Available online at www.sciencedirect.com
SCIENCE DIRECT®

The Foot 15 (2005) 175–179

The Foot
www.elsevierhealth.com/journals/foot

The effect of different ankle brace–skin interface application pressures on the electromyographic peroneus longus reaction time

E.S. Papadopoulos [a,*], C. Nicolopoulos [b], A. Baldoukas [c], E.G. Anderson [c], S. Athanasopoulos [a]

[a] *Physical Therapy Laboratory, Department of Physical Education and Sports Science, University of Athens, Greece*
[b] *ORTHO-FOOT CENTER, Department of Podiatry, Cyprus*
[c] *Department of Engineering, Technonological Educational Institute of Halkida, Greece*

Abstract

Electromyographic peroneal reaction time measurements is a well established and reliable method of assessing the dynamic defence mechanism of the ankle joint against ankle sprains. Ankle bracing has been proved to be an effective prophylactic measure against injury since it restricts joint ROM. However, its role in improving the dynamic defence mechanism of the ankle according to the skin–brace interface application pressure, is unclear. The aim of this study was to investigate the effect of different pressures of ankle brace application in the peroneus longus reaction time. Thirty-three young, male, uninjured, physical education students were measured under three conditions: (1) without brace, (2) with brace and 30 kPa application pressure and (3) with brace and 60 kPa application pressure, as measured by a pressure sensitive sensor. Peroneal reaction time was assessed with surface electromyography, during a sudden inversion stress test on a trapdoor. The results demonstrated significant differences between the control (no brace condition) and the two brace conditions, with a significant increase of the peroneal reaction time, with increasing ankle brace application pressures, more pronounced in the 60 kPa pressure. The findings of this study show that prophylactic ankle bracing when applied tightly, seems to have a detrimental effect in the dynamic defence mechanism of the ankle joint, since it delays the peroneous longus activation onset during a simulated ankle sprain. Whether different brace application pressures introduced in this study can affect the incidence of ankle sprains remains to be examined.

Keywords: Peroneal reaction time; Dynamic defence mechanism; Ankle bracing

1. Introduction

Protective ankle bracing is commonly used by sports participants in order to prevent lateral ankle sprains which comprise one of the most common types of injuries occurring during recreational and full-time sporting activities. Several epidemiological studies have shown that about 10–28% of all sports injuries are ankle sprains [1,2] leading to the longest absence from athletic activity, compared to other types of sports injuries [3–5]. Despite the fact that ankle sprains are common among recreational athletes, they most frequently occur during full time athletic activities and especially in those that involve jumping activities. Indeed, it has been reported that more than 50% of ankle sprains occurred in basketball during landing with the foot in supination on another player's shoe, following a high jump [5]. Several studies have investigated the short and long term effects of ankle bracing and have reported that not only it is effective in reducing the incidence of ankle sprains [6–8], but also they do not hinder athletic performance [9–14]. One of the protective effects of bracing that has also been investigated, is its effect on the EMG peroneal stretch reflex amplitude [15,16] which, together with the peroneal reaction time (latency), is the only dynamic defence mechanism against lateral ankle sprains [17,18]. Cordova and Ingersoll [15], showed that a semirigid ankle brace application for 8 weeks, significantly increased the amplitude of the peroneus longus stretch reflex compared to a laced up ankle brace. The authors concluded that both the short and the long-term use of ankle bracing increased the amplitude of the peroneal stretch reflex. These results are in accordance with those by Nishikawa et al. [16] who carried

* Corresponding author.
E-mail address: epapadop@phed.uoa.gr (E.S. Papadopoulos).

0958-2592/$ – see front matter
doi:10.1016/j.foot.2005.06.002

out two experiments in order to document the time-dependent characteristics of the peroneus longus short latency stretch reflex amplitude, following application of an ankle brace and showed that it was significantly increased by 25%.

Lastly, in dynamic activities, in two studies by Cordova et al. [19] and Tomaro and Burdett [20], it was shown that braces have no positive or negative effect on muscle activity during cutting movements and walking, respectively.

