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DO CUSTOMIZED ANKLE FOOT ORTHOSES IMPROVE POSTURAL STABILITY IN OLDER ADULTS?

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INTRODUCTION

Falls are a major health concern for the rapidly growing elderly population. Estimates of the proportion of elderly that fall each year have ranged from 22.1% to almost 40% [1,2]. There is a large volume of studies that have shown the benefits of ankle foot orthoses (AFO's) for individuals that have suffered a stroke or non-progressive brain lesions [3]. AFO's have been shown to reduce a number of fall risk factors through improving gait and balance in these populations, however research involving a less restrictive sample of the elderly population is lacking. Therefore, the purpose of this investigation was to determine whether a customized AFO could reduce fall risk in ambulatory elderly individuals.

METHODS

Subjects aged 65 years or older who were able to walk unassisted for 20 meters were recruited. Individuals with hemiplegia or excessive lymphedema were excluded from the study. During the initial visit subject demographics and shoe size were collected and castings for the customized AFO were performed. The AFO used in the current project were with open dorsal ankle design with customized footplate and arch support as shown in figure 1.

Figure 1. AFO with customized arch support, footplate and adjustable straps

At the second visit, balance assessments were performed using a system of body worn sensors (LegSys™, BalanSens, Biosensics LLC). Inertial sensors were placed on the subject's shank and lower back which tracked the ankle and hip motion during a modified Romberg's test. The test required subjects to stand as still as possible for 30 seconds with their arms folded across their chest. The method of estimation and validation has been described in detail in Najafi et al [4,5]. Each subject performed a balance test with eyes open and eyes closed under three footwear conditions: barefoot, with standardized shoes, and with standardized shoes and bilateral AFO.

With a similar arrangement of sensors, a functional reach (FR) task was performed similar to Duncan et al [6]. The task requires the subject to stand erect with his arms stretched and hands laid one over the other. On command the subject leans forward as far as possible, bending only at the hips. A sliding scale was attached to a static door to measure the reach distance. The reciprocal compensatory indexes (RCI) [4] in the anterior-posterior and media-lateral directions during FR task were calculated to study postural control strategy during reaching tasks. RCI values closer to 0 indicate good postural control. Two trials of FR test were administered while standing barefoot, with standardized shoes, and with standardized shoes and bilateral AFO.

In addition to the standing assessments, a timed up and go (TUG) test was performed by the subjects while wearing the standardized shoes with and without AFO's. This test requires subjects to rise from the sitting position, walk 10ft, turn around, walk back to the chair they were sitting in, and sit back down. Two trials were collected for each footwear condition.

A fall efficacy scale (FES-I) questionnaire was also administered to assess the concern level of fear of falling. A paired two sample t test was used to test the significance of differences between each footwear condition during balance, TUG and FR assessments. A one way ANOVA was administered to study the effect of foot conditions (barefoot, shoes, shoes with AFO) on postural sway using center of mass (COM). For all tests, the alpha value was 0.05 and statistical analysis was performed with Minitab software.

RESULTS AND DISCUSSION

15 subjects (3 male, 12 female) were recruited whose average age was 73(8.0) years. BMI ranged from 22 to 37.2. FES-I scores averaged at 30.6(7.87) demonstrating the participants to be ranging from low fear of falling to moderate concern for falls. During eyes open balance

assessments, use of AFO with shoes reduced the COM sway significantly ($p<0.05$) by 68% and 75% when compared to shoes and barefoot respectively. Similar significant drops of 53% and 61% were observed when compared to shoes and barefoot during the eyes closed Romberg's test with customized AFO's.

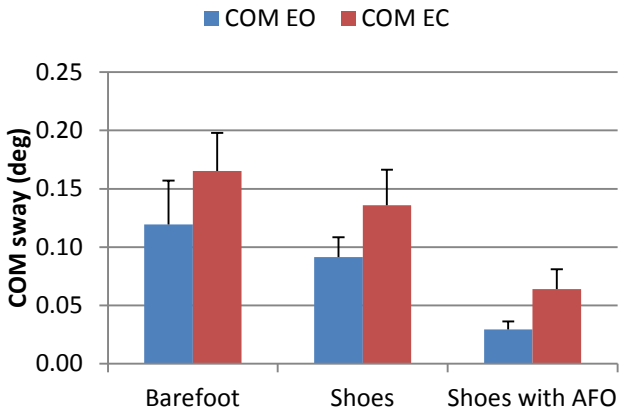

Figure 1: Center of mass sway in degrees during eyes open (COM EO) and eyes closed (COM EC) balance assessments during barefoot, shoes and shoes with AFO conditions.

One way ANOVA test shows footwear significantly affected sway during static balance assessments during both eyes open and eyes closed conditions. No significant differences of functional reach distance were observed between the barefoot, shoes and shoes with AFO's conditions. However, an 18% significant drop of RCI values in media-lateral direction was observed while using AFO's when compared to both barefoot and standard shoes conditions. This indicates that although the AFO's provide good postural stability, they did not restrict the reach distance. No significant differences were observed in the time required to complete the TUG test suggesting AFO's do not influence the time taken for normal activities. TUG results were 14.6(4.1) sec with standard shoes and 15.3(4.7) sec with AFO's in standard shoes suggesting mobility is not hindered with the use of AFO's.

CONCLUSIONS

The results of this study indicate the use of an AFO provides an immediate reduction of fall risk in the elderly, without encumbering functional reach or gait. Additional studies are required to determine if the reduced fall risk actually translates into fewer falls.

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