

The Effect of Swiss Ball Exercises Versus Plinth Exercises on Trunk Control and Balance among Post-Stroke Patients

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Abstract: *Background: Stroke is a major health disorder which is the commonest cause of disability worldwide. There is multi directional impairment of group of muscles. Balance and trunk control is an important functional outcome and also an early predictor for functional activities of daily living after stroke. Aim: The aim of the study is to compare the effect of Swiss ball exercises versus plinth exercises on trunk control and balance among post-stroke patients. Objectives: The objective of the study was to assess the effect of Swiss ball exercises versus plinth exercises on trunk control and balance among post-stroke patients. Methods: A total 30 patients were selected based on inclusion and exclusion criteria. This study conducted on Outpatient Department, Sree Abirami College of Physiotherapy, Coimbatore. They were divided into Group A (Experimental Group (N=15)) and Group B (Control Group (N=15)). The experimental group received Swiss ball exercises and control group received plinth exercise for 45 min/day, 5days/week for 2 months. The outcome values (Pretest and post-test) were measured by using Trunk Impairment Scale (TIS) and Berg Balance Scale (BBS). Then the gathered data values were interpreted by SPSS Version 31.0.0 respectively. Result: The study concluded that the Swiss ball exercise was more effective in improving trunk control and balance than when compared to plinth exercise.*

Keywords: stroke rehabilitation, trunk control, balance training, Swiss ball exercises, plinth exercises, physiotherapy

1. Introduction

Stroke is a neurological condition marked by an abrupt loss of brain function caused by acute, localized damage to the central nervous system. This damage can result from cerebral infarction, intracerebral hemorrhage, or subarachnoid hemorrhage. ⁽¹⁾ Stroke is also known as a cerebrovascular accident (CVA), brain attack, or apoplexy. ^(2,3) Because it remains a leading cause of disability and death, stroke has become a major global health concern and continues to attract widespread attention. ⁽⁴⁾

CVA is the fourth major cause of death and long duration disability among adults. ⁽⁵⁾ It is expected that by 2030, the number of stroke cases and related deaths will rise to 23 million and 7.8 million, respectively. Highest stroke mortality rates are seen among the developing countries. India is also a developing country with a large population of more than 900 million. In this stroke the people in India have low life expectancy of about 61 years and among young population 33.8% are less than 15 years, 59.1% between 15 and 59 years and only 7.1% are 60 years and above ^(6,7).

Stroke is the most common cause of disability or dependence in activities of daily living (ADL) among the elderly. The aim of rehabilitation program is to reduce the degree of dependence in ADL and other related interventions for patients who have suffered for stroke. The crucial component to perform ADL is trunk control. Some studies based to found that trunk control or sitting balance at an early stage in patients after a stroke. ⁽⁸⁾

Balance is a condition in which all the force acting on the body are balanced such that the centre of mass (COM) is within the stability limits, the boundaries of base of support (BOS). ⁽⁵⁾ Balance maintenance is a very important for independent performance in ordinary life of movements and walking. Stroke patients suffer from balance disability due to abnormalities in the proprioceptive system, sensory system, trunk muscles, and muscles of the limbs. In especially, reduce in the activity of the muscles leads to reduces movement of the pelvis, development of asymmetry of the trunk and preventing use of strategies protecting against the risk of balance loss. ⁽⁹⁾

Trunk stability is the central component of maintaining proper spinal alignment and overall postural control. Effective trunk muscle function enables the body to stay upright, manage weight shifting, and perform selective trunk movements. This control is essential for maintaining a stable base of support during both static and dynamic postural adjustments. In hemiplegic patients, trunk muscle strength is commonly impaired. Although hemiplegia primarily affects one side of the body, it can still lead to bilateral deterioration of trunk muscle function, compromising proximal stability.

Trunk control is also recognized as an important early predictor of functional outcomes following a stroke. Impaired trunk position sense, altered movement adjustments, and trunk muscle weakness significantly contribute to balance difficulties in stroke survivors. These muscles are crucial for maintaining an erect posture in antigravity positions such as sitting and standing, especially during reaching tasks. According to neurodevelopmental principles, motor control develops from proximal to distal

body segments; therefore, rehabilitation for these patients places strong emphasis on improving trunk control.

