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Research Article

Effect of Short Foot Exercise for Fall Prevention in Elderly Community Dwelling Individuals an Experimental Study

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ABSTRACT

Aim: To study the effect of short foot exercise on fall prevention in elderly community dwelling individuals.

Methodology and analysis: A experimental study was conducted among 26 elderly community dwelling individuals above 60 years of age. Elderly with lower limb fracture, ankle trauma, vestibular impairments, visual impairments, severe neurological impairments, foot ulcers, CVS, respiratory conditions, psychological disorders, any surgery of the lower limb in past were excluded. Risk of fall was assessed using time up and go test, fall efficacy scale.

Result: Normality of the data was calculated by Kolmogorov and Smirnov test, based on normality of the data p value obtained was less than 0.05.

Conclusion: We found that 4 weeks of Short Foot Exercise (SFE) program was effective in reducing risk of fall and fear of fall among community dwelling elderly individuals.

Keywords: Short foot exercise; Fall prevention; Lower limb fracture; Ankle trauma; Vestibular impairments; Visual impairments

INTRODUCTION

Fall is an unaccepted loss of balance that leads to failure of postural stability or it is a sudden and unexpected change in position which usually result in landing on floor [1,2]. Fall is a major cause of dependence in older adults and may result in long term disability, reduced QoL and even death [3]. The risk of fall and fall related injuries increases with age due to loss of agility, visual acuity, side effects from medications predisposing to dizziness and syncope [4]. The incidence of fall is 28%-35% in elderly aged more than 65 years and 32%-42% in elderly aged more than 75 years [5]. In elderly fall leads to considerable mortality, morbidity, reduced functioning and premature hospital admissions [6]. Falls may be caused due to variety of intrinsic and extrinsic factors. The intrinsic (personal) factors include balance impairments, neurological disorders, sensory deterioration, musculoskeletal disorders, postural hypotension etc. The extrinsic (environmental) factors include ill-fitting footwear, poor lighting, slippery surface and inappropriate furniture etc. [7]. The studies have reported that reduced peripheral sensations, muscle weakness, increased reaction time are the contributing factors to postural instability in elderly leading to fall [8]. The human foot is a highly complex structure and it contributes to postural stability in most static and dynamic activities [9].

As the only source of direct contact with the ground during weight bearing tasks, the foot contributes to the maintenance of stability in 2 main ways:

- By providing mechanical support for the body via osteoligentous architecture of the arch and the co-ordinated function of lower limb.
- By the provision of sensory information regarding body position from plantar tactile mechanoreceptors. Therefore deficits in foot such as flexibility, strength, sensation impairments predispose to loss of balance [10].

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Short Foot Exercise (SFE) was first recommended by Janda in 2007 for proper positioning and stimulation of foot muscles.

The Short Foot (SF) is a foot posture with increased Medial Longitudinal Arch (MLA) to improve the biomechanical position of the foot. By training the foot with the SFE and gradually progressing though more difficult stages, we can improve the control of the foot muscles and in turn, create a more stable base of support for the leg, hips and the rest of the body [11].

Janda and Vavrova proposed that short foot exercise is used for balance training intervention that improve ankle proprioception and strengthen the intrinsic foot muscles so as to elevate and support medial longitudinal arch of the foot and improve dynamic standing balance [12].

Short Foot Exercise (SFE) training is an exercise activity has been shown to have an effective means of recruiting the abductor hallucis muscle and to prevent excessive lowering of the medial longitudinal arch. The exercise aims to activate weakened or inhibited intrinsic plantar foot muscles by intensifying and optimizing the soles contact with the floor. Plantar intrinsic muscles originate and insert within the foot itself and function to improve dynamic alignment, control the arch position and stimulate proprioceptors on the sole of the foot to improve balance [13].

Aim

To study the effect of short foot exercise on fall prevention in elderly community dwelling individuals.

Objective

To find the effect of short foot exercise on fall risk. To find the effect of short foot exercise on fear of fall.

