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Original Research Article

EFFECT OF BILATERAL ANKLE JOINT MOBILISATION ON FUNCTIONAL BALANCE IN COMMUNITY DWELLING ELDERLY

Ramzan Mohammed Rafique *, Sanjeev Kumar Singh, Farheen Farooque Khan.

M.A Rangoonwala College of Physiotherapy and Research, Pune, Maharashtra, India.

ABSTRACT

Background: Falls are most frequent cause of accident related injury and are frequently associated with accident related death in the elderly.[1] While an individual's risk for falling is associated with a variety of sensory, motor, cognitive and environmental variables, it ultimately depends on their frequency of loss of balance episodes and their ability to recover balance by stepping, grasping or swaying (via the ankle strategy or hip strategy). Although visual, vestibular and somatosensory functions are known to be contributing factors in maintaining balance, they are not as easily altered as muscle strength and joint range of motion and stiffness. The study aimed To assess the effects of bilateral ankle joint mobilisation on functional balance in community dwelling elderly

Materials and methods: In the present study a convenience sample of 60 community dwelling elderly between the age 65 to 75 years wererandomly and evenly divided into 2 groups :The Experimental Group &Control Group.For the purpose of selecting the subject in the study they were evaluated with the Time Up And Go Test.Maitland joint mobilization three times a week for four weeks was performed for bilateral ankle joint for the experimental group.The Control group were not given any exercises during the study protocol. At the end of 4 weeks, the outcome measures Functional Reach Test (FRT) andOne leg Stance Test (OLST) were assessed pre & post intervention in both the groups and the data was statistically analysed.

Results: Intragroup analysis of both groups pre and post intervention showed statistically significant values for both the outcome measures FRT and OLST (p value< 0.05). Intergroup analysis also showed statistically significant values for outcome measures inferring that experimental group was better than the control group (p value < 0.05).

Conclusion: The study concludes that Ankle joint mobilisation helps in improving the dynamic balance in elderly individuals.

KEY WORDS: Ankle joint mobilisation, Community dwelling elderly, Functional Balance.

Address for correspondence: Dr. Ramzan Mohammed Rafique, Physiotherapist, post Asgani, Taluka Khed, Ratnagiri, Pune, Maharashtra 415708, India. **E-Mail:** ramzanrafique2@gmail.com

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INTRODUCTION

Falls are most frequent cause of accident related injury and are frequently associated with accident related death in the elderly [1]. In India, the prevalence of falls has been estimated as 14 - 53% [2]. While an individual's risk for falling is associated with a variety of sensory, motor, cognitive and environmental variables, it ultimately depends on their frequency of loss of balance episodes and their ability to recover balance by stepping, grasping or swaying (via the ankle strategy or hip strategy) [1,2]. Although visual, vestibular and somatosensory functions are known to be contributing factors in maintaining balance, they are not as easily altered as muscle strength and joint range of motion and stiffness [3,4].

Aging may contribute to balance deficit through

the impairment of the visual, vestibular, and proprioceptive systems, as well as through decreased joint mobility [3,5]. In the case of elderly people who have insufficient exercise, range of motion decreases as atrophy and loss of bone density advances and muscle contractility decreases due to reductions in muscle fiber. According to a study, correlation has been found between range of motion (ROM) at ankle and balance in community dwelling elderly.[1] Foot problems are common in older people and are associated with impaired balance and functional ability. Compared to those who did not fall, fallers exhibited decreased ankle flexibility [1]. Flexibility loss in the ankle joint due to aging may have considerable influence on some activities of daily living [6]. All of these factors result in decreased ability to maintain equilibrium. As a result, the frequency of falls accidents among elderly people increases.

Functional balance is the integration of static & dynamic balance training to maintain or improve Activities of daily living. Among the joints associated with gait & balance the ankle, with its set of movements and forces, plays a primary role in the maintenance and correction of the static and dynamic balance [3]. It also plays a primary role in the maintenance of postural stability [6,7]. Every movement in the ankle is related to maintaining balancing during walking, and the ankle joint also controls the interaction between feet and the ground [3,4].

