

Effects of Ankle Stability Exercises on Balance in Stroke Patients

Faisal Ali, Mirza Obaid Baig

Department of Rehabilitation & Allied Health Sciences, Riphah International University, Islamabad.

Abstract

Background: Stroke is one of the most common cause of disability in adults. Impaired gait and balance is a common manifestation after having a stroke attack. Different treatment approaches exist for stroke rehabilitation. Strengthening and stability trainings have proven to improve the overall functioning and balance in stroke patients.

Objective: The purpose of the study was to determine the effects of ankle stability exercises on the balance in stroke patients.

Methodology: It was a clinical trial that was conducted in Yusra General Hospital, Islamabad. The duration of this study was 6 months and the sample size was 36. Patients of both genders with age between 40-60 years, having Stroke duration between 6 weeks to 6 months were recruited on the basis of following inclusion criteria; Modified Ashworth scale of lower extremity ≤ 2 , Modified Rankin scale 2 and 3, a mini-mental state examination- score of 24 or higher, mild to moderate risk of fall on Berg Balance Scale. Patients having vestibular compromise, visual or auditory disorders, or any other neurological disorder i.e. Parkinson's, Alzheimer's etc. were excluded from the study. The tools used in the study were Berg Balance Scale, Time Up and Go Test, 2 Minute Walk Test, Cumberland Ankle Instability Tool, and Stroke Specific Quality of Life.

Results: There was noticeable improvement in mean values of all the tools after 6 weeks of intervention in both control and experimental group. Mean values of Berg Balance Scale, Time Up and Go Test, 2 Minute Walk Test, and CAIT were improved more in experimental group as compared to control group after 6 weeks of treatment and there was significant difference of BBS at 6th week as $p < 0.05$

Conclusion: It is concluded that ankle stability exercises improved balance and functional mobility better than conventional stroke therapy alone. These exercises are associated with improvement of scores in Berg Balance Scale and 2 Minute Walk Test.

Key words: Ankle stability, balance, stroke.

Introduction

Stroke is a cerebrovascular accident, result from impaired blood flow to the cells of the brain. World health organization (WHO) has defined CVA in 1970 as "neurological deficit of cerebrovascular cause that persists for more than 24 hours or is interrupted by death within 24 hours". CVA is considered to be the prominent cause of disability

Corresponding Author:

Mirza Obaid Baig

Department of Rehabilitation & Allied Health Sciences
Riphah International University, Islamabad.
Email: obaid.baig@riphah.edu.pk

Received: 24 May 2019, Accepted: 21 May 2020,

Published: 24 June 2020

Authors Contribution

MOB conceptualized the project. FA did the data collection and literature search. Statistical analysis along with the drafting, revision & writing of manuscript was also done by MOB & FA.

worldwide, in older adults. It is known as a clinical syndrome, of vascular cause. Each year number of people affected by stroke ranges between 174 to 216 per 100,000 and is responsible for 11% of mortality rate. It is believed that cerebral infarctions account for 85% of stroke, 10% by primary hemorrhage and 5% by subarachnoid hemorrhage. The chances of having a stroke attack again are 26% during 5 years of first attack and the number increases up to 39% by 10 years.¹ A study was conducted in a major university hospital in Karachi and was concluded that 519 subjects with CVA were admitted during the period of twenty-two months. A study concluded that 796/12,454 (6.4%) cases reported with CVA in 2 hospitals during a period of eight years.²

The hip and ankle joint have a vital role in giving stability to body during training balance in stroke patients. Posture is controlled through various strategies, ankle strategy is one of them and plays an important role during standing balance by

contracting the muscles surrounding the ankle joint.³ Early involvement of physical therapist has proven to be effective and they have to do their own assessment to what extent he/she can work with a patient to produce the desired effects. Better results have been seen after an early mobilization even after the potential confounding effect of disease severity. Rehab should be consistent as possible wherever the rehab measure is taking place. Category and threshold of exercise must be according to the need of patient, not by location.⁴ Poor balance is reported in people after CVA who has hemiplegia or hemiparesis. The sway in their posture is almost double of that of the individual of the same age with no stroke. Weight distribution is also uneven after a CVA, which is less weight beard on the weak side and almost 80% of the whole body weight is taken through the sound limb. In addition to that patients with hemiplegia also have decreased stabilization that is explained as the amount of distance for which a person can move his weight without losing the balance.⁵