MATERIALS AND METHODS

The study design is experimental study. It was conducted in Jalgaon. The duration for the study was 6 months. The method of sampling was convenient sampling and sample size was 26.

Inclusion criteria

- Old adults with the age group of 60 and above.
- Subjects of both genders.
- Subjects with informed consent.

Exclusion criteria

- Lower limb fracture
- Ankle trauma.
- Vestibular impairments or Visual impairments.
- Severe neurological impairments.
- Foot ulcers.
- CVS or respiratory conditions.
- Psychological disorders.
- Surgery of the lower limb in past.

Timed Up and Go (TUG) test

Equipments used: Arm chair, measuring tape, stop watch. The test begin with the subject sitting correctly (hips all of the way to the back of the seat) in a chair with arm rests. The chair should be stable and positioned such that it will not move when the subject moves from sit to stand. The subject is allowed to use the arm rests during the sit–stand and stand–sit movements. A piece of tape was placed on the floor 3 meters away from the chair so that it is easily seen by the subject [13-15].

The subject should be given a practice trial that is not timed before testing.

Cut of score indicating risk of fall in elderly population is >13.5

Fall efficacy scale: On a scale from 1 to 10, with 1 being very confident and 10 being not confident at all, how confident are you that you do the following activities without falling. A total score of greater than 70 indicates that the person has a fear of falling.

Procedure

To conduct the study permission was taken by the ethical committee. An experimental study was administered and subjects were included by convenient sampling based on inclusion and exclusion criteria. The purpose and procedure of the study was explained to the participants and written consent form was obtained from subjects. A brief demographic data of all patients was obtained and participants, who meet the inclusion criteria, were assessed for risk of fall and fear of fall by using time up and go test, falls efficacy scale. Participants performed SFE with 3 sets of 15 repetitions in sitting as well as in standing for 4 weeks daily.

Pre and post-interventions outcome were recorded.

Intervention: Short Foot Exercise (SFE)

To perform SFE, participants were asked to elevate the medial longitudinal arch, shorten the foot in the anterior-posterior line, to approximate the first metatarsal head toward the heel without toe flexion. Elevated MLA position was maintained for 5 seconds in each repetition. First participants performed the exercise in sitting and then standing (stance) 3 sets of 15 repetitions in sitting and standing were performed for both legs, 10 seconds of rest was allowed after every set. and the protocol was performed for 4 weeks (Figures 1 and 2).

IN SITTING

Figure 1: Short foot exercise in sitting.

IN STANDING

Figure 2: Short foot exercise in standing.

RESULTS

Total 26 samples were collected for the study, assessment and analysis was carried out (Table 1). In our study, the mean age and standard deviation of participants was 71.6 ± 6.4 as shown below (Figures 3 and 4).

Table 1: Shows the baseline data of participants based on age and gender.

S. no.	Variables	Groups	Frequency	Percentage
1	Age	60-70	10	38.40%
		71-80	14	53.80%
		81-90	2	7.60%
2	Gender	Male	9	34.60%
		Female	17	65.30%

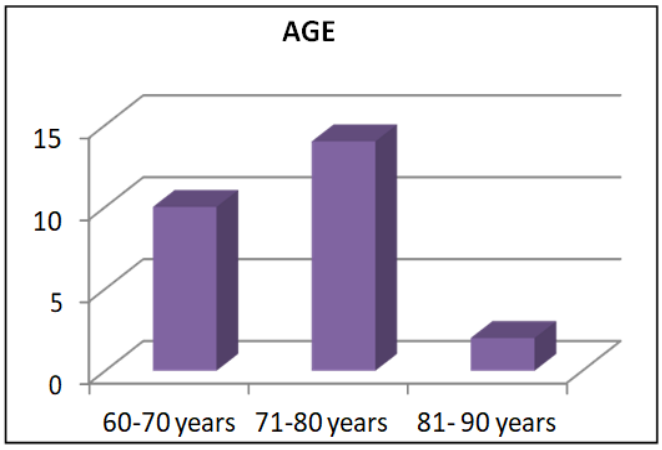

Figure 3: Shows the baseline data of participants based on age.

