ORIGINAL ARTICLE

Effects of core muscles strengthening exercises with routine physical therapy on trunk balance in stroke patients: A randomized controlled trial

Iqra Nadeem[1], Sara Khawar Butt[2], Iqra Mubeen[3], Ayesha Razzaq[4]

Abstract

Objective: To compare the effects of core muscle strengthening exercises with and without routine physical therapy on trunk balance in chronic stroke patients.

Method: The randomised controlled trial was conducted at Mubarak Medical Complex, Sargodha, Pakistan, from October 28, 2021, to April 28, 2022, and comprised patients of either gender with chronic stroke aged 40-60 years. The subjects were randomised using the lottery method into group A that was managed with routine physical therapy, and group B which was further managed with core strengthening exercises. The intervention comprised 4 sessions per week for 8 weeks. Outcome was measured using Trunk Impairment Scale and Time Up and Go test. Data was collected at baseline, week 4 and post-intervention. Data was analysed using SPSS 23.

Results: Of the 80 individuals screened, 74(92.5%) were included. There were 37(50%) patients in group A; 30(81%) males and 7(19%) females with mean age 56.73±2.37 years. The remaining 37(50%) patients were in group B; 27(73%) males and 10(27%) females with mean age 55.65±2.88 years. Trunk balance and functional mobility improved significantly post-intervention in both groups ($p<0.05$), but group B values were significantly better compared to group A values ($p<0.05$).

Conclusion: Core muscle strengthening exercises combined with routine physical therapy were found to be more effective compared to routine physical therapy alone in chronic stroke patients for improving trunk balance and functional mobility.

R**egistration Number:** IRCT20211116053070N1.

Keywords: Stroke, Cerebrovascular accident, Muscle strengthening exercise, Physical therapy, Trunk balance, Functional mobility. (JPMA 74: 848; 2024) **DOI: https://doi.org/10.47391/JPMA.9660**

Introduction

Stroke is a common reason of disability and a leading cause of mortality globally.[1] Stroke is the second leading cause of mortality in adults aged 60 years, and the 5th most common cause of death for those aged 15-59 years across the world.[2]

Stroke, also known as a cerebral vascular accident, is a neurological disorder and a major global health issue.[3] Hypertension, cardiovascular disease, diabetes mellitus, arterial disease, cigarette smoking, alcoholism, high serum cholesterol levels, obesity, a sedentary lifestyle, stress and several other variables are major risk factors for stroke. Spasticity, weakness and loss of equilibrium on the affected side are common symptoms of stroke, resulting in an inability to maintain balance and postural alignment.[4]

[1-3]University Institute of Physical Therapy, University of Lahore, Lahore, Pakistan; [4]Department of Physiotherapy, Mayo Hospital, Lahore, Pakistan.
Current Affiliation: Physiotherapist in physical therapy department university of health sciences, lahore,
Correspondence: Ayesha Razzaq. e-mail: drayesharazzak@gmail.com
ORCID ID. 0000-0002-1364-9445

Submission complete: 02-05-2023 **Review began:** 17-06-2023
Acceptance: 17-01-2024 **Review end:** 13-12-2023

Following a stroke, there is a significant correlation between assessments of balance, gait, and functional capacity and boot performance. Despite data supporting the significance of boot performance after stroke, lower muscle strengthening is frequently overlooked, and weak limbs are the main focus of most reported investigations.[5]

In stroke, a blood clot in an artery restricts blood flow, damaging the central nervous system (CNS), resulting in impaired balance, sensory and motor functions and speech as well as in cognitive deficit.[6] More than 80% of subjects who have suffered first onset of stroke tend to have balance disability.[7] There is strong relationship between trunk performance and measurement of balance, gait and functional mobility after a stroke.[2]

Studies have reported the effectiveness of core strengthening exercise programme on trunk balance in different patient populations, like Parkinson's patients and elderly fallers with mild cognitive impairment.[8] A study showed the effectiveness of core stability exercises and treadmill training on balance of children suffering from Down syndrome.[9] Furthermore, a study reported the effectiveness of core exercises on abdominal muscle thickness and gait when combined with selective abdominal muscle activation in acute or subacute stroke.[10]

The current study was planned to investigate the effects of core muscle strengthening exercises (CSEs) with routine physical therapy (RPT) on trunk balance and functional mobility in chronic stroke patients.

