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Research Article

EFFICACY OF OTAGO EXERCISE VERSUS BOSU BALL EXERCISE IN BALANCE-IMPAIRED ELDERLY PEOPLE

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ABSTRACT

Objective: The objective of this study was to compare the effect of OTAGO exercise and BOSU ball exercise on balance training among geriatric population. Geriatric indicates the elderly people with age group more than 60. Balance is the state of equilibrium; three sensors drive a sense of balance (vision, proprioception, and vestibular). As the age increases, there will be some degenerative changes, the loss of any one of these systems affects balance which may result in falls and increased morbidity. The study focuses on the effectiveness of OTAGO exercise and BOSU ball exercise in elderly people.

Methodology: Thirty subjects were selected and divided into two groups based on selection criteria with age group between 60-70, both male and female, people who scored 35–45 in Berg balance scale (BBS) grading test and four in fall risk assessment questionnaire was included and people with recent fracture and surgery, stroke, parkinson's disease, psychiatric illness, severe pain, and muscle weakness were excluded from the study. Pre-test was done using BBS as an outcome measure, proceeding with treatment protocol; Group A: received BOSU ball exercise (unilateral heel raise, one leg stand, knee bend, split stance with torso rotation, and marching) for 30 min – each set of exercise was given for 5–8 repetition with rest period of 2 min. Group B received OTAGO exercise (Backward walking, sideways walking, toe walking, sit to stand, and one leg stand) for 30 min – each set of exercise was given for 5–8 repetition with rest period of 2 min. After the cessation of the treatment protocol, post-test was done using the same outcome measure.

Results: Result of the study proves that each group shows p value ($p \leq 0.001$); however, Group A (BOSU ball exercise) shows more significant improvement than Group B (OTAGO exercise).

Conclusion: Conclusion of the study shows that both BOSU ball exercise and OTAGO exercise were effective in improving balance among elderly people. However, BOSU ball exercise was better than OTAGO exercise in improving balance among elderly people.

Keywords: Balance, Elderly, Berg balance scale, BOSU ball, OTAGO exercise.

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INTRODUCTION

Balance is defined as the state of equilibrium, in which the body's center of gravity lies within its base of support. DYNAMIC BALANCE – balance required in maintaining the body's cog over its base during movements such as reaching or walking. STATIC BALANCE – balance required in maintaining the body's cog over its base during quiet standing or sitting [1].

Visual, vestibular, and other somatosensory stimuli contribute information about the body's position in space and its center of gravity. Geriatric population indicates people with age group of 65 and above. People in this age are known to be at high risk of disequilibrium [2].

Loss of balance is a common characteristic among the aging population. It occurs when the center of gravity falls out of alignment with the base of support. Maintaining balance in the human body is an intricate process. To maintain balance, it is necessary to have a functional awareness of the BOS to better accommodate the changing COG [3].

Falls are considered the most common geriatric syndrome [4]. About 35% of adults over the age of 65 fall each year. Falling has a significant impact on the confidence and independence of an individual and may lead to hospitalization, institutionalization, or death [5]. The structural changes that occur as a result of aging imply an important decrease in physical condition [6].

Balance is controlled by three systems: Sensory, motor, and central processing. The central nervous system integrates sensory inputs and generates the motor commands which control the position of the body both at the station and as it moves within its environment. An impairment in any of these systems can result in a deficit in balance control.

Sensory inputs related to balance will reach the central nervous system by the visual, vestibular, and proprioceptive apparatus. The vestibular apparatus plays a vital role in providing information about the position and movements of the head. Like a vision, vestibular function also deteriorates with normal aging.

Proprioceptive acuity declines with normal aging. Muscle spindles, Golgi tendon organs, and joint capsule mechanoreceptors provide information about joint position and movement. Specific pathologies interfere with proprioception, which include peripheral neuropathy and degenerative joint disease [7].

Exercise to improve muscular strength and balance help in fall prevention in elderly people [8]. Lack of exercise, fitness and nutrition lead to gradual decrease in muscle strength and functional capacity which can result in falls in the elderly. The OTAGO exercise program was defined as a tailored, home based, strength, and balance retraining program designed to prevent falls in older people living in the community. This exercise program significantly reduces risk of death in older adults and also reduces falls [9].

BOSU ball was first invented by a personal trainer, David Weck. The term BOSU stands for "Both Sides Up." It is an apparatus that was

designed for balance training within the athletic and recreational active population.