In orthostatic posture, the feet function as a small support base for the body [4]. Therefore, ankle movement is an essential component of walking and maintenance of equilibrium.

Several therapeutic interventions are available to promote balance and prevent falls among elderly people, such as exercises for muscle strengthening and joint flexibility. Joint mobilizations are believed to increase the ankle's ROM and, thus, in view of the importance of this joint in postural control, to improve balance [3]. According to Kaltenborn, joint mobilization can increase the physiologic and accessory movements by increasing the extensibility of the non - contractile capsular and ligamentous tissues and improve the transmission of afferent information by stimulating the joint mechanoreceptors [3,9].

Also, the combination of increasing afferent activity and enhancing the neuromuscular function of joint stabilizing muscles suggests that joint mobilization may enhance postural control [6]. Considering that the articular mobilization may increase ROM, promote postural control, and improve balance, the aim of this study was to evaluate the effects of bilateral mobilization of the talocrural joint on the balance of community dwelling elderly. Elderly individuals often suffer from fatal or debilitating falls due to the inability to recover from a loss of balance during daily physical activities. They are now being encouraged to participate in exercise-based fall prevention programs that include balance, agility, and strength training [6]. However, some elderly individuals are not capable of performing such programs safely, due to injury, or lack of physical activity [6]. Without a safe, exercise-based, fall prevention program that is easily performed, barely mobile elderly individuals will be less likely to regain mobility and return to daily activity.

The effect of lower extremity strength on balance has been heavily researched; however, most of these studies focus on the effect of hip and thigh strength on balance. Yet, there hasn't been much research done on the effect of ankle mobilization on balance. Thus, the purpose of the study was to find out whether passive mobilization of ankle joint has an effect on improving functional balance in community dwelling elderly.

METHODOLOGY

A convenient sample of 60 subjects were included in the study with 30 subjects in each group following the inclusion criteria

Inclusion Criteria:

· Community dwelling elderly individuals within the age group of 65 –75yrs.

· Elderly individuals with a score of more than 13.5 (at a risk of fall) sec in TUG test.

Exclusion criteria:

Elderly individuals having the following:

· cognitive impairment

· known History of dislocation of lower limb

· Fracture of the lower limb, within the six months prior to inclusion.

· Known history of Neurological disorders or vestibular impairments

· Malignancy

· Bone disease detectable on radiographs

· Excessive pain

· Hypermobility of ankle joint

Systemic connective tissue diseases such as rheumatoid arthritis, in which the disease weakens the connective tissue

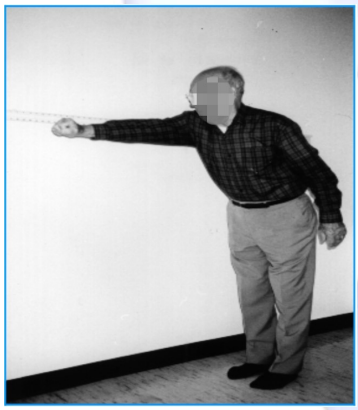
Outcome measures

Functional Reach Test: The subject stood with the back against (but not in contact with) a wall. Subjects were given instructions and encouragements to reach directly forward as far as possible without overbalancing, taking a step or touching the wall. The contralateral arm was by their side during the reach. Both were fully in contact with the support surface throughout the task. The reaching distance was measured within the range in which lower limb flexion and trunk rotation did not occur [5,8].

Interpretation: A score of 6 inches or less indicates a significant increased risk for falls.

A score between 6-10 inches indicates a moderate risk for falls.

Reliability: 0.73-0.99



One leg Balance test: The One Leg Balance test (OLB) is one of the most common tests used to measure balance in older people and is a simple predictive test for injury-related falls.

The subject stood on one leg with the other slightly flexed, first the right and then the left, for as long as possible without shoes, looking at a target. Three trials on each leg were allowed. During the test, the subject was not allowed to move the foot from the floor. The subjects were asked to stand on the right foot and then the left foot and the execution time was measured [5].

