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Ffectiveness Of Trunk Exercise In Improving Postural Control Between Right And Left Hemiplegic Patients

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ABSTRACT

Goals

A common neurological deficit following a stroke is hemiplegia, often resulting in significant postural control abnormalities. Such impairments increase the risk of falls, leading to substantial economic and social repercussions. The trunk plays a pivotal role in postural control, and deficits in trunk control are frequently observed after brain lesions. This study aims to evaluate the effectiveness of trunk exercises in improving postural control in right and left hemiplegic patients.

Methods

The study included patients with right and left hemiplegia post-stroke. 15 Participants in each group respectively underwent a structured trunk exercise program aimed at promoting pelvic mobility, trunk rotation, and selective trunk movements. Interventions were assessed for their impact on postural control, balance, and functional outcomes. Outcome measures included the Gross Motor Function Scale (GMFS) and other standardized assessments of trunk control and balance.

Discussion

The results showed significant improvements in trunk control and balance in both right and left hemiplegic patients following the trunk exercise program. GMFS scores indicated enhanced motor function, and caregivers reported noticeable improvements in upper limb function and overall mobility. These improvements were more pronounced in patients who received targeted trunk exercises. Trunk exercises significantly improve postural control and balance in hemiplegic patients post-stroke.

Conclusion

The study underscores the importance of incorporating specific trunk exercises in rehabilitation programs for right and left hemiplegic patients. These findings highlight the necessity for tailored interventions to address this population's unique postural control challenges, ultimately enhancing their quality of life and functional independence.

Keywords: *Stroke, Trunk control, Quality of life, Health, Posture*

1. INTRODUCTION

Hemiplegia, a prevalent neurological deficit post-stroke, frequently results in significant abnormalities in postural control,

thereby elevating the risk of falls and contributing to substantial economic and social challenges. Postural control, the ability to maintain the body's position in space for stability and orientation, is critical for balance.[1] Key factors impacting postural stability include movement techniques, biomechanical limitations, cognitive functions, vertical orientation awareness, and sensory channels (somatosensory, visual, and vestibular). Sensory reintegration and reweighting also occur in the central nervous system (CNS). These mechanisms can be profoundly affected following a stroke, as noted by Oliveira et al. (2008).[2,3]

The trunk control is important for core stability, which is essential for good posture. Trunk muscles play a crucial role in maintaining balance, and deficits in trunk control are often observed following brain lesions. According to Geert Verheyden et al. (2007), trunk control serves as a significant early predictor of functional outcomes after a stroke.[4] Effective trunk control enables changes in body position and weight shifting, allowing the extremities to move freely. Trunk control tasks range from maintaining an upright posture, reestablishing movement in three planes, and adapting to extremity movement, to generating power for dynamic activities like walking, jumping, and running

Impaired motor control of the trunk muscles plays a necessary role in the recovery following a stroke, as having stable trunk muscles is important for maintaining both sitting and standing positions. Patients who experience stroke commonly exhibit reduced trunk control, difficulties with bilateral integration, and impairments in automatic postural adjustments. Evaluation of trunk control in stroke patients is an essential initial step in their rehabilitation.

Postural control impairments occur in patients with lesions in both the right and left hemispheres, but the mechanisms vary. Left hemisphere lesions disrupt axial movement planning and are often associated with increased apraxias, particularly trunkal apraxia, due to frontal lobe damage.[5] Motor activities that require intricate planning are more severely impacted by left hemispheric injuries.[6]

In contrast, right hemispheric lesions primarily disrupt spatial postural representation. Increased weight-bearing on the unaffected side can alter postural alignment. Research indicates the right hemisphere is key for postural control, resulting in self-perception issues, neglect of the space opposite the injury, and visual-motor difficulties.[7–9]These deficits highlight the essential role of the right hemisphere in spatial awareness and postural balance.