Swiss ball exercises help enhance flexibility, improve proprioception, and provide visual sensory feedback. They also facilitate better equilibrium reactions while increasing the strength and endurance of weakened muscles. As a result, these exercises support functional recovery after stroke and promote greater body awareness and symmetry. In addition to Swiss ball training, other therapeutic approaches such as motor learning techniques, neurophysiological interventions, gait training, stretching, and strengthening exercises have been shown to further improve balance, trunk control, and mobility.

Trunk muscle activation is significantly higher when exercises are performed on a Swiss ball due to its unstable surface, which introduces postural perturbations that require continuous muscular adjustments to maintain proper alignment. The primary aim of this study was to evaluate the effectiveness of a Swiss ball exercise program as a stand-alone intervention for improving balance and trunk control in post-stroke patients, enabling them to achieve greater independence and a healthier lifestyle.

2. Aim of the study

The aim of the study was to effect of Swiss ball exercises versus plinth exercises on trunk control and balance among post stroke patients.

3. Objective of the Study

To assess the effect of Swiss ball exercises on trunk control and balance among post stroke patients. To assess the effect of plinth exercises on trunk control and balance among post stroke patients. To compare the effect of Swiss ball exercises versus plinth exercises on trunk control and balance among post stroke patients.

4. Methodology

A total 30 patients were selected based on inclusion and exclusion criteria. They divided into **Group A** and **Group B**. Then the Group-A (Experimental Group (N=15)) were given Swiss ball exercises and Group-B (Control Group (N=15)) were given plinth exercises.

4.1 Study Design

Quasi experimental study and non-probability sampling (convenient sampling) method.

4.2 Study Duration

45min/day, 5 days/week for 8 weeks.

4.3 Study Setting

Patients (Subjects) were selected from Physiotherapy Outpatient Department (PT-OPD), Sree Abirami College of Physiotherapy, Coimbatore.

4.4 Inclusion Criteria:

Age: 40-60 years, Gender: Both male and female, Single time stroke patients, Both Right and left Hemiplegic were included, Duration of stroke less than equal to six months, Berg balance scale score below 40, Modified Ashworth scale 1+ or 2 grade patients were selected.

4.5 Exclusion Criteria:

Uncooperative patients, Musculoskeletal disorder, Cardiac abnormalities, Head injury, Brain tumor, Neurological diseases affecting balance other than a stroke such as for instance cerebellar diseases and Parkinson's diseases.

4.6 Outcome measures:

4.6.1 Berg balance scale (BBS)

The BBS is used to determine a patient ability to safely balance during a series of predetermined tasks. It has 14 component each component consisting of 5-point ordinary scale range from 0 to 4. Test-retest reliability: 0.98, interrater and interrater reliability: 0.98.

4.6.2 Trunk Impairment Scale (TIS)

The TIS scale aim to evaluate the trunk in patients who suffered a stroke. the TIS assesses static and dynamic sitting balance and trunk coordination in a sitting position. The total score for TIS ranges between 0 for a minimal performance to 23 for a perfect performance. Test/retest and interobserver reliability - 0.96 and 0.99, respectively.

4.7 Procedure

Participants: In this experimental pre post design, 30 post stroke patients who signed the written informed consent were recruited in this study. All the subjects were screened for selection criteria. The subjects who have met the inclusion criteria were selected for this study and the subjects who haven't met the inclusion criteria and who are under the exclusion criteria were excluded from the study and who were selected for the study are grouped into two groups: Group-A and Group-B. Then the pre and posttest values can be measured by using berg balance scale and trunk impairment scale by means of convenient sampling method.

