THE EFFECT OF AFO ON PLANTAR PRESSURE DISTRIBUTION DURING WALKING IN SUBJECTS WITH DROP FOOT

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Abstract

An ankle-foot orthosis (AFO) is frequently prescribed to patients with paretic dorsiflexor muscles in order to improve their walking ability and to prevent stumbling. The aim of the study was to find out the influence of AFO on plantar pressure distribution during walking in subjects with drop foot. PLS AFOs were found to redistribute plantar pressures during walking in subjects with drop foot. That needs to be taken into account, especially in subjects with severe deformities of fore foot.

INTRODUCTION

An ankle-foot orthosis (AFO) is frequently prescribed to patients with paretic dorsiflexor muscles in order to improve their walking ability and to prevent stumbling. In subjects with paretic ankle dorsiflexsors, an AFO prevents foot drop during the swing phase of gait and helps to control foot placement after heel strike (1). AFO does not lower EMG activity (1), does not influence restoration of strength in patients with recent peripheral paresis (2) and does not influence time needed for 10m, but it slightly increases distance walked in 6 minutes (3). Usually, off-the-shelf AFO with a design of posterior leaf string (PLS AFO) is used. They are individually adjusted to fit the patient, but no big changes are usually made to unload the callosities or sole areas with increased plantar pressures.

There are several possible causes of dorsiflexsor paresis and drop foot, such as compression or injury of deep peroneal nerve, stroke, poliomyelitis, multiple sclerosis and others. Most of the patients are elderly and have some other foot deformities or problems.

The aim of the study was to find out the influence of AFO on plantar pressure distribution during walking in subjects with drop foot.

METHODS AND SUBJECTS

Methods

In-shoe plantar pressures were measured by the F-Scan system (Tekscan, Boston, MA). The system consists of 0.18mm-thick sensor insoles, which have pressure-sensitive, resistive, and conductive silver-based inks arranged in 60 columns and 21 rows embedded in Mylar coating. The columns and rows intersect, creating a "cell". There are 960 cells in each insole. The resistance at each cell is inversely proportional to the pressure applied on its surface. These insoles are connected to cuff units (preamplifiers), which are attached to the lower leg with a Velcro strap. A 9.25m cable attaches the sensor and cuff unit to a computer. The data were collected at 50 Hz. The F-scan has excellent resolution and provides reliable measures of relative pressure values (4, 5).

In all the patients, the measurements were taken twice, first without orthoses and then with newlyfitted orthoses.

Subjects

Ten subjects with drop foot, nine men and one woman, from 16 to 79 years old (59 years old on average), who already had an AFO but no other severe impairments of lower limbs were included into the study. All had drop foot problems for more than one year. Three had drop foot due to impairment of lumbar root lesions resulting from prolapsed intervertebral disk, three due to stroke, two due to hip endoprosthesis, and one due to TBC spondylolitis and injury of deep peroneal nerve.

RESULTS

The results of plantar pressure distribution are shown in table 1. All the patients were satisfied with the orthosis and said that they walked better with it. The orthotist was satisfied with the results of the correction of gait pattern in seven and partially satisfied with the correction in three patients.

***Table 1:** Plantar pressures with and without AFO under several areas of sole*

	Without AFO (mean ± sd) [Pa]	With AFO (mean ± sd) [Pa]	p
Big toe	60.6 ± 19.5	77.7 ± 24.7	.079
Head of 1st metatarsal	62.40 ± 21.5	75.30 ± 24.0	.123
Head of 2nd metatarsal	73.7 ± 20.8	82.8 ± 15.3	.068
Head of 3rd and 4th metatarsal	82.9 ± 13.0	89.1 ± 9.7	.150
Head of 5th metatarsal	83.7 ± 13.7	91.8 ± 10.1	.045
Lateral part	63.6 ± 19.0	77.9 ± 16.7	.032
Heel	65.5 ± 15.1	60.4 ± 17.9	.174

DISCUSSION

PLS AFOs were found to redistribute plantar pressures (Table 1). They especially increased pressures under the lateral part and the head of the fifth metatarsal head, while the increase under the other metatarsal heads was not significant. The latter was due to the force in this area, which keeps the foot in neutral or slightly dorsiflexed position to prevent plantar flexion. Due to that force at the time of the push-off, the wearers have to push more to achieve some plantar flexion, which increases plantar pressures. That may be a problem in subjects with severe deformities of the forefoot, when additional soft padding or insoles may be needed.

Slight but not significant decrease in plantar pressures under the heel was observed. That was quite surprising, since, by preventing drop foot, AFOs should improve the heel loading after the heel contact phase of gait. The reason for that may be inappropriate shoes which did not really push the heel into the heel part of the orthoses. Decreased plantar pressures under the heel have been observed by Rahdolph (5), but he used AFO for decreasing the heel area, not PLS AFO to prevent drop foot.

The main limitation of the study was the small number of the subjects with drop foot resulting from different reasons. However, orthoses are not prescribed and fitted on the basis of the aetiology of the impairment but due to functional problems while performing activities.

CONCLUSION

It can be concluded that PLS AFOs redistribute plantar pressures during walking in subjects with drop foot. That needs to be taken into account especially in subjects with severe deformities of fore foot.

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