Although it seems that ankle bracing may increase the EMG peroneal stretch reflex amplitude, its effect on the peroneal reaction time has not been investigated. Furthermore, in all previous studies that have investigated, the effect of ankle bracing on several parameters related to function and performance, have not examined the technique of brace application.

Therefore, the aim of this study was to investigate the effect of different skin–brace interface application pressures of a soft laced-up ankle brace, on the reaction time of the peroneous longus muscle.

Fig. 1. McDavid ankle brace.

2. Patients and methods

The study comprised of 33 young male, healthy physical education students which after signing the written consent form volunteered to take part. Subjects included in the study had to be in the age range of 18–25 years, had no previous ankle and lower limb injuries, were not full-time sports participants, did not systematically use braces or other types of ankle support, did not have obvious biomechanical abnormalities and did not have ankle instability. Demographic data of the study sample are presented in Table 1.

A trap-door which was able to tilt 30° in the frontal plane, was constructed by one of the authors (B.A.), according to the specifications of a previous study [17], in order to cause sudden inversion of the subtalar joint and assess the peroneus longus reaction time (Fig. 3). The reliability of peroneal reaction time measurements has already been assessed previously [21].

Peroneus longus reaction time was measured in all 33 subjects under three different conditions: (i) without brace, (ii) with brace and low application pressure (30 kPa) and (iii) with brace and high application pressure (60 kPa). The laced-up McDavid ankle brace was used for the measurements in the study (McDavid Ankle Guard Inc) (Fig. 1).

Skin brace interface pressures were measured with the 9810 Tekscan pressure sensor which has also been used to measure skin brace interface pressures in different ankle joint angles [22] (Fig. 2).

Table 1
Demographic data of examined subjects (mean ± S.D., $n = 33$)

Variable	Value
Age	21.5 (±1.5)
Weight (kg)	77.9 (±8.9)
Height (cm)	177.5 (±7.4)
Body mass index (BMI)	24.8 (±2.9)
Fat (%)	19.9 (± 4.1)
Lean body mass	62.2 (±6.1)
Activity level	8.5 (±1.5)

The pressure sensor was calibrated according to Buis and Convery [23], and applied in the inner side of the frontal aspect of the ankle brace, and stabilized in that position with a hypoallergic adhesive spray as described for amputee surfaces by Convery and Buis [24]. The reason for choosing this site was because the ankle and foot skin surface was more even without bony prominences and the pressure application could be measured more evenly compared to other sites (Fig. 3).

Subjects were asked to stand with both legs on the trapdoor without shoes, and an inter-feet distance of 15 cm. Measurements of the peroneal reaction time were performed on the dominant leg which was defined as the preferred leg to kick a soccer ball. Therefore, tilting of the platform was performed only on the dominant side with an electromagnetic switch by the researcher (E.P.), at an unexpected time so that the subject would not be prepared to pre-activate the muscle.

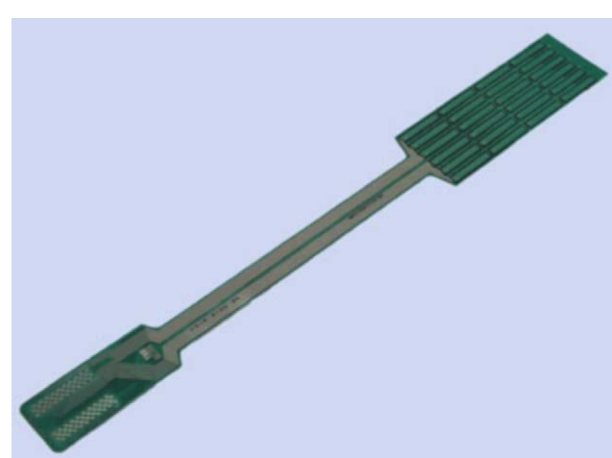

Fig. 2. The 9810 Tekscan pressure measurement sensor.