Interpretation:

Age Matched norms

Single Limb Stance	Age in years	Mean in seconds
	20-29	30.0
	30-29	30.0
	40-49	29.7+/-1.3
	50-59	29.4+/-2.9
	60-69	22.5+/-8.6
	70-79	14.2+/-9.3

Reliability: 0.75-0.98

Study Participants:

After the approval from the ethical committee a convenience sample of 60 community dwelling elderly between the age 65 to 75 years were recruited for this study after screening the subjects according to the inclusion and exclusion criteria. The written consent and an evaluation Proforma was obtained prior to the study from all the participants.

Method: The subjects selected following the inclusion and exclusion criteria were randomly and evenly divided into 2 groups:

1. The Experimental Group &

2. Control Group

For the purpose of selecting the subject in the study they were valuated with the Time Up And Go Test. For this test the subject was seated on a corner chair and the time for them to get, touch the wall 3 meters in front of them, return and sit on the chair again was measured using a stopwatch [5]. Three trials were performed and the mean time was calculated.Subjects scoring greater than 13.5 were considered as high risk fallers and were included in the study. To measure the Functional Balance of the subjects the following test were performed pre and post intervention :

1. Functional Reach Test

2. One leg Stance Test

Maitland joint mobilization three times a week for four weeks was performed for bilateral ankle joint for the experimental group. The mobilization session consists of Joint Mobilization for Bilateral Talocrural & Subtalar Joint. Grade 3 and grade 4 Posterior gliding of the talocrural joint and Lateral gliding of the subtalar joints with 30 seconds for each mobilization.The Control group were not given any exercises during the study protocol. At the end of 4 weeks, the outcome measures were reassessed in both the groups and the data was statistically analysed.

Statistical Analysis: In the present study we evaluatedthe effect of bilateral ankle joint mobilisation on functional balance in community dwelling elderly.

· Intra group analysis was done using paired t-test.

· Inter group analysis was done using unpaired t- test post intervention for both groups.

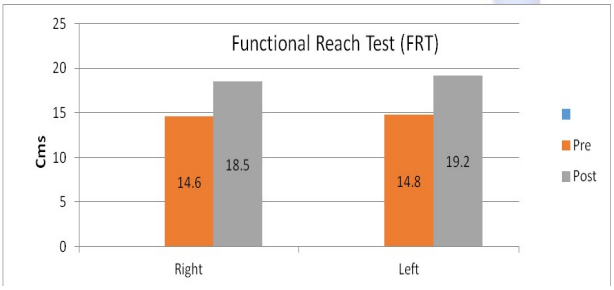
DATA ANALYSIS AND RESULTS

Table 1: Intragroup comparison of mean values pre & post 4 weeks of intervention.

Variables	Mean		t value	p value	interpretation of p value
	Pre	post			
Functional Reach Test (cms)					
Right	14.6	18.5	-12.55	1.51E-13	Significant
Left	14.85	19.24	-10.54	9.95E-12	Significant
One Leg Stance Test (seconds)					
Right	4.66	7.91	-12.24	2.82E-13	Significant
Left	4.7	8.1	-16.78	8.94E-17	Significant

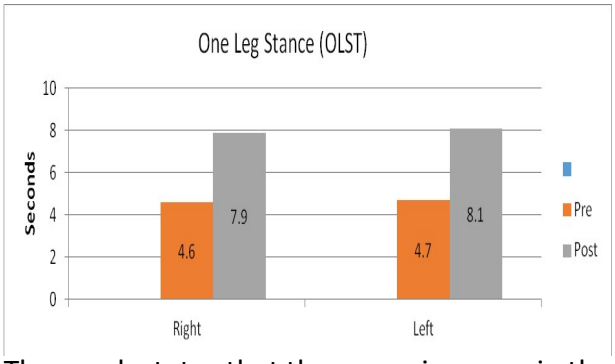
The above table indicates that there was statistically significant difference observed in all the variables pre and post 4 weeks of intervention ($p < 0.05$).

Graph 1a: Comparison of mean of Functional Reach Test of right & left side pre & post intervention in Experimental Group.



The above graph shows that there was increase in the mean FRT value in Experimental Group pre & post 4 week of intervention with significant difference ($p<0.05$).

