/RESEARCH/0920 Dated 24.08.2021)

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Conflict of Interest: Nil

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