

EVALUATION OF COMFORT AND THE MOVEMENT PROCESS WHEN WEARING ORTHOPEDIC ORTHOSES

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Background

Modern lifestyles lead to degenerative processes in the feet for almost two thirds of the adult population. Obesity, wearing shoes with high heels, physical exercise and connective tissue weakness cause ligament and muscle insufficiency. As a result, the longitudinal and transverse arches are flattened and the head of the talus lowers and presses on a slightly incompetent plantar calcaneonavicular ligament.

Orthopedic orthoses with a longitudinal and transverse arch support are used to correct the foot position and relieve the tarsal joints. They cushion the step and reduce pressure peaks. Until now, little research has been done into the importance of the fit of the shoes and orthoses and the properties of the foot orthoses when it comes to perceived comfort and whether this can also change the movement process.

The aim of this study was therefore to examine the influence of orthopedic foot orthoses with three different levels of support and firmness (with soft, medium and strong orthotic cores) on perceived comfort and the movement process of the foot and the lower leg.

In addition, it was assumed that these effects would be increased by a good match between the foot and shoe or last shape.

Study design

Methods

Sample: n = 52 (25 females, 27 males), age: 47 to 61 years
Test orthosis: orthopedic orthosis (ErgoPad weightflex 2 with a soft (E1), medium (E2) and strong (E3) orthotic core; Bauerfeind)

Test method

- **Comfort questionnaire**
 Evaluation of the foot orthoses with regard to heel support, arch support, flexibility, fit, comfort and stability
- **Examination of the fit between the foot and the shoe**
 Capturing a three-dimensional image of the foot and last shape using a scanner system (DynaScan4D): Classification of the fit according to "wide", "good", "narrow".
- **Kinematic gait analysis (Vicon):**
 checking the angle of the joint between the lower leg and hindfoot as well as between the hindfoot and forefoot
- **Responder analysis**
 Differentiated view of the individual test subjects' responses with regard to the variables being investigated

Data analysis

Inclusion criteria: test subjects who are 40 years of age or older
Exclusion criteria: test subjects who are younger than 40



ErgoPad weightflex 2, medium orthotic core



ErgoPad weightflex 2 – supports physiological movement

Results

Definition of the fit between the foot and the shoe

The foot and shoe fit was determined by measuring the height of the ball of the foot, the length of the medial ball of the foot and the orthogonal heel width. This showed that the shoe fitted 12 test subjects **well**, while 21 test subjects had a somewhat **narrow** fit and 16 test subjects had a somewhat **wide** fit.

Positive effect on wearing comfort

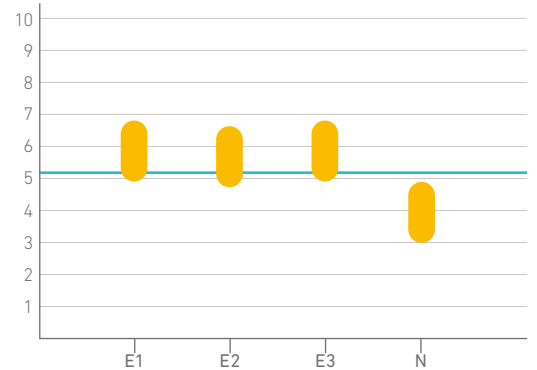
In each group, the presence of an arch support was clearly noticed, regardless of the core's firmness level. However, the biggest effect could be achieved when the fit between the foot and the shoe was described as "narrow".

With the foot orthosis in the shoe, the test subjects felt that, in the case of each model, the flexibility of the orthosis only slightly decreased in comparison with the control condition. The foot orthosis therefore performed its supporting and guiding function, but was not perceived as rigid or unpleasant. In a well-fitting shoe, the foot orthosis did not have a negative effect on the wearing comfort.

