



Original Article

Effects of wearing ankle weight on knee joint repositioning sense in the elderly

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Abstract. [Purpose] To investigate the effects of different ankle weights on knee joint repositioning sense in elderly individuals. [Subjects and Methods] Twenty-one subjects were divided for assessment as follows: young (20–30 years, n=10) and elderly (60–70 years, n=11). Knee joint repositioning error was measured by asking the subjects to reposition the target angle of their knee joints while wearing different ankle weights (0%, 0.5%, 1%, and 1.5%) in an open kinetic chain. The Hawk Digital System (60 Hz; Motion Analysis, Santa Rosa, CA, USA) was used to measure knee joint repositioning error. Differences in knee joint repositioning error between the young and elderly groups according to ankle weight load were examined by using two-way mixed repeated-measures analysis of variance. [Results] The knee joint repositioning error was lower with than without ankle weights in both groups. The error value was lowest with the 1.0% weight, though not significantly. Knee joint repositioning error was significantly higher in the elderly under all the ankle weight conditions. [Conclusion] Knee joint repositioning sense can be improved in elderly individuals by wearing proper ankle weights. However, weights that are too heavy might disturb knee joint positioning sense.

Key words: Knee joint, Repositioning sense, Ankle weight

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INTRODUCTION

Proprioception has been shown to decline with age, and reduced proprioception in elderly individuals has been suggested to be responsible for the initiation and advancement of degeneration^{1, 2)}. Joint positioning sense, an element of proprioception³⁾, indicates the ability to reproduce and perceive previous predetermined joint positions or ranges of motion⁴⁾. Joint repositioning error increases in individuals with muscle fatigue or osteoarthritis of the knee^{5, 6)}. Interventions such as kinesio taping, ice application, and therapeutic exercise have been used to improve the repositioning sense of the knee joint in individuals with knee injury^{7–9)}. In particular, Barnett et al. reported that ankle weights are useful for ankle stability and that they should be minimized in order to maximize walking velocity¹⁰⁾. In addition, Odéen et al. reported that using ankle weights while walking could reduce muscle tone in patients with spastic paraplegia¹¹⁾. Several studies on the relationship between joint positioning sense and age have been published recently^{12, 13)}. Bullock-Saxton et al. reported that knee joint positioning sense decreased with increasing age¹⁴⁾. By contrast, Franco et al. suggested that joint positioning sense does not differ between young and elderly individuals¹²⁾. Joint positioning sense is becoming increasingly recognized as an important clinical indicator of functional capacity. The relationship between age and proprioceptive sense in functional stability is of great concern to clinicians⁶⁾. Therefore, the purpose of this study was to investigate the effects of different ankle weights on knee joint repositioning sense in elderly individuals.

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SUBJECTS AND METHODS

Twenty-one subjects were divided into two age groups for assessment as follows: young (20–30 years, n=10) and elderly (60–70 years, n=11). The exclusion criteria were as follows: (1) significant injury of the dominant leg within the prior 6 months; (2) history of neurological disorders; (3) history of surgery, including total knee replacement; and (4) history of serious degenerative knee joint disease. The subjects' characteristics are shown in Table 1. Approval for the study was obtained from the Kyungshung University Human Ethics Committee, and informed consent was obtained from all the subjects prior to their participation in the study. To measure knee joint repositioning error while wearing ankle weights, the subjects were asked to reposition the target angle of the knee joint while wearing randomly different ankle weights (0%, 0.5%, 1%, and 1.5%) in an open kinetic chain. The test was started with the subject sitting on a table, with 90° knee flexion and 90° hip flexion. After practicing the various target knee joint angles, the subjects were verbally asked to extend the knee 30°, 45°, and 60°, in random order, from the start position. The subjects were asked to maintain for 10 seconds the knee joint angle that they thought was the target angle before returning to the start position. The Hawk Digital System (60 Hz; Motion Analysis, Santa Rosa, CA, USA) was used to measure knee joint repositioning error. During the positioning attempts, the subjects were induced to reach the target angles by real-time monitoring of the interior angles between the vector from the anterior superior iliac spine to the lateral femoral epicondyle and the vector from the lateral femoral epicondyle to the lateral malleolus. The knee joint repositioning error angle was defined as the difference between the passively induced target knee joint angle and the actively induced knee joint angle, using a musculoskeletal model provided by the SIMM version 6.2 program. For each condition, the knee joint repositioning test was conducted three times, and the average of the error angle values was used in the data analysis. Differences in knee joint repositioning error between the young and elderly groups according to ankle weight load were examined by using two-way mixed repeated-measures analysis of variance. Statistical significance was defined by a probability level of $p < 0.05$.

