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Unique Impact of Strengthening of Ankle Eversion Muscles with Proprioceptive Indoctrination in Older Adults for Fall Prevention- A Case Report

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ABSTRACT

Falls are a major concern for older adults, with around one-third of individuals aged 65 and above experiencing them. Key contributors to these falls include muscle weakness-particularly in the ankle eversion muscles-and compromised proprioception. These factors not only lead to significant injuries but also contribute to considerable healthcare costs and impacts on quality of life. This case study aims to enhance our understanding by examining the impact of strengthening ankle eversion muscles alongside proprioceptive training in older adults who have a history of recurrent falls.

To measure outcomes, we utilized muscle strength grading for the ankle eversion muscles, the Timed Up and Go (TUG) test, and the Berg Balance Scale (BBS), and readings were noted on pre and post-treatment. Current study findings demonstrate that the unique impact of strengthening ankle eversion muscles with proprioceptive indoctrination in older adults for fall prevention can effectively improve balance and reduce the risk of falls in older adults.

The notable enhancements in muscle strength, balance, and functional mobility seen in this patient underscore the necessity of integrating these exercises into fall prevention strategies. As our population continues to age, implementing evidence-based interventions like this becomes essential to ensure the health, safety, and independence of older adults.

Keywords: Fall prevention, Strengthening ankle eversion muscles, Proprioception training, older adults.

INTRODUCTION

According to estimates, one-third of people 65 and over fall each year, making falls one of the leading causes of injury in this age group (1). Muscle weakness, particularly in the ankle eversion muscles, and impaired proprioception are critical factors contributing to falls (2). Falls are a major public health issue for older persons, causing morbidity, mortality, and healthcare expenditures, and causing fractures, brain trauma, and death (3).

Both internal and external factors contribute to falls in the elderly. Intrinsic factors include muscle weakness, balance issues, and diminished proprioception, while extrinsic factors include environmental dangers. Lower extremity muscle weakness,

particularly in the ankle joint, increases fall risk, especially during unstable activities (4).

Through proprioceptive input from the muscles, tendons, and joints, the central nervous system receives information necessary for balance and movement coordination. Because proprioceptive acuity decreases with age, balance is compromised, and the risk of falls increases (5). Exercise-based treatment has attracted increasing attention recently as a form of fall prevention. Similarly, the benefits of interventions that combine physical and cognitive elements, such as proprioceptive exercises, in improving overall functional outcomes(6).

By examining the outcomes of the intervention program, this case report seeks to provide insights into the practical application of these research findings in a clinical setting.

Despite the evidence supporting the benefits of strength and proprioceptive training, there is limited research specifically targeting muscles of ankle eversion strengthening in conjunction with proprioceptive exercises. Given the critical role of the ankle muscles for eversion in lateral stability and the prevention of foot inversion, the combined intervention focusing on these muscles, alongside proprioceptive training, could provide a more comprehensive approach to fall prevention in older adults.

This case report aims to contribute to the existing body of knowledge by exploring the unique impact of strengthening ankle eversion muscles with proprioceptive indoctrination in older adults for fall prevention

Patient Information

The patient is a 72-year-old male who came to OPD with a history of recurrent falls, reporting three falls in the past year with no significant injuries. He has a history of osteoarthritis in the knees.

Clinical Findings

The patient demonstrated weak eversion muscles with a manual muscle testing grade of 3/5 bilaterally, impaired proprioception in the lower limbs, and Muscle tightness of bilateral tendo-achillis, piriformis, and hamstrings.

Follow-up and Outcome Measures

Outcome measures included manual muscle strength grading of the muscles of ankle eversion, the Berg Balance Scale BBS(7), and the Timed Up and Go (TUG) test (8). Reading was noted on pre and post of treatment.

Therapeutic Intervention

The intervention comprised a 12-week program conducted three times per week, which integrated ankle eversion muscle strengthening and proprioceptive exercises with standard physiotherapy treatment. The typical physiotherapy regimen included hamstring curls (10 repetitions in two sets), dynamic quadriceps exercises (10 repetitions in two sets), and free leg swings (10 repetitions each) in the anterior, lateral, and posterior orientations. Hip flexion, abduction, and extension otago exercises were also conducted while standing with a half-kilogram weight cuff (9). Bilateral muscle stretching was performed for the tibialis anterior, piriformis, and hamstrings (holding for 15 seconds, three sets), along with mini-squats for 15 repetitions.