The design of the BOSU provides a solid plastic base integrated with an inflatable rubber hemisphere that resembles a halved Swiss ball. It is meant that BOSU ball can be used on either side: The dome or the platform. The use of the BOSU balance trainer has become increasingly popular among fitness and medical personnel [10].

In clinical practice, many different balance devices are used such as wobble boards, soft mats, tilt boards, and BOSU balls. Proprioceptive exercises on unstable surfaces (Swiss ball or BOSU ball) have been shown to improve flexibility, balance, and lower limb strength [11].

Unstable surfaces like BOSU ball have been used to increase the neuromuscular stress in the core muscles compared with a stable surface. Performing exercises on an unstable surface have been proposed to increase proprioceptive demands and stress the muscles to a greater extent than preforming exercises on a stable surface. The BOSU ball will stress the core muscles more than a linear plane, such as floor, to improve trunk stability, and balance [12].

In the aging population, the BOSU ball plays an important role in improving the balance and also improves their functional fitness. Using the ball for rehabilitation purposes, after injury or surgery in any population also can be an effective application of the equipment [13].

The Berg balance scale (BBS) was developed in 1989 to measure balance in the elderly. The scale consists of 14 observable tasks common to daily life activities and used to evaluate functional balance.

BBS is a reliable, valid, and widely used tool. The validity of this test for screening the balance ability of older adults is well established. Although the BBS was originally developed to measure balance in the elderly, it is now commonly used to measure balance in people with varying conditions and disabilities.

The maximum score that can be achieved is 56, and each item possesses an ordinary scale of five alternatives which vary from 0 to 4 points. The test is simple, easy to administer, and accompanies the evolution of older patients.

The score is zero if the patient needs any assistance to stand, and 4 if the patient is able to stand independently. A score below 45 is considered as evidence of altered balance and predictive of falls [14].

METHODOLOGY

Thirty subjects were selected and divided into two groups based on selection criteria with age group between 60 and 70, both male and female, people who scored 35 and 45 in BBS grading test and 4 in fall risk assessment questionnaire was included and people with recent fracture and surgery, stroke, parkinson's disease, psychiatric illness, severe pain and muscle weakness which were excluded from the study. Pre-test was done using BBS as an outcome measure, proceeding with treatment protocol; Group A received bosu ball exercise (unilateral heel raise, one leg stand, knee bend, split stance with torso rotation, and marching) for 30 min – each set of exercise was given for 5–8 repetition with rest period of 2 min. Group B received OTAGO exercise (Backward walking, sideways walking, toe walking, sit to stand, and one leg stand) for 30 min – each set of exercise was given for 5–8 repetition with rest period of 2 min. The study was conducted for 4 weeks (5 days/week). After the cessation of the treatment protocol, post-test was done using the same outcome measure. The statistics were done based on the data collected. The collected data were tabulated and analyzed using both descriptive and inferential statistics. All the parameters were assessed using Statistical Package for the Social Science (SPSS) version 24. Paired t-test was adopted to find the statistical difference within the groups and independent t-test (student t-test) was adopted to find the statistical difference between the groups.

BOSU ball exercise

- All these exercises were done initially with support; later, it was progressed to without support.

1. Unilateral heel raise
   - Place one foot on the ball
   - Raise the heel which is placed on the floor and lower
   - Repeat it for 5–8 times.
2. Marching
   - Stand on the ball
   - Start to march (20 counts)
   - Repeat it for 5–8 times.
3. Knee bend
   - Stand on the ball
   - Bend both knees
   - Maintain the position for 10 counts
   - Repeat it for 5–8 times.
4. Split stance with torso rotation
   - Place one leg on the ball
   - Rotate your trunk with arms raised
   - Repeat it for 5–8 times
5. One leg stand
   - Stand on the ball
   - Raise one leg
   - Hold it for 10 counts
   - Repeat it for 5–8 times.

OTAGO exercise

- All these exercises were done initially with support, later it was progressed to without support.

1. Backward walking
   - Walk backwards
   - Repeat it for 5 times.
2. Sideways walking
   - Walk sideways
   - Repeat it for 5 times.
3. One leg stand
   - Stand on one leg
   - Repeat it for 5 times.
4. Toe walking
   - Walk on toes
   - Repeat it for 5 times.
5. Sit to stand
   - Sit on the chair and stand up
   - Repeat it for 5 times.

RESULTS

Table 1 reveals the mean, standard deviation (S.D), t-test, and p-value of the BBS between pre-test and post-test within Group A (***- p≤0.001).

There is statistically highly significant difference between the pre-test and post-test values within Group A (***- p≤0.001).