RESULTS

Knee joint repositioning error was generally lower with than without ankle weights in both groups. It is interesting that the error value was lowest with the 1.0% ankle weight among the other conditions. However, the difference was not significant. Knee joint reposition error was significantly higher in the elderly group than in the young group under all the ankle weight conditions ($p < 0.05$; Table 2). No interaction was observed between ankle weight and age group ($p = 0.84$).

DISCUSSION

In a previous study, Chou et al. stated that physiological changes associated with aging lead to decreased functionality and reduced independence¹⁵. Physiological changes include a progressive reduction in the visual, vestibular, and proprioceptive senses that are essential to maintaining and recovering balance¹⁶. Deterioration in joint proprioception, including joint positioning sense, has been postulated to result in increased body sway¹⁷, increased risk of falling¹⁸, and changes in gait pattern¹⁹. In clinical practice, the joint repositioning error test is one of a number of tests used to evaluate proprioceptive sense in the extremities. Age-related decline in knee joint repositioning sense has been reported by several researchers^{20, 21}.

Table 1. Subjects' characteristics (mean \pm SD)

Variable	Group	
	Young (n=11)	Elderly (n=10)
Age (years)	23.3 \pm 2.2	65.8 \pm 5.8
Height (cm)	172.5 \pm 6.2	160.8 \pm 8.5
Weight (kg)	72.6 \pm 7.8	68.6 \pm 6.4

Table 2. Comparisons of the knee joint reposition error depending on different ankle weights (mean \pm SD) (Unit: degrees)

Group	Ankle weight			
	0 kg	0.5 kg	1.0 kg	1.5 kg
Young (n=11)	2.71 \pm 1.24	2.49 \pm 1.33	2.00 \pm 1.28	2.52 \pm 1.14
Elderly (n=10)	4.49 \pm 1.76*	3.53 \pm 1.85*	3.38 \pm 1.26*	3.93 \pm 1.57*

* $p < 0.05$, significantly different between the young and the elderly.

The main purpose of this study was to compare knee joint positioning sense between the young and elderly populations, and to determine whether ankle weight could reduce knee joint repositioning error. The results of this study showed a statistically significant difference in knee joint positioning sense between the young and elderly groups. These results are similar to the findings of Bullock-Saxon et al., who reported that elderly individuals tended to overshoot the target angle more often than young individuals¹⁴). On the other hand, Franco et al. found no significant differences in joint positioning sense between young and elderly adults. However, their elderly group showed lower sensitivity in the two-point discrimination test than their young group¹²). It is interesting that knee joint repositioning error was lower with 0.5% and 1.0% ankle weights than without weights, but increased with 1.5% ankle weights. Therefore, although ankle weights are useful for improving joint positioning sense, too high of a weight can disturb the proprioceptive systems. According to Bernett et al., light ankle weights improved walking speed and minimized oxygen consumption¹⁰).

The limitations of this study were the small sample size, which may have influenced the outcome, and possible measurement errors. Nevertheless, the results indicate that knee joint repositioning sense can be improved in elderly individuals by wearing proper ankle weights. It should be noted that weights that are too heavy can disturb knee joint positioning sense.

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