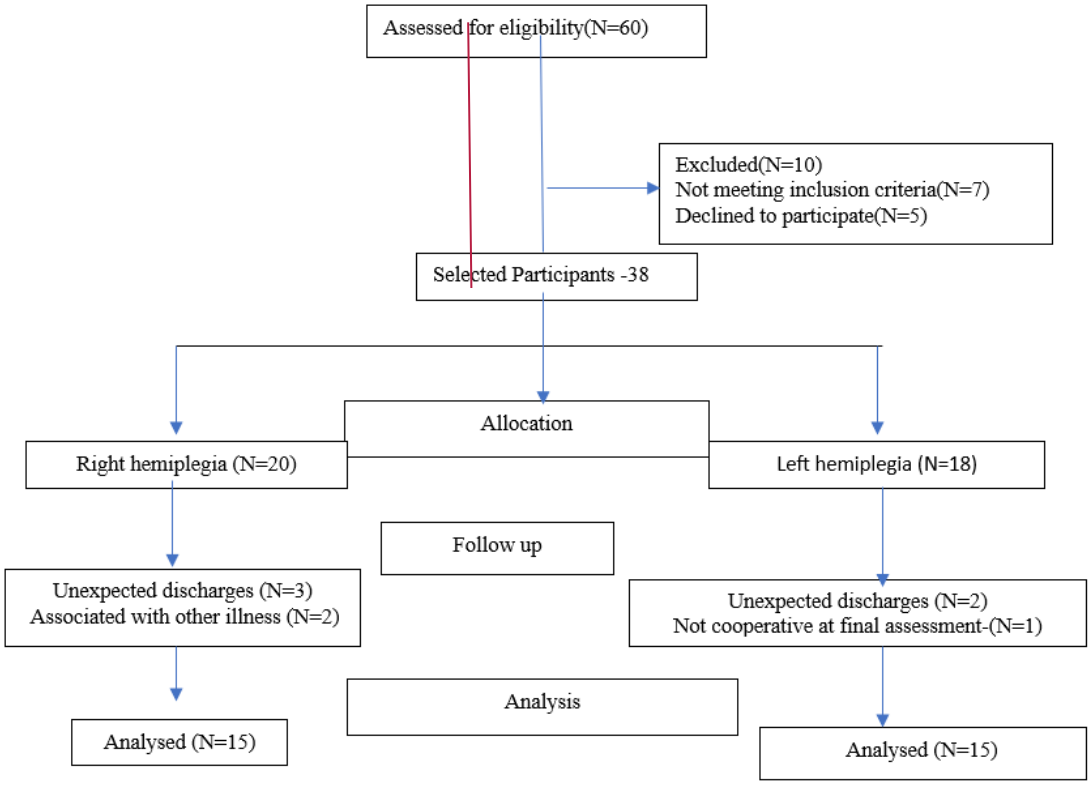
Trunk exercises are essential for enhancing pelvic mobility and postural control in hemiplegic patients. Training in trunk awareness improves sitting weight symmetry after a stroke, and selective trunk movements lead to better trunk control and balance than gait training alone.[10,11] Functional bed mobility exercises and reaching activities in sitting provide beneficial proprioceptive and sensory input, improving trunk performance post-stroke.

Despite the extensive focus on motor rehabilitation of the upper and lower extremities in post-stroke patients, trunk rehabilitation remains underexplored. This study evaluates the effectiveness of selective trunk exercises in enhancing postural control in patients with right and left hemiplegia, highlighting the critical necessity of targeted trunk exercises in the treatment regimen for these patients.

Methodology:

This study received approval from the Sri Ramachandra University's ethics committee (CSP/11/AUG/18/54). It involved two groups: right and left hemiplegic patients. This experimental study was conducted at the Sri Ramachandra Medical Centre (Inpatient department). Sample size was 30 patients, evenly divided into two groups of 15 individuals each, representing right hemiplegic and left hemiplegic patients. Convenience sampling was used to select these participants, with the selection process thoroughly documented and illustrated in the Consorts flowchart (refer to Figure 1).