Impaired balance and abnormal gait is a common manifestation after a stroke attack. With age, there is a remarkable change in generalized muscle strength. Ankle instability, resulting from muscle weakness, is often reported by elderly and is a great predictor of falls. There is a need to address the two problems simultaneously. The purpose this study was conducted to observe the effects of ankle stability exercises on balance in stroke patients. Null hypothesis was that there will be no effects of ankle stability exercises on balance in stroke patients and there will be no association of Berg Balance Scale (BBS), Time Up and Go (TUG) test, 2 Minute Walk Test (2MWT) and Cumberland Ankle Instability Test (CAIT) against ankle stability exercises Alternate hypothesis was, that ankle stability exercises will produce positive effects in improving balance. And there will be association of BBS, TUG, 2MWT AND CAIT against ankle stability exercises.

Methodology

This was an RCT, and was conducted in Yusra General Hospital, Islamabad. The study was conducted for 6 months from July to December 2018; sample size was 36, calculated by using epitools. Informed consent was taken from all the participants. Sampling technique was purposive non probability sampling and randomization was done through tossing coin. Samples were enrolled as per inclusion criteria; modified ashworth scale (MAS) lower extremity ≤ 2 , modified rankin scale (MRS) 2 and 3, a mini-mental state examination- score (MMSE) ≥ 24 , mild to moderate risk of fall on berg balance scale (BBS), stroke age: 6 weeks to 6 months, patient age between 40-60 years of both genders. Patients who had vestibular compromise, visual or auditory disorders, neurological disorders other than stroke i.e. Parkinson's, Alzheimer's etc. were excluded from the study. The tools used in the study were, stroke-specific quality of life (SS-QOL) urdu translated version, cumberland ankle instability tool (CAIT), burg balance scale (BBS), timed up and go (TUG) test, 2 minute walk test. The study was approved by the institutional ethics committee of Riphah College of Rehabilitation & Allied Health Sciences.

Thirty six diagnosed patients of stroke who met the inclusion criteria, were enrolled in the study and randomly distributed into control group and experimental group 18 in each, randomization was done through coin tossing. 2 subjects from experimental group and 5 from conventional group weren't able to follow up the study and were dropped out due to transportation issue, dependency over the caregiver and medical issues. Control group was given conventional treatment for 20-30 minutes which included warm up for 5 minutes consisting of active complete range of motions for shoulder and hip joint, ankle pumping. Followed by range of motion ROM and stretching exercises to the upper extremity and ankle joint. Unilateral patterns of proprioceptive neuromuscular facilitation with resistance progressing to thera band for 2 sets of 10 repetitions.

Period	Composition	Training methods	Time	Rest
0-6 weeks	On the floor	Standing on two feet	1 m	15 s
		Standing with both knees flexed	1 m	15 s
		Standing on the affected leg while holding a chair with the unaffected arm	1 m	15 s
		Alternate leg raise: standing on a foothold 20 cm high	1 m	15 s
0-6 weeks	On a balance pad	Standing on two feet	1 m	15 s
		Standing with both knees flexed	1 m	15 s
		Standing on the affected leg while holding a chair with the unaffected arm	1 m	15 s
		Alternate leg raise: standing on a foothold 20 cm high	1 m	15 s

Figure: Ankle stability exercises.

Following balance regimen was adapted:

- Step ups; stepping forward and sideways onto a step.
- Chair raising; rising from a seated position.
- Toe rises; toes standing (42)

Subjects in experimental group, after 5 minutes of warm up including general stretching exercises and resisted ankle pumping received 4 balance exercises targeting the ankle joint (Figure).