Table 2 reveals the mean, standard deviation (S.D), t-test, and p-value of the BBS between pre-test and post-test within Group B (***- p≤0.001).

There is statistically highly significant difference between the pre-test and post-test values within Group B (***- p≤0.001).

Group A-BOSU ball exercise and Group B-OTAGO exercise

Table 3 reveals the mean, standard deviation (S.D), t-test, degree of freedom, and p-value of the BBS between Group A and Group B in pre-test and post-test.

This table shows that there is no significant difference in pre-test values of the BBS between Group A and Group B (*p>0.05).

It shows statistically highly significant difference in post-test values of the BBS between Group A and Group B (***- p≤0.001).

Table 1: Comparison of berg balance scale score between pre-test and post-test within Group A

Group – A	Pre-test		Post-test		t-test	Significance
	Mean	S. D	Mean	S. D		
Berg balance scale	38.0	2.36	45.73	3.45	20.14	0.000**

Table 2: Comparison of berg balance scale score between pre-test and post-test within Group B

Group – B	Pre-test		Post test		t-test	Significance
	Mean	S. D	Mean	S. D		
Berg balance scale	37.86	2.49	41.13	3.72	7.92	0.0002**

Table 3: Comparison of berg balance score between Group A and Group B in pre-test and post-test

#BSS	#Group – A		#Group – B		t-test	df	Significance
	Mean	S. D	Mean	S. D			
Pre-test	38.0	2.36	37.86	2.49	0.144	28	0.8852
Post-test	45.73	3.45	41.13	3.72	2.065	28	0.0008**

From the data analysis, on comparing Group A and Group B who underwent BOSU ball and OTAGO exercise obtained the mean difference of (7.73) and (3.27) in BSS, respectively. Group A and Group B reveal that "t" value of BBS (20.14) and (7.92), p value of BBS (0.000**) and (0.0002**), respectively. Each group shows p value (p≤0.001); however, Group A shows more significant than Group B. Hence, the study accepts the alternative hypothesis and rejects null hypothesis.

DISCUSSION

Geriatric population indicates people with age group of 65 and above. As individuals age, they tend to become increasingly sedentary which contributes to impaired balance. Balance impairment in older adults estimates a prevalence range between 20% and 50%. Loss of balance is a common characteristic among the aging population. Improving the balance will help to decrease the risk from falling.[15,16]

Evidence from various studies reported that exercises has been shown to improve the balance of older individuals.

OEP is effective for the reduction of the incidence of falls among senior citizens with a history of falls, identified by Dadgari *et al*.

Paterson *et al*. stated that when joint flexibility decreases with age, with the potential to affect normal daily function, older adults do maintain the ability to improve flexibility through exercises.

Rozzi *et al*. found that balance training may be used to restore ankle stability; hence, it may also improve the ability of proprioceptive pathways that were affected, resulting in improvement in balance and decrease in sway parameters. Soderman *et al*. investigated the use of balance board training in the prevention of traumatic lower extremity injuries.

The purpose of a training program with the physioball (BOSU) should not be to gain strength but to gain stability, improve balance, and to improve proprioceptive capabilities stated by Behm *et al*.

Stanek *et al*., measured center of pressure (COP) and average sway velocity and found that BOSU ball seemed to be most challenging one

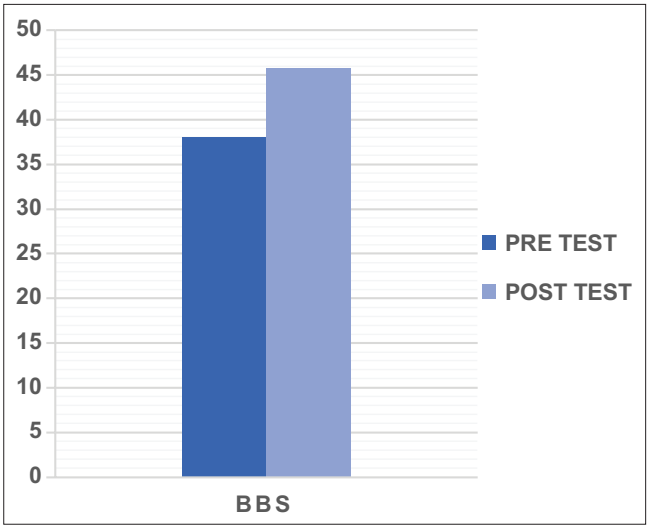

Fig. 1: Comparison of berg balance scale score between pre-test and post-test within Group A