Graph 1b: Comparison of mean of One Leg Stance of right & left leg pre & post intervention in Experimental Group.



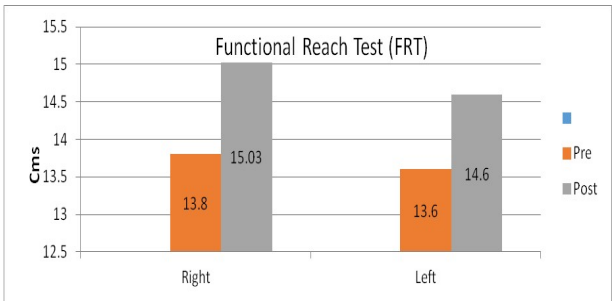
The graph states that there was increase in the mean OLST value in Experimental Group pre & post 4 week of intervention.

Table 2: Intragroup comparison of mean values pre & post 4 weeks in Control Group.

Variables	Mean		t value	p value	interpretation of p value
	Pre	post			
Functional Reach Test (cms)					
Right	13.88	15.033	-7.13	3.70E-08	Significant
Left	13.65	14.68	-6.9	6.83E-08	Significant
One Leg Stance Test (seconds)					
Right	4.86	5.96	-6.59	1.58E-07	Significant
Left	4.88	5.93	-7.36	2.04E-08	Significant

The above data indicates that there was significant difference in all variables ($p < 0.05$) in Control Group.

Graph 2a: Comparison of mean of Functional Reach Test of Right and Left side in Control Group.



Graph 2b: Comparison of mean of Functional Reach Test of Right and Left Leg in Control Group.

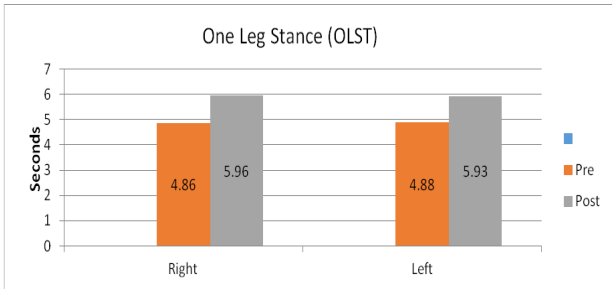
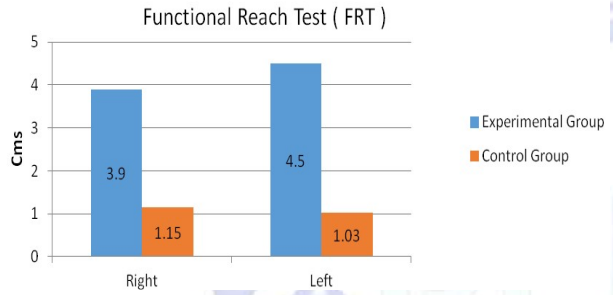


Table 3: Intergroup Comparison of mean difference of variables between Experimental Group & Control Group.

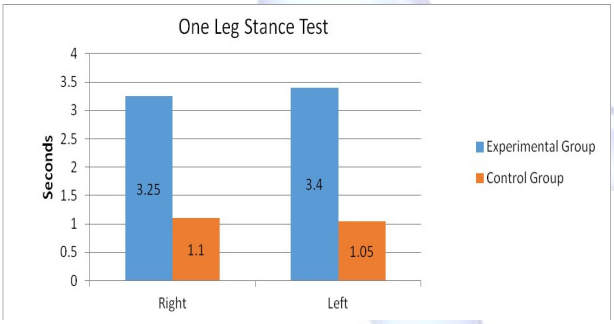
Variables	Mean		t value	p value	interpretation of p value
	Experimental	Control			
Functional Reach Test (cms)					
Right	3.9	1.15	7.86	5.22E-11	Significant
Left	4.55	1.03	8.46	5.14E-12	Significant
One Leg Stance Test (seconds)					
Right	3.25	1.1	6.85	2.56E-09	Significant
Left	3.4	1.05	9.48	1.05E-13	Significant

The above table indicates that there was significant difference observed in all variables with p value less than 0.05. The results state that experimental Group was better than the Control Group.