Patients and Methods

The single-blind randomised controlled trial (RCT) was conducted at Mubarak Medical Complex, Sargodha, Pakistan, from October 28, 2021, to April 28, 2022. After approval from the ethics review board of the University of Lahore, Lahore, Pakistan, the sample size was calculated using Epi tool[11] with 5% level of significance and 95% power of the test In the light of literature while employing the formula:[12]

$$n = \frac{(Z_{1-\beta} + Z_{1-\alpha/2})^2 + (\delta_1^2 + \delta_2^2)}{(\mu_1 - \mu_2)^2}$$

The sample was raised using simple random sampling technique. Those included were patients of either gender aged 40-60years who had had ischaemic or chronic stroke at least 6 months previously and were medically stable who could understand and follow simple verbal instructions. They were subjected to evaluation with mini mental state examination (MMSE)) and those with score >24 were included.[13] Those excluded were patients with severe aphasia, neglect of paretic limb, severe spasticity, assessed as Modified Ashworth Scale (MAS) score >3, as well as visual and sensory deficit were excluded.[13]

After taking informed consent, the subjects were randomised using the lottery method into two groups. Subjects in group A received RPT, while Group B received CSE in addition to RPT.

RPT in both groups comprised stretching, passive mobilisation, range of motion (ROM) exercises of paretic limb, walking between parallel bars, occupational therapy and nursing care. One session lasted 30 minutes. CSE comprised 7-10 repetitions and each step was maintained for 6-10 seconds with adequate rest interval. One session last 15-20 minutes. CSE were performed in 3 steps, according to level of difficulty. Step I included trunk bracing, segmental rotation and bridging exercise. Step II included dead bug, hamstring curls and crossed extension. Step III included Side Bridge, bird dog and belly blaster exercises. Step I exercises were performed in 1-2 weeks of treatment, step II in 3-5 weeks and step III in 6-8 weeks. The intervention lasted 4 sessions per week for 8 weeks. A professional physical therapist conducted all the treatment sessions.

Data was collected using the Trunk Impairment Scale (TIS)[14] and Time-Up-and-Go (TUG) test[15] at baseline, at week 4 and post-intervention. The assessor was blinded to group randomisation.

TIS is a reliable tool for measuring trunk balance with intra class correlation (ICC) coefficient for test-retest reliability being r=0.96 and inter-rater reliability r=0.99. The total score ranges 0-23, assessing static and dynamic sitting balance and coordination. TUG test is a valid and reliable tool for assessing functional mobility. Those completing it in <10 seconds are considered normal, while those taking >10 seconds are considered at the risk of falling.

Data was analysed using SPSS 23. Data was expressed frequencies and percentages, or as mean±standard deviation, as appropriate. Normality of data was assessed using Kolmogorov Smirnov and Shapiro-Wilk tests, and data was found to be non-parametric. To compare the difference of outcome variables between the groups, Man Whitney U test was used. Friedman test was applied for non- parametric data to analyse intragroup outcomes. P<0.05 was considered significant.

Results

Of the 80 individuals screened, 74(92.5%) were included (Figure). There were 37(50%) patients in group A; 30(81%) males and 7(19%) females with mean age 56.73±2.37 years. The remaining 37(50%) patients were in group B; 27(73%) males and 10(27%) females with mean age 55.65±2.88 years. In group A, 10(27%) patients had right-side involvement and 27(73%) had left-side involvement, while in group B, the corresponding values were 8(21.6%) and 29(78.4%).

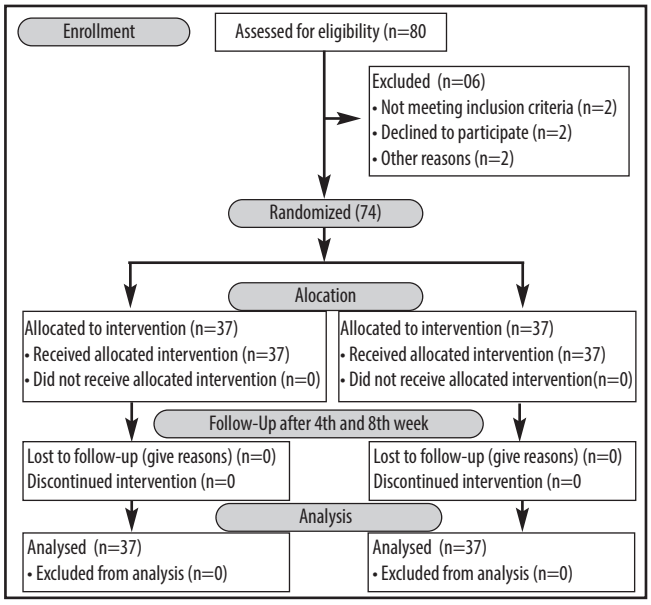

Figure: Consolidated Standards of Reporting Trials (CONSORT) flow diagram.

