INTRODUCTION

Knee osteoarthritis (OA), which occurs symptomatically in approximately 11% of 65 years of age and older, account for more mobility disability in the elderly than other disease. Although surgical treatment such as high tibial osteotomy and total knee replacement have been providing successful results for knee osteoarthritis, there is a need to improve conservative treatment as cost-effective and non-invasive care for the patients.

A lateral wedged insole is widely used as conservative treatment for patients with medial knee OA. Several studies have reported clinical and biomechanical effect of the insole. Toda [1] reported that the lateral wedged insoles with elastic strapping of the subtalar and ankle joint changed femorotibial angles (FTA) and talar tilt angles in medial knee OA patients. They showed that the strapping insole had clinically better effects than conventionally used lateral wedged insole. Our previous study revealed that the knee joint load in medial compartment was reduced with use of ankle strapping insoles in patients with moderate knee OA [2]. However, it was not clear whether the insole have any adverse effects on the ankle.

The purpose of this study was to quantify the changes in knee and ankle joint loads during gait with use of two types of lateral wedged insole in medial knee OA patients. We hypothesized that the strapping insole changes the dynamic loads in the knee as well as the load in the ankle joint.

METHODS

Twenty-eight OA knees in 17 patients (16 women, 1 man) were involved in this study. The patients were 67 to 81 (mean 73) years old and had radiographic OA of at least grade 2 severity according to the Kellgren-Lawrence scale. Before the examination, Institutional Review Board for this study and informed consent were obtained for all subjects. The patients were tested at gait laboratory, using a four camera system (Pro-reflex, Qualysis) and a force plate (AM6110, Bertec) with a sample frequency of 120Hz and with 6 retro-reflective markers on the limb [3]. Knee mechanics was calculated using an inverse dynamics approach. The patients performed level walking at their comfortable walking speed. They were tested barefoot (without insoles), wearing lateral wedged insoles (conventional insole) and wearing lateral wedged insoles with strapping (strapping insole) on both sides. The order of testing of each condition was randomized. A silicon rubber of 10mm lateral wedge was used for two types of insoles. The peak knee adduction moment in stance phase and walking speed were evaluated by Wilcoxon signed-ranks test. Statistical significance level was set at p<0.05.

RESULTS AND DISCUSSION

Peak knee varus moment (knee adduction moment) during walking without insole, with the conventional insole and with the strapping insole were 4.5±2.0, 4.3±1.9, 4.1±1.7 (%BW*Ht) respectively and they were statistically different (Figure 1). The reductions in the peak knee adduction moment were larger with the strapping insole compared to the conventional insole. The strapping insole reduced the peak knee varus moment by 7.9% compared to bare foot, and the conventional insole reduced the moment by 4.4% compared to bare foot. On the other hand, peak ankle varus moment during walking without insole,
with the conventional insole and with the strapping insole were 1.8±1.1, 1.8±1.2, 1.8±1.0 (%BW*Ht), respectively. There were no statistically differences among the three conditions (Figure 2).

There were no statistically differences in walking velocity and cadence among the three conditions (Table 1).

![Figure 1](image1.png) **Figure 1** Peak knee varus moment during gait.

![Figure 2](image2.png) **Figure 2** Peak ankle varus moment during gait.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Walking speed and cadence with each condition (mean±SD).</th>
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<tbody>
<tr>
<td></td>
<td>Barefoot</td>
</tr>
<tr>
<td>velocity (m/s)</td>
<td>0.68±0.21</td>
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<tr>
<td>cadence (stride/min)</td>
<td>104±13</td>
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The results supported our hypothesis that both insoles changed the dynamic loads at the knee, but did not change the loads at the ankle.

Valgus in talocalcaneal angle would be induced by both lateral wedged insoles. The varus deformity of the knee should not be changed by conventional lateral wedged insole, because valgus inclination of the calcaneus occurs in the subtalar joint, and it should cancel the effect of the lateral wedge. Since the elastic strap would fix the subtalar and ankle joint, the strapping insole should cause valgus inclination of the talus and tibia, and result in correction of varus alignment of the limb in patients with knee OA. As the varus deformity was corrected by strapping insoles and mechanical axis shifts laterally, they may effect to reduce the load in medial compartment of the knee.

Toda et al reported that the FTA was corrected when wearing strapping insole in patients with knee OA [2]. However, the influences on the ankle joints during gait wearing strapping insoles were not examined. Although our analysis was limited on the coronal plane moment, there was no change in the dynamic load in the ankle with use of the strapping insole. Therefore, it is recommended to use this type of insole as an effective and primary treatment for medial knee OA.

**SUMMARY/CONCLUSION**

Strapping insoles had greater effect to reduce the joint load at the knee and had little influence to the load at the ankle joint. The strapping insole can be used as an effective conservative treatment for the medial knee OA patients.

**REFERENCES**