Comparison of pressure distribution between Prefabricated and Custom-made Solid Ankle Foot Orthoses

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SUMMARY
In this study, foot pressures were measured in 13 healthy people while walking with custom-made Solid AFO (MAFO) and prefabricated Solid AFO (PAFO). Peak pressures (PP) were calculated for 10 regions in plantar surface using pedar-x system and in 5 regions between calf and AFO by pliance-x system. The findings indicate that PP in heel, heel side/ankle, and medial calf shell strap regions were reduced in the MAFO compared to the PAFO. While in the mid foot, first to fifth metatarsal, hallux, second toe, toes 3–5 in addition, in the medial and lateral calf shell and lateral calf shell strap regions there was no significant difference in PP between AFOs.

INTRODUCTION
Ankle foot orthoses (AFO) are the most widely used in neuromuscular pathologies such as spinal cord injury [1, 2], stroke and polio to minimize gait deviations and improve walking ability [2]. In addition, they are prescribed in peripheral neuropathy like diabetes to relieve elevated plantar pressures [3]. Despite the effectiveness of orthotic devices, the cost can be prohibitive for some patients regarding that insurance plans often do not cover these costs [4]. This has led many people to purchase prefabricated devices. Although they are much less expensive than MAFOs [5], their ability to achieve desired control motion as well as their intimate fit can be compromised, because they are mass-produced in various "typical" sizes [6]. The variability types of AFOs and their design has been evaluated in previous studies [6, 7], but literature search revealed the lack of any publications on comparing AFOs which are constructed in different ways. Plantar pressure assessment is a widely used method for evaluation of orthotic efficacy [8-10]. Previous studies have been evaluated pressure distribution AFOs in various disorders [11-13] but no publications assessing the differences between fabrications methods regarding plantar pressure distribution have been found.

The aim of present study was to quantify the peak pressures differences between MAFOs and PAFOs during gait. Our initial hypothesis was that the MAFOs would have a more favorable impact on pressure distribution in comparison with PAFOs.

METHODS
After obtaining the Tehran University Ethics Committee approval, the study conducted by recruiting 13 healthy people, aged 23 to 34 (7 females and 6 males). Participants with foot and ankle pathologies, previous injuries and surgery to the foot and ankle, lower limb length discrepancies were excluded [9, 14].

For this study, MAFOs were fabricated by one qualified orthotist for non-dominant limb of the participants. PAFOs were in three different sizes, with each subject allowed to wear the best fitting AFO. Plantar pressures were measured using Pedar-x in-shoe pressure system while pressure insole was placed between foot and AFO. Footwear was standardized; All the participants used the appropriate size of the same brand shoes [14]. A half-hour afterwards following at the same procedure at the first part, the interface pressures between calf and AFO were assessed with five pliance-x sensors which were arranged as follows: two in the calf shell region, one in the heel side/ankle region and two sensors were positioned underneath the calf shell strap [11]. Subjects completed a total of three 8-m walking trials in each of two types of AFOs at a self-selected walking speed [15]. The outcome variable of interest was peak pressure. For final analysis ASCII-files were processed using MATLAB routines then to analysis pressure distribution, plantar pressures were calculated into 10 regions. These regions were the heel, mid foot, first, second, third, fourth and fifth metatarsal, hallux, second toe and toes 3–5 and peak Ankle/foot interface pressure were calculated for each sensor. The paired sample t- testing was used to compare test performance between wearing various types of AFOs.

RESULTS AND DISCUSSION
A total of healthy subjects13 were recruited with a mean ages of 24.7 ± 4.84 yrs (range: 24–34 yrs); with 7 being females and 6 males. The PP demonstrated significant difference between AFO conditions for heel (103.75± 10.63 Kpa MAFO and 117.55± 8.98 Kpa PAFO, P= 0.042), heel side/ankle region (.39±.249 MAFO and 15.10±5.63 PAFO, P= 0.019), medial calf shell strap region (9.24±1.68 MAFO and 16.139±3.23 PAFO, P= 0.038). No significant differences were observed at the other regions.

The results of this study indicate that PP was significantly decreased in the heel, heel side/ankle and medial calf shell strap regions in MAFO when compared to PAFO. It has already been suggested a possible relationship between area,
In our study, the pathomechanics on the foot remained the same when comparing two AFOs, as each subject acted as his own control. Thus, since the subject’s weight was the same, any changes in force readings when comparing MAFO against PAFO, must be equated to changes in surface area [8, 16]. In fact increase in surface area in MAFO results in a decreased PP which to improve intimate fit AFO in these regions. Difference PP in the other regions calf was not statistically significant; table1 shows the calf shell flange in two AFO exhibited little or no pressure at all. These findings of the current study are similar to the results of a study by Nowak et al [11]. Also in the other regions in plantar surface there was no significant difference in PP between AFOs. It appears reasonable to suggest that in these regions surface area for two AFO is the same.

CONCLUSIONS
The result of this study show that MAFO was more effective at reducing PP compared with the PAFO in during walking. As a result, it would be essential to notice that the PAFO is not a reasonable alternative to the MAFO especially in patients with peripheral neuropathy.

References