Table-1: Intragroup comparison of trunk balance score.

Group	Mean Rank	Mean±SD	DF	*p*-value
Control Group (A)				
Trunk Balance at Baseline	1.00	6.48±0.76	2	<0.01
Trunk Balance at 4th week	2.00	9.43±0.55		
Trunk Balance at 8th week	3.00	16.64±0.78		
Experimental Group (B)				
Trunk Balance at Baseline	1.00	6.48±0.55	2	<0.01
Trunk Balance at 4th week	2.00	12.45±0.55		
Trunk Balance at 8th week	3.00	18.89 ±0.80		

SD: Standard Deviation

Table-2: Intergroup comparison of trunk balance score.

Group	Mean±SD	Mean Rank	*p*-value
Trunk balance score at Baseline			
Control Group (A)	6.48±0.76	37.77	<0.92
Experiment Group (B	6.48±0.55	37.23	
Trunk balance score at 4th week			
Control Group (A)	9.43±0.55	19.01	<0.01
Experiment Group (B	12.45±0.55	55.99	
Trunk balance score at 8th week			
Control Group (A)	16.64±0.78	20.09	<0.01
Experiment Group (B	18.89±0.80	54.91	

SD: Standard Deviation

Baseline trunk balance scores of the groups were not significantly different (p=0.92). Trunk balance improved significantly post-intervention in both groups (Table 1), but group B values were significantly better compared to group A values (Table 2).

Functional mobility score at baseline was 33.1081±0.90627 in group A and 33.5676±1.51915 in group B (p=0.92). Post-intervention scores were 10.2703±0.45023 in group A and 7.5946±0.45023 in group B (p<0.001). Functional mobility scores improved significantly post-intervention in both groups, but group B values were significantly better compared to group A values (p<0.05).

Discussion

The comparative study showed that RPT with CSEs was more effective in improving trunk balance and functional mobility than RPT alone. An RCT comprising sub-acute stroke patients,[13] another RCT comprising elderly fallers with mild cognitive impairment[9] and a study comprising Parkinson's patients reported similar findings in favour of CSEs.[16]

A study concluded that trunk stabilisation exercise programme was beneficial in improving balance and mobility when combined with selective abdominal muscles activation.[17] These results correlate with the present findings.

A systematic review comprising 11 RCTs also concluded that addition of core training was expeditiously beneficial in improving trunk stability and dynamic balance.[18]

Another systematic review comprising 14 studies supported the evidence that CSEs alone or combined with other therapies produced better results compared to conventional treatment.[19]

The current study has limitations, including a small sample size and a single-centre data. There were difficulties in terms of transportation of patients, and there was a general lack of interest on the part of the patients in terms of performing the exercise as directed due to low morale in the face of the chronic phase of stroke.

Conclusion

CSEs combined with RPT were more effective compared to RPT alone in improving trunk balance and functional mobility of chronic stroke patients.

Disclaimer: None.

Conflict of Interest: None.

Source of Funding: None.