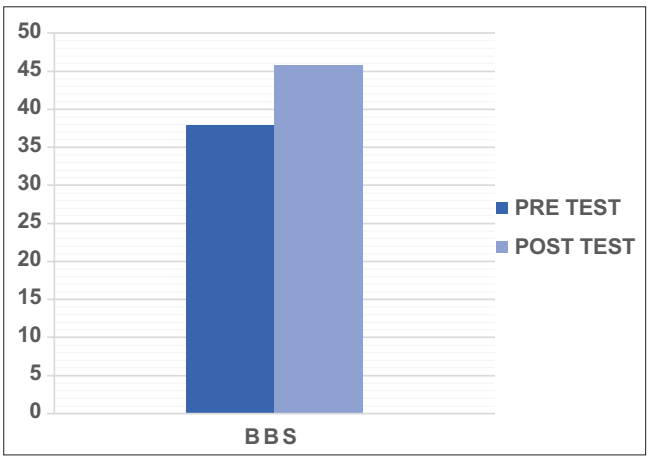

Fig. 2: Comparison of berg balance scale score between pre-test and post-test within Group B

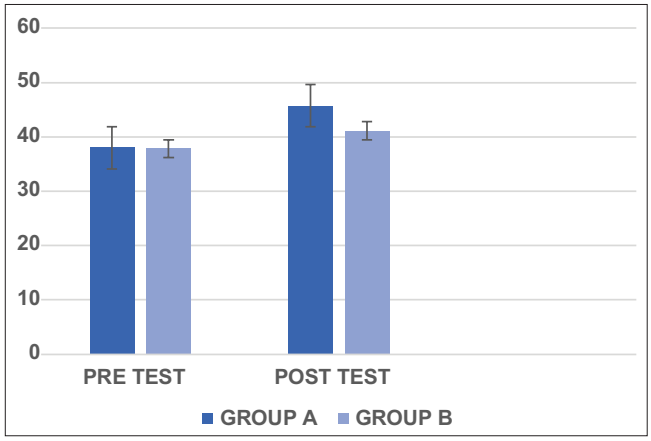

Fig. 3: Comparison of berg balance score between Group A and Group B in pre-test and post-test

in terms of both COP and sway velocities. The frequent inversion-eversion directional changes and associated peroneal muscular activity monitored by proprioceptors and the protective musculature will induce an increased activation of the afferent pathways and thereby

establish improved stability. This is found by the study by Clark and Burden, who investigated the biomechanical effects of balance training.

The above discussions provide evidence that both OTAGO and BOSU ball exercise individually improve balance in elder people. In the present study, we had implemented both the exercise together to find the effectiveness among these exercises. The data analysis and statistic interference have brought to check the effectiveness of BOSU ball exercise and OTAGO exercise in balance impaired elderly people.

In the study, Group-A which underwent for BOSU ball had significant improvement in improving balance among elderly people. The Group B which underwent OTAGO exercise also had significant improvement in improving balance among elderly people.

The mean value of BBS between Group A pre-test mean value (38.0) and post-test mean value (45.73) showed a significant difference (Fig.1). The mean value of BBS between Group B pre-test mean value (37.86) and post-test mean value (41.13) showed a significant difference. It was evident from the mean score that both groups showed improvement in the BBS (Fig. 2).

Result of the present study showed patients of Group A treated with BOSU ball, as shown a significant improvement ($p<0.001$). The independent "t" test of Group A and Group B reveals that "t" value of BBS (20.14) and (7.92), respectively. This may help the patient to improve their quality of life by improving balance in elderly people (Fig. 3).

Our data supported alternate hypothesis that BOSU ball was more effective than OTAGO exercise in balance impaired elderly people. Hence, null hypothesis is rejected.

CONCLUSION

Conclusion of the study shows that both BOSU ball exercise and OTAGO exercise were effective in improving balance among elderly people. The OTAGO exercise program is a safe, effective, practical, eminently feasible, and cost effective. Performing exercises on unstable surfaces like BOSU ball, the subjects found the exercise to be more motivating, valuable, and a fun-filled skill, which are more safe, effective, and a challenging balance training program for older adults. However, BOSU Ball exercise was better than OTAGO exercise in improving balance among elderly people.

AUTHORS' CONTRIBUTIONS

Dr. V. Pavithralochani participated in the design of the study and performed the statistical analysis, where Rebecca Sandhiya. D, Majitha Parveen. M, and Vijay. P contributed to draft the manuscript and data collection work.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest and no funding has been obtained from any source.

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