Table 1. Therapeutic Intervention

Phase I (weeks 1–4):
Exercise 1 involved resisting ankle eversion using elastic bands. Participants sat with their legs extended, with the band around the forefoot, and performed three sets of 10–15 repetitions per side. (as shown in Figure 1)
Exercise 2 consisted of isometric eversion holds. Participant pressed their foot against a stable surface (shown in Figure 2, e.g., a wall) in an eversion position for five seconds, completing three sets of 10 repetitions per side.

Exercise 3 required standing on one leg for 20-30 seconds, with three sets per side. **Exercise 4** included ankle perturbation exercises on a firm surface as demonstrated in Figure 3, in which the ankle was gently nudged while the participant maintained balance(10).
Phase II (weeks 5–8): Progression involved increasing the resistance of the elastic bands and extending the hold time in isometric exercises to ten seconds. Standing eversion exercises with added resistance bands were also performed. Unstable surfaces, such as foam pads or wobble boards, were incorporated for double-leg perturbation and weight shifts. Single-leg stance and perturbation exercises were performed on these surfaces as demonstrated in Figure 4 **Exercise 5** involved a tandem stance on an unstable surface, as shown in Figures 5 and 6, progressing to a single-leg stance(11).
Phase III (Weeks 9–12): **Exercise 6** Involved lateral bands walking, where participants stood with a resistance band around their ankles and took side steps while maintaining band tension, performing three sets of 10 steps in each direction. **Exercise 7** involved eccentric ankle eversion, where participants slowly controlled the return movement after pushing against resistance, completing three sets of 8-12 repetitions per side. **Exercise 8** included dynamic balance exercises, such as stepping over objects, walking on uneven terrain, and lateral weight-shifting on an unstable surface. **Exercise 9** involved functional reach tasks as performed in Figure 7, while standing on an unstable surface to further challenge proprioception (12).

Figure 1 Resisting ankle eversion using elastic bands

Figure 2 Participants pressed their Foot against a stable surface

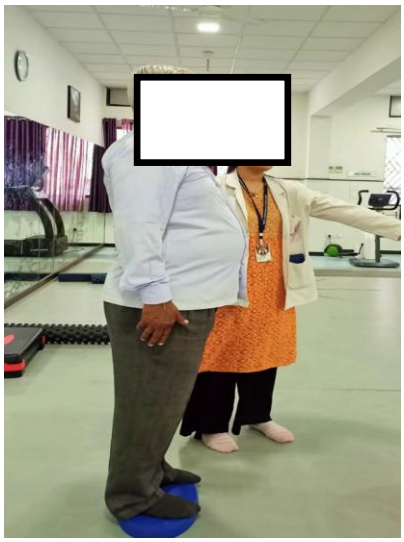

Figure 3 Ankle perturbation exercises on a firm surface

Figure 4 Progression Single-leg stance

Figure 5 Tandem stance on an unstable

Figure 6 Stepping over objects

Figure 7 Functional reach tasks while standing on an unstable surface to challenge proprioception

Table 2 Outcome of Ankle Muscles Strengthening and Indoctrination in Older Adults Pre-Post

Outcome Measures	Manual Muscle Testing (MMT) for Lower limb ankle eversion muscles bilaterally	Berg Balance Scale (BBS)	Time Up and Go Test (TUG)
Pre-treatment Score	Ankle eversion grade 3 out of 5 on both sides.	15, indicating a high risk of fall.	40 seconds,
Post-treatment Score	Ankle eversion grade 4 out of 5 Improved for ankle eversion muscles	11, indicating a reduced risk fall.	50 seconds,

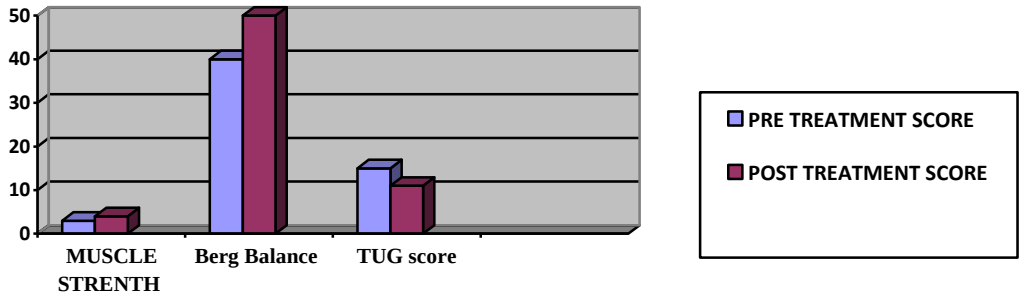

Figure 8 Pre- and post-intervention graphical representation of ankle muscles strengthening and indoctrination in Older Adults Pre-post