Both groups were provided the treatment of 20-30 minutes per session, 5-days a week for 6 weeks. The assessment of each subject was done on baseline (at the time of recruitment), on 2nd week, 4th week and on 6th week. Assessment was done on the basis of berg balance scale (BBS), timed up and go test (TUG), 2-minute walk test (2MWT), Cumberland ankle instability tool (CAIT) and stroke specific quality of life (SS-QOL). The data collected was analyzed through SPSS 21.

Results

Comparison between experimental group and control group was done. There was significant p-value of BBS between the groups at fourth and sixth week (Table-1) which showed that the interventions need to affect the dynamic balance over BBS. While there was no effect noticed over the TUG as the p-value was not significant at any of the observation (Table-2).

Table 1: Comparison of BBS score between control and experimental.

Variable	Control Group		p value
	Mean±SD	Experimental Group Mean±SD	
BBS baseline	25.46±5.05	24.62±3.095	0.309
BBS 2 nd Week	30.38±3.948	29.44±2.756	0.269
BBS 4 th Week	34.92±4.873	34.69±3.156	0.030
BBS 6 th Week	37.77±4.126	38.50±1.897	0.038

Table 2: Comparison of TUG score between control and experimental.

Variable	Control Group		p value
	Mean±SD	Experimental Group Mean±SD	
TUG baseline	26.46±5.285	26.56±3.483	0.155
TUG 2 nd Week	21.69±3.816	21.75±2.978	0.304
TUG 4 th Week	20.00±3.937	18.44±3.464	0.722
TUG 6 th Week	18.85±4.337	15.88±3.304	0.492

Two minute walk test indicated the effects of interventions at four weeks; afterwards as well as before four weeks there was no significant effects of interventions (Table-3). The results showed no

difference in both the groups at SS-QOL and CAIT (Table-4 & 5 respectively).

Table 3: Comparison of 2 MWT score between control and experimental.

Variable	Control Group		p value
	Mean±SD	Experimental Group Mean SD	
2 MWT baseline	30.157.175	28.88±4.334	0.077
2 MWT 2 nd Week	35.38±7.622	35.25±5.791	0.238
2 MWT 4 th Week	40.54±10.105	41.88±7.247	0.036
2 MWT 6 th Week	45.46±10.517	49.88±9.701	0.810

Table 4: Comparison of SS-QOL score between control and experimental.

Variable	Control Group		p value
	Mean±SD	Experimental Group Mean±SD	
SS-QOL baseline	117.77±29.828	112.0618.013	0.155
SS-QOL 2 nd Week	123.85±17.353	116.44±19.943	0.836
SS-QOL 4 th Week	135.38±15.506	125.00±22.815	0.179
SS-QOL 6 th Week	143.62±12.231	135.00±21.021	0.104

Table 5: Comparison of CAIT score between control and experimental.

Variable	Control Group		Experimental Group		p value
	Median	IQR	Median	IQR	
CAIT baseline	30.00	± 7.00	27.00	± 9.00	0.156
CAIT 2 nd Week	30.00	± 7.00	28.00	± 8.00	0.423
CAIT 4 th Week	30.00	± 4.5	29.50	± 2.00	0.749
CAIT 6 th Week	30.00	± 4.5	30.00	± 1.00	0.559

Discussion

BBS was used to measure balance in this study, and for both control and experimental group the mean value of BBS was improved. Same results was reported in a study where they assessed the effects of coordination exercises on functionally unstable ankle for proprioception.⁸ Our study results are supported by Ogaya. S et.al who checked the effects of balance board training on stationary and dynamic balance.⁹