Inference: Maximum individuals were of age group 71-80 years (n=14).

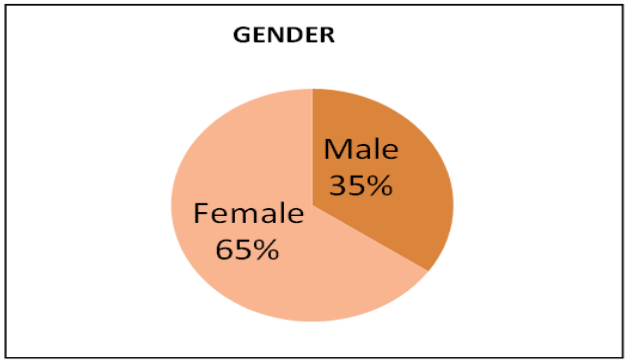

Figure 4: Shows the baseline data of participants based on gender.

Inference: Maximum individuals were females (n=17).

Table 2 and graph shows the pre and post-mean and standard deviation of time up and go test, which shows there is statistically significant improvement in duration of time up and go test (Figure 5).

Table 2: Shows the pre and post mean and standard deviation of time up and go test.

Test	n	Mean	SD	P-value	Significance
Pre	26	17.46	6.2	<0.0001	Extremely significant
Post	26	16.7	5.9		

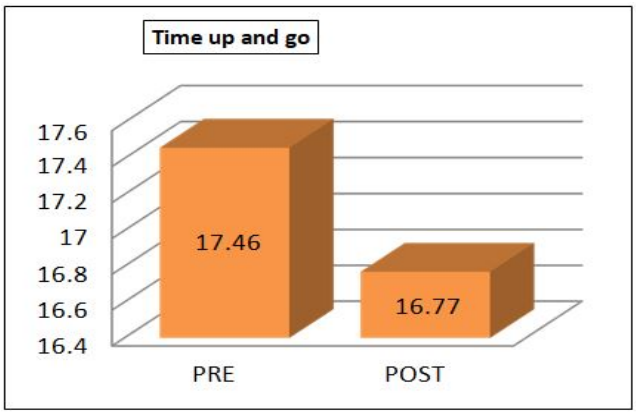

Figure 5: Graph shows the pre and post mean and standard deviation of time up and go test.

Table 3 and graph shows the pre and post mean and standard deviation of fall efficacy scale, which shows there is statistically significant improvement in score of fall efficacy scale (Figure 6).

Table 3: ws the pre and post-mean and standard deviation of fall ef

Test	n	Mean	SD	P-value	Significance
Pre	26	56.4	12.7	<0.0001	Extremely significant
post	26	53.4	12.8		

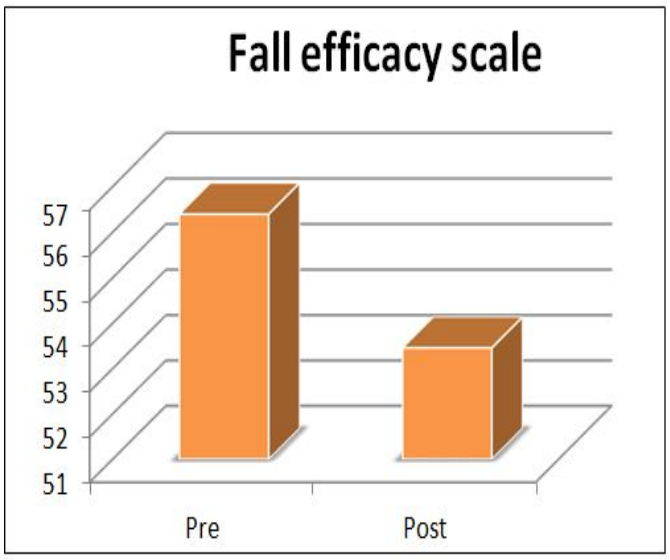

Figure 6: Graph shows the pre and post mean and standard deviation of fall efficacy scale.