Figure1. Consort Flow chart



Subject Recruitment:

Participants were selected based on specific criteria, including age (35-70 years), acute onset of hemiplegia, good comprehension [Mini-Mental State Examination (MMSE) score of 24 or more], and absence of perceptual disorders. Both genders were screened. Detailed information about the study was provided to all subjects and informed written consent was obtained.

Inclusion criteria: Participants must be over 35 years of age have an acute stroke, and presented with either right or left hemiplegia. They should also be able to understand and follow simple verbal instructions, with a minimum score of 24 on the Mini-Mental State Examination (MMSE), and achieve at least a score of 1 on the first item of the Postural Assessment Scale for Stroke.

Exclusion criteria: Participants were excluded if they had neurological diseases affecting balance (other than stroke), musculoskeletal disorders in the trunk or lower limbs, visual impairments, cognitive or perceptual difficulties, or postural hypotension.

Procedure:

The study's nature and purpose were thoroughly explained to patients prior to their recruitment. Informed written consent was obtained in English or a regional language. Thirty subjects with hemiplegia were selected based on inclusion and exclusion criteria, with 15 subjects each assigned to right and left hemiplegic groups. Clear instructions regarding the exercise protocol were provided.

Subjects underwent a structured exercise regimen involving selective movements of the upper and lower trunk, performed in both supine and sitting positions.

Exercise Protocol:

Supine Exercises:

1. Pelvic bridge
2. Unilateral bridge
3. Flexion rotation of the upper and lower trunk

Sitting Exercises:

1. Selective flexion and extension of the lower trunk
2. Lateral flexion of the upper and lower trunk
3. Trunk rotation
4. Forward and lateral reach

Pretest values of the Postural Assessment Scale for Stroke were recorded before beginning therapy. Subjects in both right and left hemiplegic groups performed the same exercises.

The supine exercises were conducted on the patient's bed, while the sitting exercises were done with the patient seated on a chair with hips and knees bent at 90-degree angles and feet on the floor.

The trunk exercises started with moderate assistance to ensure proper movement quality and progressed to no assistance. Adequate rest periods were provided between exercises. Exercise intensity was increased by adjusting the base of support, lever arm, balance limits, and hold time. The trunk exercise training was conducted for 45 minutes a day over 10 sessions. Post-test values were recorded at the end of the tenth session using the Postural Assessment Scale for Stroke.

Data Analysis

The obtained results were meticulously tabulated and analyzed using appropriate statistical tests. Pretest and posttest values of the Postural Assessment Scale for Stroke (PASS) were collected for both right and left hemiplegic patients and compared using Student's t-test.

2. RESULTS

Data analysis was conducted utilizing SPSS version 15 software, focusing on the postural control assessments between right and left hemiplegic patients. This study involved 30 subjects, divided into two groups (right and left hemiplegic), to evaluate postural control using the PASS. The collected data was distinctly tabulated for the right and left hemiplegic groups.

Demographic Data

Table 1: Age

The mean age for the left hemiplegic group was 53.80 years (SD = 9.453), while the mean age for the right hemiplegic group was 55.27 years (SD = 9.453).

Group	N	Mean	SD
Hemiplegia (Left)	15	53.08	9.453
Hemiplegia (Right)	15	55.27	

Table 2: Gender comparison between right and left Hemiplegia

In the Left hemiplegic group, 73.3% were male and 26.7%were female. In the right hemiplegic group, 66.7% were male and 33.3% were female. Overall, 70% of the subjects were male and 30% were female.

