

Comparison of Toe Plantar Flexors Strength and Balancing Ability between Elderly Fallers and Non-fallers

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Abstract. [Purpose] We compared the differences in individual toe flexor muscle strength and balancing ability between elderly fallers and non-fallers and determined the correlation between individual toe flexor muscle strength and the functional reach test (FRT). [Subjects] Thirty community-dwelling older adults (15 fallers and 15 age- and sex-matched non-fallers) between 65 and 83 years of age participated in this study. [Method] Individual toe flexor muscle strength was measured using a dynamometer, and balance ability was assessed with the FRT, Berg balance scale, and a sensory organization test (SOT). [Results] The hallux and second toe flexor muscle strengths in the non-faller group were significantly stronger bilaterally than those in the faller group, whereas no significant differences in the third and fourth toe flexor muscle strengths were found. The individual toe plantar flexor muscle strengths were moderately correlated with FRT ($r = 0.489-0.765$). The non-faller group showed significantly greater balance ability in the FRT and SOT than the faller group. [Conclusion] The results of this study suggest that the force-generating capability of the hallux and second toe flexor muscle are related to the incidence of falls among elderly individuals.

Key words: Toe plantar flexors strength, Balance, Faller

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INTRODUCTION

Falls are defined as “events that result in a person coming to rest unintentionally on the ground or other lower level, not as the result of a major intrinsic event or overwhelming hazard”¹⁾. Fall injury is one of the major factors reducing the quality of the life of elderly people. One third of community-dwelling elderly people aged 65 years or over have reported falling at least twice a year^{2,3)}. An elderly person who has experienced a fall worries about other accidents and feels less confident while performing physical and social activities⁴⁻⁶⁾. Accordingly, it is essential for elderly individuals to maintain their balance ability through postural control so that they can perform activities of daily living safely.

In order to maintain the center of gravity on the base of support while carrying on activities of daily living, it is necessary to integrate information from the visual, vestibular, and somatosensory systems. Information on body movements is perceived by the sensory systems, integrated by the central nervous system, and then passed on

to the effector, the musculoskeletal system. Sufficient strength in the lower limb muscles is essential for maintaining static and dynamic balance. Many studies have considered muscle weakness in the lower limbs of elderly people as one of the major factors leading to fall accidents and injuries⁷⁻¹⁰⁾. The decline in muscle strength in the lower limbs with aging is responsible for balance impairment¹¹⁾. Some studies have demonstrated that the muscle strength in the lower limbs of elderly individuals is highly correlated with their walking and balance ability¹²⁾. Chu et al.¹³⁾ reported that risk factors leading to injuries in falls were weakness of the lower limbs and unstable tandem walking.

Like the hip, knee, and ankle joints and surrounding muscles, the toes play an important role in maintaining stability during forward reach and forward propulsion during walking^{1,14)}. Menz et al.¹⁴⁾ reported that the strength of the toe plantar flexor muscles was a significant independent predictor of the balance and functional abilities of elderly people. However, they measured the overall toe plantar flexor strength using a paper-grip test rather than individual toe plantar flexor muscles. Therefore, this study