DISCUSSION

The evidence suggests that integrating ankle eversion muscle strengthening with proprioceptive exercises can substantially reduce the risk of falls in older adults by enhancing muscle strength and proprioceptive skills. This case supports the inclusion of these strategies in fall prevention programs for seniors, aligning with recent studies that emphasize the importance of lower limb strength and balance in minimizing fall risk(12).

The findings from this case report demonstrate that a 12-week program combining ankle eversion muscle strengthening with proprioceptive training effectively decreased fall risk in older adults with a history of frequent falls. The significant improvements in ankle eversion strength, balance, and functional mobility underscore the potential of targeted exercise programs to mitigate fall risk among the elderly. Ankle eversion muscles play a crucial role in maintaining lateral stability, particularly during balance-challenging activities such as walking on uneven terrain or making abrupt directional changes. Weakness in these muscles can result in ankle inversion, thereby increasing the likelihood of falls. Initially, the patient exhibited a manual muscle strength grade of 3 out of 5 for the ankle eversion muscles, which improved to 4 out of 5 following the intervention utilized in the current study. This improvement is clinically significant, as even a slight increase in muscle strength can markedly enhance an individual's ability to maintain balance and prevent falls.

Incorporating proprioceptive training into the intervention was essential for the positive outcomes. There exists a weak to moderate correlation between proprioception and both dynamic and static balance control, as well as between cutaneous sensitivity and static balance control. Furthermore, a weak to moderate association is observed between muscle strength and dynamic balance control.(13).

The proprioceptive exercises employed in this case, such as single-leg stance and dynamic balance tasks on unstable surfaces, were designed to challenge and enhance the patient's proprioceptive abilities.

The substantial improvement in the patient's Berg Balance Scale (BBS) score from 40 to 50 indicates that these exercises effectively enhanced her balance and reduced her fall risk. The reduction in the Timed Up and Go (TUG) test time from 15 to 11 seconds further corroborates the intervention's effectiveness. The observed improvement in TUG time suggests that the intervention not only improved the patient's strength and balance but also translated into better functional mobility and, consequently, a lower risk of falling. This finding is consistent with previous studies that have demonstrated that exercise interventions focusing on strength and balance can significantly reduce fall risk in older adults (14).

The combined approach of strengthening and proprioceptive training is supported by current evidence-based guidelines that recommend multimodal exercise programs for fall prevention in older adults. Research has shown that interventions combining strength, balance, and proprioceptive exercises are more effective in reducing fall risk than single-component programs (12). This case report adds to the body of evidence by demonstrating the practical application of such an intervention in a clinical setting.

As this was a single case study, the findings cannot be generalized to all older adults. Additionally, the intervention duration was relatively short, and long-term follow-up is necessary to determine whether the observed benefits are sustained over time. Future research should aim to replicate these findings in larger, more diverse populations and explore the long-term effect of combined ankle eversion muscles strengthening and proprioceptive training on fall prevention.

CONCLUSION

The case report findings demonstrate a unique impact of strengthening ankle

eversion muscles with proprioceptive indoctrination in older adults for fall prevention that emphasizing how enhancing the strength of ankle eversion muscles can significantly improve balance and reduce fall risk in older adults.

The positive changes in muscle strength, balance, and overall mobility seen in this patient underscore the necessity of including these targeted exercises in fall prevention strategies. As our population ages, implementing such evidence-based methods becomes increasingly vital for ensuring the health, safety, and independence of older adults.

Clinical Implication:

Focusing rehabilitation efforts on strengthening eversion muscles and integrating proprioceptive training is essential for preventing falls among older adults. This strategy not only improves safety and mobility but also enhances ankle muscle strength during rehabilitation. Continued research in this field will provide valuable insights for patients, researchers, and students in academia.

Declaration by Authors

Informed Consent: Informed written consent was obtained from the patient to enrol in the current study.

Acknowledgement: We acknowledge the patient's participation in the study.

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Conflict of Interest: The authors declare no conflict of interest.

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