SEX	Group	Hemiplegia (Left)	Hemiplegia (Right)	TOTAL
Male	Count	11	10	21
	%Within Group	73.3%	66.7%	70%
Female	Count	4	5	9
	%Within Group	26.7%	33.3%	30%

Comparison of Postural Assessment Scores in Right and Left Hemiplegic Groups (T-test)

Table 3: PASS scores between Right and Left Hemiplegic groups

The pretest mean and SD for the left hemiplegic group were 10.53 and 0.915, respectively. For the right hemiplegic group, the pretest mean and SD were 11.33 and 1.633, respectively. The post-test values were higher for the right hemiplegic group with a mean and SD of 26.53 and 3.044, compared to the left hemiplegic group with a mean and SD of 18.53 and 2.731

Group	N	Mean	SD	Std Deviation	t- value	p - value
PASS Pretest (Left Hemiplegic)	15	10.53	0.915	0.236	-1.655	0.109
PASS Pretest (Right Hemiplegic)	15	11.33	1.633	0.422	-1.655	0.112
PASS Pretest (Left Hemiplegic)	15	18.53	2.731	0.236	-7.324	0
PASS Pretest (Right Hemiplegic)	15	26.53	3.044	0.786	-7.324	0

The P value for the pretest value of the Postural Assessment scale for stroke (PASS) is less significant. In the post-test score of PASS, the P values for both right and left hemiplegic groups are significant. The 95% confidence interval for the pretest in the left hemiplegic group ranged from 1.790 to 0.190, and for the right hemiplegic group, it ranged from 9.896 to 5.570, and the right hemiplegic group ranged from 9.897 to 5.569. All values were found to be significant.

Table 4: PASS scores in left hemiplegic patients (t-Test)

In the left hemiplegic group, paired t-tests were performed. The mean value and SD in the pretest score were 10.53 and 0.915, respectively, while the post-test values were 18.80 and 2.731, respectively

	Mean	N	Std. Deviation	Std. Error Mean
PASS Pre Test	10.53	15	0.915	0.236
PASS Post Test	18.8	15	2.731	0.705

Paired Sample Test

	Mean	Paired Differences		95%CI of the Difference	t	df	Significance(2-tailed)
		STD. DEVIATION	STD. ERROR MEAN				
PASS Pre and Post Test	-8.267	2.463	0.636	-9.631to -6.903	-12.999	14	0

The difference in mean and SD between pretest and posttest scores of the Postural Assessment Scale for Stroke in the left hemiplegic group were -8.267 and 2.463, respectively, and the P value was 12.999. These values are significant.

Table 5: PASS scores in Right hemiplegic Patients (t-test)

In the right hemiplegic group, paired t-tests were performed. The mean value and SD in the pretest score were 11.33 and 1.633, respectively, while the posttest values were 26.53 and 3.044, respectively.

	Mean	N	Std. Deviation	Std. Error Mean
PASS Pre Test	11.33	15	1.633	0.422
PASS Post Test	26.53	15	3.044	0.786

Paired Sample test

	Mean	Paired Differences		95%CI of the Difference	t	df	Significance (2-tailed)
		STD. DEVIATION	STD. ERROR MEAN				
PASS Pre and Post Test	-15.200	1.935	.500	-16.271to-14.129	-30.429	14	0.000

The difference in mean and SD between the pretest and post-test scores of the postural Assessment scale for stroke in the right hemiplegic group were -15.200 and 1.935, respectively, and the p-value was -30.429. These values are significantly higher when compared to the left hemiplegic group

3. DISCUSSION

Cerebrovascular disease resulting in hemiplegia can lead to a reduction in patients' limits of stability after a stroke, as the anticipatory postural adjustment of trunk muscle activity is impaired[12]. In the present study, 30 subjects with hemiplegia (15 right hemiplegia and 15 left hemiplegia) who met the inclusion criteria were included. The subjects were recruited from the inpatient department of Sri Ramachandra Hospital. Right and left hemiplegic patients with the ability to sit with minimal support were recruited to investigate the effect of trunk exercise in improving postural control and their improvement in maintaining trunk posture and changing the trunk in different positions.

The majority of the samples in both right and left hemiplegic groups were males (n = 21 males and n = 9 females). In the right hemiplegic group, there were 11 males and 4 females, while the left hemiplegic group had 10 males and 5 females.