TUG test was used to conclude the risk of fall and analyze the improvement of balance, sit to stand and ambulation. There was a noticeable change in mean values of TUG over the course of 6 weeks of intervention in both control and

experimental group, however the change was more remarkable in the group that received ankle stability exercises. This was in line with the study that was done to see the definite effects of balance and gait training on physical performance amongst the weak senior citizens. The study determined that balance training enhanced static balance, and gait training advances dynamic balance and ambulatory functions.¹⁰ Two (02) MWT was used to measure the endurance by assessing distance over two minutes. There was noticeable increase in the mean value of both groups with more marked increase seen in experimental group. The results were supported by an RCT that observed the effects of low to moderate intensity balance training on power, endurance, mobility, and frequency of fall in elderly with chronic stroke. They concluded that balance exercises can increase endurance, strength, mobility, and task performance in persistently impaired, fall-prone senior population.¹¹

There was noticeable increase in CAIT score in experimental group as compared to control group, suggesting that ankle stability and balance training exercises can help alleviate ankle instability. In 2018, a study concluded that exercise for ankle upgraded the proprioceptive sense and improvement in stability capacity of the ankle joint.¹²

Lower QOL scores were associated with balance impairment and fall risk among chronic stroke survivors. Arlene S et al concluded in their study that balance could improve and be preserved in chronic stroke, it is expected that individuals will benefit with upgraded QOL.¹⁰

Ankle stability exercises have improved balance, general mobility and stability of ankle joint and decreased the risk of fall in elderly people after a stroke attack. They were also associated in improving the scores of BBS, TUG, and 2 MWT.

Study was on smaller scale with less number of controls for comparison. As the treatment protocol was of 5 days a week for 6 weeks, it wasn't feasible for few patients to visit the hospital for specific time. There was only one sample setting for data collection hence recommended for future to address the diversity from different settings. As the

patients in the study were charged for the treatment, some subjects didn't volunteer for the study

Conflict of interest: None declared.

References

1. Party ISW. National clinical guideline for stroke. London: Royal College of Physicians; 2012.
2. Khealani BA, Hameed B, Mapari UU. Stroke in Pakistan. *J Pak Med Assoc* 2008; 58(7): 400-3.
3. Lee Y, Her JG, Choi Y, Kim H. Effect of ankle-foot orthosis on lower limb muscle activities and static balance of stroke patients authors' names. *J Phys Ther Sci* 2014; 26(2): 179-82.
4. Harwood R, Huwez F, Good D. *Stroke Care: A practical manual*; 2011.
5. Geiger RA, Allen JB, O'Keefe J, Hicks RR. Balance and mobility following stroke: effects of physical therapy interventions with and without biofeedback/forceplate training. *Phys Ther* 2001; 81(4): 995-1005.
6. Kelly-Hayes M, Beiser A, Kase CS, Scaramucci A, D'Agostino RB, Wolf PA. The influence of gender and age on disability following ischemic stroke: the Framingham study. *J Stroke Cerebrovasc Dis* 2003; 12(3): 119-26.
7. Walker SP, Rimm EB, Ascherio A, Kawachi I, Stampfer MJ, Willett WC. Body Size and Fat Distribution as Predictors of Stroke among US Men. *Am J Epidemiol* 1996; 144(12): 1143-50.
8. Bernier JN, Perrin DH. Effect of coordination training on proprioception of the functionally unstable ankle. *J Orthop Sports Phys Ther* 1998; 27(4): 264-75.
9. Ogaya S, Ikezoe T, Soda N, Ichihashi N. Effects of balance training using wobble boards in the elderly. *J Strength Cond Res* 2011; 25(9): 2616-22.
10. Shimada H, Uchiyama Y, Kakurai S. Specific effects of balance and gait exercises on physical function among the frail elderly. *Clin Rehabil* 2003; 17(5): 472-9.
11. Rubenstein LZ, Josephson KR, Trueblood PR, Loy S, Harker JO, Pietruszka FM, et al. Effects of a group exercise program on strength, mobility, and falls among fall-prone elderly men. *J Gerontol A Biol Sci Med Sci* 2000; 55(6): M317-21.
12. Ha SY, Han JH, Sung YH. Effects of ankle strengthening exercise program on an unstable supporting surface on proprioception and balance in adults with functional ankle instability. *J Exerc Rehabil* 2018; 14(2): 301-5.