DISCUSSION

This study was conducted to find the effect of short foot exercise for fall prevention in elderly community dwelling individuals.

Total 26 participants were included in the study according to the selection criteria. The results showed that SFE for 4 weeks reduce the fall risk and fear of fall significantly in community dwelling elderly individual.

As fall is one of the major leading causes of unintentional injury related death in elderly population it is important to prevent fall and fall related injury.

The foot is a direct interface between the body and ground so it contributes to postural stability in most static and dynamic activities. The intrinsic foot muscles such as abductor hallucis, flexor digitorum brevis and interosseus contribute to stabilize the foot arch during propulsion. SFE activates the intrinsic foot muscle while the long flexors are relaxed. The abductor hallucis is largest foot intrinsic muscles and it acts during flexion of first MTP joint.

The study conducted by Scott K. Lynn, Ricardo A. Padilla on Differences in Static and Dynamic-Balance Task Performance After 4 Weeks of Intrinsic-Foot-Muscle Training: The Short-Foot Exercise Versus the Towel-Curl Exercise (TCE) suggested that the SFE is more effective than the more traditional TCE at training the IFM to maintain the height of the MLA during dynamic-balance tasks [16].

According to the EMG study conducted by Do-Young Jung a, Moon-Hwan Kim on A comparison in the muscle activity of the abductor hallucis and the medial longitudinal arch angle during toe curl and short foot exercises concludes that SF exercise is a more useful strengthening exercise than TC exercise in activating the AbdH muscle and in preventing lowering of the MLA. Which stabilizes the 1st meta tarsal head agaist the ground during propulsion [17].

According to the previous study conducted by Hylton B menz, Meg E morris et al in 2005 on foot and ankle characteristics associated with impaired balance and functional activity in older people. Concluded that foot and ankle characteristics, particularly tactile sensitivity, ankle flexibility and toe strength are important determinants of balance and functional ability in older people. Intervention studies to reduce risk of falling may possibly benefit from agumenting sensory information from the foot and the inclusion of strecting and strengthening exercises for foot and ankle [10].

Another study conducted by Eunsang Lee, Juchul Cho on short foot exercise promotes quantitative somatosensory function in ankle instability: A Randomised control trail concludes that SFE training significantly improves proprioception and dynamic balance in patients with ankle instability who have experienced recurrent ankle sprain and it was more effective than proprioceptive sensory training (PSE) [18].

The study conducted by patrick o McKeon, Jay Hertel on the foot core system a new paradigm for understanding intrinsic foot muscle function in 2017 includes the mechanism that foot core system consists of 3 subsystems which include neural, passive and active subsystems in which active subsystem consists of intrinsic foot muscles (local stabilizers),extrinsic foot muscles (global stabilizers) and training the intrinsic foot muscles of foot has been shown to improve balance and agility. There is evidence which suggests strengthening the IFM can improve arch height index and dynamic balance [19].

So the above mechanisms supports that short foot exercise can effectively reduce the fall risk and fear of fall by strengthing the intinsic foot muscles and increasingfoot proprioception leading good quality of life in elderly community dwelling individuals.

CONCLUSION

The present study concludes that 4 weeks of Short Foot Exercise (SFE) program is effective in reducing risk of fall and fear of fall among community dwelling elderly individuals.

LIMITATIONS

- SFE needs some practice.
- Study includes relatively small sample size.
- The assessment was directly taken prior to the exercise protocol and directly after 4 weeks of protocol. In between no assessment was taken.

CLINICAL IMPLICATIONS AND FUTURE SCOPE

- Short foot exercise can be used as adjunct to other forms of exercises which are used for fall prevention in elderly.
- It can be carried out easily and it is cost efficient.
- Individual can perform this exercise at any given time irrespective of place.
- Further studies must be conducted to see the long term effects of SFE after intervention.

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