Group - A (Experimental Group - Swiss ball exercise)

Table 1: Showed the treatment protocol of Group A

| S. No | Activities | Description |
|-------|------------------------------|---|
| 1 | Bridging exercise | Patient is lie down on mat in supine position. With hip flexed and knee extended and leg kept on Swiss ball. Patient lift pelvis with the Swiss ball placed under knees, then slowly and progressively the ball is placed under. The position is maintained for 10 sec and repeated 10 times. |
| 2 | Unilateral bridging exercise | Patient is lie on mat and lifting the uninvolved leg off the ball while maintaining the pelvic bridge position. This Unilateral pelvic Bridge exercise was performed in addition to pelvic bridge exercise in progression. The position is maintained for 10 sec and repeated 10 times. |
| 3 | Lower trunk rotation | In supine lying, both the lower limbs supported on the Swiss ball and to move the knees and rotate the pelvis on either side. Repeated for 10 times on either side. |
| 4 | Sitting balance | Patient sit on the Swiss ball both hip and knee flex 90°, both feet flat on the ground and to maintain a correct posture and balance maintain position for 10 sec. |
| 5 | Trunk flexion and extension | Patient sit on the ball and they do flex and extend the trunk without moving the ball backward or forward. Repeated for 10 times. |
| 6 | Trunk lateral flexion | Patient sit on the ball and to do laterally flex the trunk initiating movement from the shoulder girdle then bring the elbow towards the ball. Repeated for 10 times on either side. |
| 7 | Trunk rotation | Patient sit on the ball, clasping both the hands of than clasped hands raised up to Shoulder level. Rotate the trunk either side and repeat exercises for 10 times each side. |
| 8 | Forward and lateral reach | Patient sitting on Swiss ball reach any object in forward and lateral. Repeated exercise for 10 times. |

Group B (Control Group - plinth exercises)**Table 2:** Showed the treatment protocol of Group B

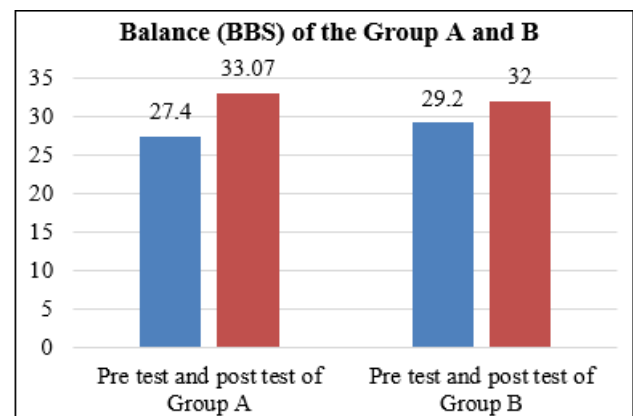
| S. No | Activities | Description |
|-------|------------------------------|--|
| 1 | Bridging exercise | Patient is lie down on mat in supine position both hip and knee flexed and feet flat on floor. Then patient lift the pelvis. The position is maintained for 10 sec and repeated 10 times. |
| 2 | Unilateral bridging exercise | Patient is lie on mat and lifting the uninvolved leg while maintaining the pelvic bridge position. This Unilateral pelvic Bridge exercise was performed in addition to pelvic bridge exercise in progression. The position is maintained for 10 sec and repeated 10 times. |
| 3 | Lower trunk rotation | In crook lying position to move the knees and rotate the pelvis on either side. Repeated for 10 times on either side. |
| 4 | Sitting balance | Patient sit on the stool both hip and knee flex 90°, both feet flat on the ground and to maintain a correct posture and balance. maintain position for 10 sec. |
| 5 | Trunk flexion and extension | Patient sit on the couch and they do flex and extend the trunk. Repeated for 10 times. |
| 6 | Trunk lateral flexion | Patient sit on the stool and to do laterally flex the trunk initiating movement from the shoulder girdle then bring towards the floor. Repeated for 10 times on either side. |
| 7 | Trunk rotation | Patient sit on the stool, clasping both the hands of than clasped hands raised up to Shoulder level. Rotate the trunk either side and repeat exercises for 10 times each side. |
| 8 | Forward and lateral reach | Patient sitting reach any object in forward and lateral. Repeated exercise for 10 times |