Graph 3a: Comparison of Functional Reach Test of Right & Left side between Experimental Group & Control Group.



Graph 3b: Comparison of One Leg Stance Test of Right & Left Leg between Experimental Group & Control Group.



DISCUSSION

Table 1 and graph 1a shows the intra-group comparison of Functional Reach Test (FRT) of right & left side of the Experimental Group pre & post 4 weeks of intervention. The mean value of FRT of right side was 14.6 pre intervention & 18.5 post intervention. Whereas, the value of FRT of left side was 14.8 pre intervention & 19.2 post intervention. These results showed an increase in the mean value of FRT in the Experimental Group with statistically significant difference ($p < 0.05$).

Similarly, the mean of One Leg Stance Test (OLST) of right leg pre & post intervention were 4.66 & 7.91 respectively. The mean of left leg was 4.7 & 8.1 pre & post 4 weeks of intervention. This shows that there was improvement in OLST after intervention.

The results demonstrate that ankle joint mobilisation was effective in improving dynamic balance of elderly. Joint mobilisation applied to the ankle joints increases the ankle ROM [5,9]. In addition to the musculoskeletal aspect, control of balance requires coordinated activity of the neuromuscular system. Accurate sensory inputs are necessary to organise motor programs & to generate effective motor responses. Postural control is acquired through sensory information, feedback or feed forward & afferent inputs from muscles and joints, and the foot & ankle play the role of allowing segmental adjustments by stimulating the proprioceptors [5].

Also, studies have proved that proprioception can be stimulated by mobilisation.[5] Similarly, mobilisation modified the transmission of proprioceptive input & improved proprioception & functional performance of lower limb [5,10].

Table 2 & graph 2a displays the intragroup comparison of FRT of right & left side of Control Group. Mean FRT pre & post 4 weeks of study protocol of right side was 13.88 & 15.033 & left side was 13.65 & 14.68 respectively.

Table 2 & graph 2b shows the mean of OLST of the Control Group. The mean of right leg was 4.86 & 5.96 pre & post 4 weeks of study protocol and that of left side was 4.88 & 5.9. These values showed statistically significant difference in both the outcome measures in control group.

The reason for the change in these values in the control group is because the activities of the subjects in control group were not monitored. There was no additional physical activity related assessment done for the subjects of the control group during the 4 week study protocol. Thus, additional physical activity of the subjects caused a significant change in the outcome measures.

Table 3 & graph 3a shows the intergroup comparison of FRT of right & left side between Experimental Group & Control Group. The mean of mean difference of right & left side was 3.9 & 4.55 in Experimental Group. Whereas, that of Control Group was 1.15 & 1.03 pre & post 4 weeks of study protocol.

Table 3 & graph 3b represents the intergroup comparison of OLST between the two groups. The mean of mean difference of right & left leg was 3.25 & 3.4 respectively in the Experimental Group. And, that of OLST of right & left leg was 1.5 & 1.05 pre & post 4 weeks in the Control Group.

These values state that there was significant improvement in the functional balance ability of both the groups. Also, the Experimental Group exhibited a significant improvement in balance following the exercise program as compared wth the Control Group.

The improvement may also be related to mechanical effects. The importance of ROM of the feet and anklejoints with regards to balance and locomotion performance is alsoknown. In our study, changes of jointROM were not measured. Functional Reach Test was the outcome measure for evaluating changes in ROM.Mecagni et al., showed a correalation between ankle ROM & FRT [5]. Vaillant et al., stated that ankle joint ROM plays an imporatant role in balance and locomotion performance and is related to the mechanical effects and increase the effectiveness of balance improvement methods [10].

Thus, the present study concluded that Ankle joint mobilization is effective in improving dynamic balance in elderly.

CONCLUSION

The study concludes that Ankle joint mobilisation helps in improving the dynamic balance in elderly individuals.

Limitations: The activity level of the control group subjects were not recorded. Follow up not done after 4 weeks to assess how long the beneficial effects of ankle joint mobilization last after cessation of the intervention.

Recommendations: Comparison with other forms of balance exercises can be done. Sample size can be larger.

Conflicts of interest: **None**

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