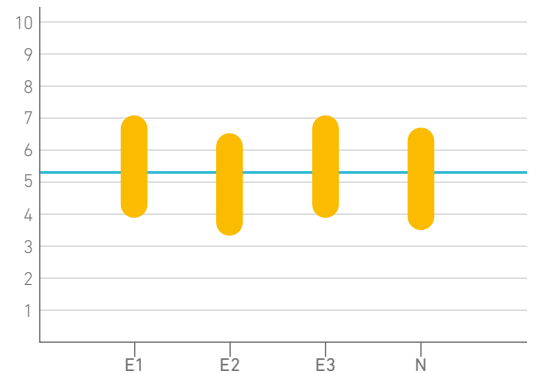
Improved guidance of the movement process

The movement process between the lower leg and foot, and between the forefoot and hindfoot was observed through kinematic analysis.

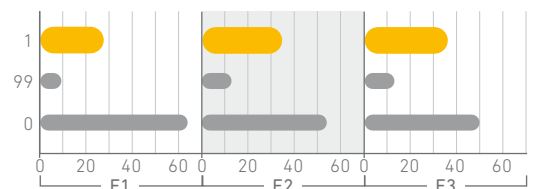
The responder analysis¹ showed that the foot orthoses could reduce the total extent of foot movement in the frontal plane by a statistically significant 27 percent ("soft" core), 34 percent ("medium" core) and 36 percent ("strong" core). As the test subjects generally reacted positively to the foot orthoses, they could help guide the foot to move in the desired manner.



ErgoPad weightflex 2, criterion: **arch support**



ErgoPad weightflex 2, criterion: **comfort**
 Comparison of the comfort in the "good" fit group



Responder analysis: **improved guidance of the movement process**

- 1: positive responder:**
the test subject reacted in line with the aim of the foot orthosis treatment;
- 99: negative responder:**
the test subject reacted contrary to the aim of the foot orthosis treatment;
- 0: neutral response:**
the test subject showed no clinically relevant difference between the foot orthosis treatment and the control condition

¹ The responder analysis was carried out in order to identify a possible "overlap" or "neutralization" of the results by comparing the average (variance analysis).

Reduced eversion

Increasing fatigue and/or high levels of strain (being very overweight/carrying heavy loads) increase the buckling or inward-sinking of the lower ankle.

The responder analysis showed that the use of the foot orthoses resulted in a clinically significant reduction ($> 2^\circ$) in maximum eversion compared to the control condition in 34 to 39 percent of all test subjects (soft: 34 percent, medium: 32 percent, strong: 39 percent).

The identified differences and effects of the foot orthoses could not be increased by a good match between the foot and the shoe. It was therefore determined that the results did not depend on the fit ("narrow", "good", "wide").

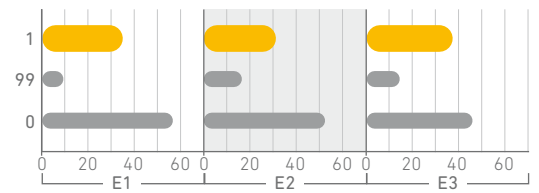
Discussion

Most people rated the arch support of the three foot orthoses highly in comparison to the control condition. This result is substantiated by the statistically significant differences between the three foot orthoses and the control condition produced through variance analysis.

The responder analysis clearly indicates that the foot orthoses had an effect on the eversion of the foot. This can be classified as a positive effect, which is also reflected in the test subjects' perception of comfort. The reduction of maximum eversion, as well as the total extent of eversion is rated by the test subjects as improved longitudinal arch support. No significant difference was found between the three orthoses either in the kinematics or in the perception of comfort.

The above extracts from the study's data analysis provide evidence of the desired mechanisms of action of the ErgoPad weightflex 2 foot orthosis:

- The guidance of the foot is better with the ErgoPad weightflex 2 orthopedic orthosis than without it.
- The physiological movement process is maintained.
- The arch support provided by the weightflex core and the structure of the foot orthosis was viewed positively and rated highly.



Responder analysis: reduced eversion

- 1: positive responder:**
the test subject reacted in line with the aim of the foot orthosis treatment;
- 99: negative responder:**
the test subject reacted contrary to the aim of the foot orthosis treatment;
- 0: neutral response:**
the test subject showed no clinically relevant difference between the foot orthosis treatment and the control condition