5. Result

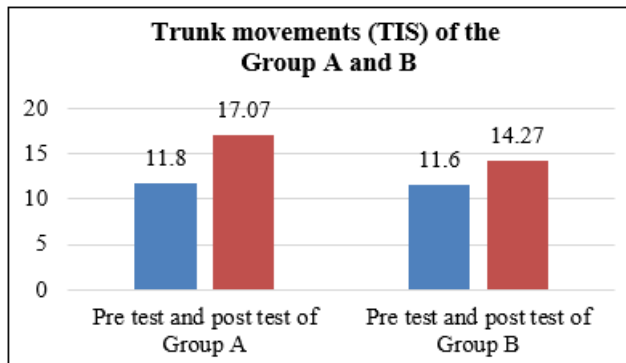
The intra-group analysis showed that both Treatment A and Treatment B are effective in terms of improvement in BBS & TIS. However, the inter-group analysis compared the two treatment groups in terms of changes in both the outcome measures and the corresponding result showed that Treatment A was more effective than Treatment B in terms of improvement in BBS & TIS.

Table 3: Showed the outcome of the balance between Group A and B

| Category | Mean | SD | t value | p value |
|--------------------------|-------|------|---------|---------|
| Group A- Pretest (BBS) | 27.40 | 5.01 | 12.20 | 0.0001 |
| Group A- Post test (BBS) | 33.07 | 4.96 | | |
| Group B- Pretest (BBS) | 29.20 | 4.77 | 19.34 | 0.0001 |
| Group B- Post test (BBS) | 32.00 | 4.81 | | |

**Graph 1** Represented the outcome of the balance between Group A and B**Table 3:** Showed the outcome of the Trunk movements between Group A and B

| Category | Mean | SD | t value | p value |
|--------------------------|-------|------|---------|---------|
| Group A- Pretest (TIS) | 11.80 | 2.14 | 28.99 | 0.0001 |
| Group A- Post test (TIS) | 17.07 | 2.05 | | |
| Group B- Pretest (TIS) | 11.60 | 2.56 | 14.27 | 0.0001 |
| Group B- Post test (TIS) | 14.27 | 2.63 | | |



Graph 1: Represented the outcome of the Trunk movement between Group A and B

6. Discussion

Table 3 and Graph 1 showed the mean difference of BBS before intervention was found to be 27.40 and post intervention 33.07 was improved for Group A. The mean difference of BBS before intervention was found to be 29.20 and post intervention 32.00 was improved for Group B. In this present study also the mean difference of BBS for Group A was 5.67 and for Group B was 2.80. This shows that Group A was significantly in improved balance than Group B. Hence, this study consistent with other literature.

Table 4 and Graph 2 showed the mean difference of TIS before intervention was found to be 11.80 and post intervention 17.07 was improved for Group A. The mean difference of BBS before intervention was found to be 11.60 and post intervention 14.27 was improved for Group B. In this present study also the mean difference of TIS for Group A was 5.27 and for Group B was 2.67. This shows that Group A was significantly in improved trunk control than Group B. Hence, this study consistent with other literature.

Hence, this study represented the significant positive impact of Swiss ball exercises (such as unilateral pelvic bridging, sitting balance, trunk rotation, lateral reach exercises) were increased greater changes in static and dynamic balance of the Group A participants compared than Group B. Finally, the Swiss ball exercises (Group A) was showed more effects than plinth exercises (Group B) in the trunk control and balance among Post Stroke Patients.

7. Conclusion

Both Swiss ball exercises and plinth exercises showed to improvement in the functional performance in the post-stroke individuals with trunk control and balance. However, it is statistical analysis, there was significant improvement in the post test functional performance of the subjects who performed Swiss ball exercise than plinth exercises. We concluded that there was significant improvement in giving Swiss ball exercises than plinth exercises on trunk control and balance among post-stroke subjects.

Hence, this study concluded that (Group A) Swiss ball exercises was effective (Group B) plinth exercises in trunk control and balance among post-stroke patients.

8. Limitations and Future Recommendations

The study was conducted only on certain age group (40-60) and in shorter duration. Kinematic and qualitative aspect of the exercise can be evaluated on larger population with different age groups and Neuro-physiological recovery of the patient (traumatic brain injuries and spinal cord injuries) also can be include for future studies.

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