References

1. King D, Wittenberg R, Patel A, Quayyum Z, Berdunov V, Knapp M. The future incidence, prevalence and costs of stroke in the UK. Age Ageing 2020;49:277-82. doi: 10.1093/ageing/afz163.
2. Muniyar KD, Darade SB. Effect of swiss ball training and conventional physio-therapy to improve balance and mobility in post-stroke patients. Int J Physiother Res 2018;6:2813-22. doi:.10.16965/ijpr.2018.156.
3. Rudberg AS, Berge E, Laska AC, Jutterström S, Näsman P, Sunnerhagen KS, et al. Stroke survivors' priorities for research related to life after stroke. Top Stroke Rehabil 2021;28:153-8. doi: 10.1080/10749357.2020.1789829.
4. Shinde SG, Ganvir SS. Effect Of Swiss Ball Training On Trunk Performance In Patients With Stroke. Rom J Physi Ther 2014;20:97-101.
5. Ko EJ, Chun MH, Kim DY, Yi JH, Kim W, Hong J. The Additive Effects of Core Muscle Strengthening and Trunk NMES on Trunk Balance in Stroke Patients. Ann Rehabil Med 2016;40:142-51. doi: 10.5535/arm.2016.40.1.142.
6. Kloska A, Malinowska M, Gabig-Cimińska M, Jakóbkiewicz-Banecka J. Lipids and Lipid Mediators Associated with the Risk and Pathology of Ischemic Stroke. Int J Mol Sci 2020;21:3618. doi: 10.3390/ijms21103618.
7. Caltenco HA, Olsson A, Aliyari A, Magnusson C, McGookin D, Kytö M, et al. Designing interactive systems for balance rehabilitation after stroke. In: TEI '17: Proceedings of the Eleventh International Conference on Tangible, Embedded, and Embodied Interaction. New York, USA: Association for Computing Machinery, ACM, Inc, 2017; pp 511-6. doi: 10.1145/3024969.3025084
8. Sadeghi H, Shojaedin SS, Alijanpour E, Abbasi A. The Effects of Core Stability Exercises on Balance and Walking in Elderly Fallers with Mild Cognitive Impairment: A Randomized Control Trial. J Res Rehabil Sci 2020;16:110-7. doi: 10.22122/jrrs.v15.3502
09. Alsakhawi RS, Elshafey MA. Effect of Core Stability Exercises and Treadmill Training on Balance in Children with Down Syndrome: Randomized Controlled Trial. Adv Ther 2019;36:2364-73. doi:

10.1007/s12325-019-01024-2.

10. Thabet AA, Alshehri MA. Efficacy of deep core stability exercise program in postpartum women with diastasis recti abdominis: a randomised controlled trial. J Musculoskelet Neuronal Interact 2019;19:62-8.
11. Pandey S. Basic principles of sample size calculation. J Pract Cardiovasc Sci 2020;6:123-31. DOI: 10.4103/jpcs.jpcs_34_20
12. Vickerstaff V, Omar RZ, Ambler G. Methods to adjust for multiple comparisons in the analysis and sample size calculation of randomised controlled trials with multiple primary outcomes. BMC Med Res Methodol 2019;19:1-3. doi:.10.1186/s12874-019-0754-4.
13. Yoo SD, Jeong YS, Kim DH, Lee M, Noh SG, Shin YW, et al. The Efficacy of Core Strengthening on the Trunk Balance in Patients with Subacute Stroke. J Korean Acad Rehab Med 2010;34:677-82.
14. Sag S, Buyukavci R, Sahin F, Sag MS, Dogu B, Kuran B. Assessing the validity and reliability of the Turkish version of the Trunk Impairment Scale in stroke patients. North Clin Istanb 2018;6:156-65. doi: 10.14744/nci.2018.01069.
15. Chow RB, Lee A, Kane BG, Jacoby JL, Barraco RD, Dusza SW, et al. Effectiveness of the "Timed Up and Go" (TUG) and the Chair test as screening tools for geriatric fall risk assessment in the ED. Am J Emerg Med 2019;37:457-60. doi: 10.1016/j.ajem.2018.06.015
16. Cabrera-Martos I, Jiménez-Martín AT, López-López L, Rodríguez-Torres J, Ortiz-Rubio A, Valenza MC. Effects of a core stabilization training program on balance ability in persons with Parkinson's disease: a randomized controlled trial. Clin Rehabil 2020;34:764-72. doi: 10.1177/0269215520918631.
17. Lee J, Jeon J, Lee D, Hong J, Yu J, Kim J. Effect of trunk stabilization exercise on abdominal muscle thickness, balance and gait abilities of patients with hemiplegic stroke: A randomized controlled trial. NeuroRehabilitation 2020;47:435-42. doi: 10.3233/NRE-203133.
18. Gamble K, Chiu A, Peiris C. Core Stability Exercises in Addition to Usual Care Physiotherapy Improve Stability and Balance After Stroke: A Systematic Review and Meta-analysis. Arch Phys Med Rehabil 2021;102:762-75. doi: 10.1016/j.apmr.2020.09.388.
19. Cabrera-Martos I, Ortiz-Rubio A, Torres-Sánchez I, López-López L, Jarrar M, Valenza MC. The Effectiveness of Core Exercising for Postural Control in Patients with Stroke: A Systematic Review and Meta-Analysis. PM R 2020;12:1157-68. doi: 10.1002/pmrj.12330.

Author Contribution:

IN: Study design, concept, data collection.
SKB: Literature search.
IM: Questionnaire design, drafting.
AR: Data analysis, interpretation.