THE EFFECTS OF ANKLE FOOT ORTHOSIS-FOOTWEAR COMBINATION ON GAIT PARAMETERS IN ASYMPTOMATIC ADULTS

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SUMMARY
In this study, the effects of Solid AFO – footwear combination on gait performance were analyzed in 24 healthy adults. Data of the Walk Across testing of the Balance Master System were compared between AFO-shoe and AFO alone conditions. The results of this study reveal a statistically significant decrease in the walking speed and step length, and no effects on step width when wearing AFO without shoe compared with AFO–footwear combination.

INTRODUCTION
Ankle-foot orthoses (AFO) are commonly prescribed in a variety of neuromuscular disorders such as stroke[1], cerebral palsy[2], multiple sclerosis[3] as well as some peripheral neuropathy like diabetes[4] to improve stance phase stability and swing phase clearance during gait[5].

Basically, AFOs are integrated with footwear[6]. Actually proper tuned AFO realigned the ground reaction force (GRF) to optimize kinetics and kinematics of gait[7]. Cook and Cozzens[8] described the consequence of tuning AFOs or shoe heel height to maximize efficiency of AFOs more than 20 years ago. However, there are only a few reports on the role of tuning in AFO intervention[6, 9]. In some societies people do not use any foot wear while indoor which may affect the effectiveness of AFO. To the best of our knowledge nobody had examined the exclusive effect of shoe combination with AFO.

The purpose of our study was to compare the effect of AFO with and without shoe on gait characteristics in asymptomatic adults. It was hypothesized that there would be differences in these gait parameters between footwear-AFO and AFO alone.

METHODS
The Iran University of Medical Sciences Institutional Review Board approved this study and informed consent was obtained from all subjects prior to their participation. Selection of healthy subjects was based on the following exclusion criteria: previous head injury resulting in a loss of consciousness[10], history of lower extremity injury occurring within the past year[11], pregnancy [10], severe malalignment of lower limb such as genu valgum or varum, fracture or dislocation of lower limb within the last 6 months, Lastly, any orthopedic surgery[12].

Once selection criteria were met, the participant's dominant leg was determined based on the limb that the participants used in at least two of the three following tests: Recovering balance after a posterior push, stepping up on a box, and kicking a ball through a goal[13]. Then a custom-made solid AFO was manufactured for the non-dominant limb of the participants which was set in neutral. Shoes were the same for all the participants with an approximately 1cm heel height (i.e. the difference in thickness between the heel and sole)[14]. Walk Across (WA) testing of the Balance Master System (NeuroCom International, Inc., Clackamas, OR) was used in the study to record the subjects' step width, step length, and speed. These subjects were asked to walk at self-selected paces with AFO-shoe and AFO alone. The paired sample t-testing was used to compare the average gait performance between wearing and not wearing the shoe while using an AFO.

RESULTS AND DISCUSSION
Twenty-four subjects who met our selection criteria—12 males and 12 females—participated in this study. Among them, 7 wore the AFO on right leg, and 17 on left; The mean age of the subjects was 24.7 ± 4.84 yrs (range: 19–34 yrs); Table 1 shows the WA test results which demonstrates a significant decrease in the step length when shoe is not used with AFO in contrast to AFO-shoe combination (P < 0.05).

Table 1: Comparison of gait parameters between wearing AFO with and without shoe.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Without shoe</th>
<th>With shoe</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>82.96±11.02</td>
<td>91.16±8.41</td>
<td>.000*</td>
</tr>
<tr>
<td>Step length</td>
<td>64.57±14.36</td>
<td>73.49±14.31</td>
<td>.030*</td>
</tr>
<tr>
<td>Step width</td>
<td>17.61±4.00</td>
<td>16.24±3.59</td>
<td>.065</td>
</tr>
</tbody>
</table>

Data were expressed as mean ± SD.

*P < 0.05.
(P < 0.000). But step width was unaffected by the different conditions (P > 0.065)

The results of this study reveal a statistically significant decrease in the walking speed when wearing AFO without shoe compared with walking AFO-footwear combination in asymptomatic people. It has already been suggested that the angle of inclination of the tibia is an important factor in improving the walking speed [15]. Actually the heel height of shoe in combination with AFO causes this anterior tibia inclination and may change the ankle-foot complex alignment in order to improve walking speed. We also noted that the step length of the healthy adult decreased while walking AFO without shoe. The shorter step length may influence on speed, as well. These differences support the finding of previous studies which clearly indicate that shoes are as important as AFO in order to improve the gait parameters [6, 16]. As it can be noticed in table1, although, the step width of walking with AFO-shoe was almost 1 cm smaller than walking AFO without shoe; there was no significant difference in step widths between AFO conditions. Since step width is related to the size of the base of support in the coronal plane. However, in this study, AFO-shoe combination has been altered the alignment of tibia in sagittal plane. This can explain why no significant difference in the step widths was noticed.

CONCLUSIONS
The results of the present study demonstrated that the combination of solid AFO with shoe is crucial in improving some gait parameters such as speed and step length in healthy adult. As a result, it would be essential to notice that those cultures that footwear is not used indoor, the AFO is not able provide the same characteristics.

REFERENCES