The Postural Assessment Scale for Stroke (PASS) was used as an outcome measure. The results revealed that left hemiplegic patients have reduced postural control when compared to right hemiplegic patients. The pretest values of the left hemiplegia group had a mean of 10.53, whereas the right hemiplegia group had a mean value of 11.33. The pretest values of both groups did not show much difference. The post-test mean value for the right hemiplegia group was 26.53, which was significantly greater than the left group, which had a mean value of 18.80.

This implies that after employing the same trunk exercise for both groups of hemiplegia, the left hemiplegic group showed greater improvement in postural control compared to the right hemiplegic group. The left hemisphere is dominant for motor control, and the right hemisphere is dominant for spatial orientation. Thus, left-side lesions of the brain can cause greater impairment of voluntary movement, while right-side lesions can cause a loss of spatial attention.[13]

Rode G compared left hemiparetic patients with right hemiparetic patients in terms of postural sway. Three postural sway parameters were used: total sway area, anteroposterior sway, and lateral sway. Left hemiparetic patients showed greater sway area and lateral displacement compared to right hemiparetic patients, indicating a predominance of postural imbalance in left hemiparetic patients.[14]

Marath E and Iofee studied the learning of new postural tasks in patients with lesions in the right and left hemispheres. There was a greater initial impairment in learning new tasks after lesions in the right hemisphere,[15] Left hemiparetic patients showed predominant postural imbalance compared to right hemiplegic patients. The right hemisphere is crucial for generating internal maps used for perceptual and proprioceptive processing of spatial information. Imbalance with right brain damage could result from a distortion of an internal postural map. [16]

Training the patient in the awareness of trunk position using trunk exercises has improved trunk control in stroke patients.

Functional bed mobility exercises that provide proprioceptive and sensory input through trunk rotation, weight shifting, and weight-bearing activities, as well as working on reaching activities, improve trunk performance after a stroke. Therefore, exercises that promote pelvic mobility, trunk rotation, and selective movement of the trunk were given to improve postural control in hemiplegic patients.

Numerous studies have examined differences in postural control following left and right hemisphere lesions, as well as the relationship between the hemisphere and their functional evolution. The present study focuses on improving postural control using specific trunk exercises, performed in lying and sitting positions for both right and left hemiplegic groups, to determine which group shows significant improvement in trunk posture in various positions after the intervention.

Before the intervention, left hemiplegic patients had slightly reduced PASS scores compared to right hemiplegic patients. After receiving 10 sessions of specific trunk exercises, both groups showed improvement. However, the right hemiplegic patients had significantly higher PASS scores compared to left hemiplegic patients.

Since the left hemisphere is dominant for motor control and the right hemisphere is dominant for spatial orientation, right hemispheric lesions result in a persistent distortion of spatial postural representation. Posture is strongly influenced by spatial attention, which is affected in this group. This implies that, given the functional differences between right and left hemispheric lesions, specific exercise protocols can be used for rehabilitation. Hence, right hemiplegic patients showed improvement in postural control after the intervention.

4. CONCLUSION

This study highlights the differential impact of cerebrovascular disease on postural control in patients with right and left hemiplegia, emphasizing the significance of targeted trunk exercises in improving postural stability. The findings reveal that left hemiplegic patients exhibit greater impairments in postural control compared to right hemiplegic patients, likely due to the dominant role of the right hemisphere in spatial orientation and postural representation.

Trunk exercise training significantly improved postural control in both groups, with right hemiplegic patients showing higher post-intervention PASS scores. These results underscore the importance of incorporating specific exercise protocols tailored to the functional differences between right and left hemisphere lesions in rehabilitation programs.

The study's limitations, including a small sample size, gender imbalance, and short duration, suggest the need for further research. Future studies should explore cognitive approaches in rehabilitation, combining trunk exercises with therapy for cognitive dysfunction and spatial disorders. Additionally, incorporating multisensory feedback devices may enhance rehabilitation outcomes.

Overall, this research contributes to our understanding of postural control in hemiplegic patients and offers insights into developing more effective rehabilitation strategies that address both motor and spatial deficits.

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Conflicts of Interest: None

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