COMPARISON OF STIFFNESS BETWEEN CONVENTIONAL AND HINDFOOT AFO

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INTRODUCTION
As the geriatric population is increasing, impairment related to ankle and subtalar arthritis has also become commonplace. Arthodesis is considered the standard procedure for severe ankle or hindfoot arthritis, but there are advocates of total joint arthroplasty, low tibial osteotomy, and distraction arthroplasty (1). In order to preserve patient mobility and function independence, ankle-foot orthoses (AFO) and hindfoot orthoses (HFO) have been utilized to treat disorders including ankle and subtalar arthritis (2, 3). Hindfoot orthoses (HFO) have the potential advantage of increased patient compliance because of smaller size and lighter weight. It is generally accepted that orthosis design affects stiffness, but there is limited published information regarding stiffness testing of these AFO or HFO devices (4). The purpose of this study was to evaluate the stiffness of AFO and HFO devices and to determine the effect of a standard brace modification used to improve patient comfort, the malleolar cut-out.

MATERIALS & METHODS
A testing apparatus was designed (Fig. 1) in which an orthosis to be tested was secured to a vertically-oriented footplate. Loads of 4.45, 8.91, 13.26, 17.82, and 14.50 kg were placed on the posterior section of the orthosis, and displacement was detected using a magnetic tracking system with a magnetic sensor applied to the posterior orthosis and magnetic source applied to the footplate (Ascension Technology Corp., Burlington, VT). By turning the apparatus 180 degrees, displacement in dorsiflexion was also tested. The orthosis was tested in the intact condition (N) and with malleolar sections cut out. Load displacement curves were calculated to determine the slope, which defined stiffness. Three conventional AFO (F) and three hindfoot orthoses (H) were tested. All orthoses were constructed of standard polyethylene material by a certified pedorthist. Statistical analysis was performed with a paired Student t-test with level of significance of p<0.05.

RESULTS
The results are shown in Figure 2. The conventional AFO was stiffer than HFO in plantarflexion (P) and dorsiflexion (D) testing, and in intact (N) and malleolar cut out (C) conditions.

DISCUSSION
This study demonstrated that conventional AFO was stiffer than HFO, with or without malleolar cut out. These data suggest that the AFO is more effective in limiting sagittal plane movement, and would be more applicable for patients with ankle arthritis than for those with hindfoot arthritis. It is common to cut out malleolar areas of an orthosis to reduce discomfort from the brace directly contacting the skin. Our results showed that this modification did not appreciably affect orthosis stiffness.

The investigation focused upon sagittal plane motion, but could be expanded further by testing displacement in coronal and transverse planes. The testing methods in the present study will enable the objective assessment of conventional orthoses and will be applicable in testing orthoses with new designs and materials in the future.

REFERENCES

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