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Short Report

Effects of Ankle Braces on Ground Reaction Force and Electromyography during Landing Movement

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Key words: ground reaction force, electromyograms, ankle braces

Abstract

The purpose of this study was to verify the effect of a new style of ankle brace on ground reaction force (GRF) and electromyography (EMG) during landing movement. Two conditions were set, 1 with a brace and 1 without. And physical tasks measured were landing movement from a 30 cm and 50 cm height in both conditions. Without a brace, the GRF condition at the 30 cm was significantly lower than at 50 cm ($p<0.05$). On EMG of interior head of gastrocnemius muscle at 50 cm, the condition of wearing a brace was significantly lower than without ($p<0.05$). This brace possibly makes the angle of the ankles pronate and supinate limitarily.

1. Introduction

The percentage of ankle injuries amongst total sports injuries is about 15%. The percentage of ankle sprains amongst total ankle injuries is about 85% [1-4]. Furthermore, it was reported that most of people who have had ankle sprains have them again within a year [5-7].

Landing movement has a high probability of injuring ankle sprains. It was reported that fixation by braces makes the potential of injury low [8, 9]. Ankle braces are used for prevention of sprains and prevention of recurrence of injury. Therefore, various types of the braces, taping and shoes were developed [10].

Recently, various types of braces are developed and sold. The new featured brace developed by company D is 15 g. The form of this brace is different from the conventional brace in that the point that of most of the foot parts are not covered. This brace is mounted so as to wind around the ankle, consists of a movable pad made from foam material and has a stretching belt. The brace works by adding pressure to the tibia and fibula, and on the muscles relating to plantar flexion and dorsiflexion. And this brace is expected to facilitate the muscles relating to buffer action. However, no study has inspected for these effects. Therefore, the purpose of this study was to verify the effect of ankle braces on ground reaction force (GRF) and electromyography (EMG) during landing movement.

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2. Methods

2. 1. Subjects

Ten healthy male young subjects were chosen. The means of their age, height and body weight were 21.4 ± 1.9 years, 171.8 ± 3.7 cm, and 62.2 ± 6.2 kg. All subjects gave informed consent.

2. 2. Measurements and materials

GRF and EMG during landing movement were measured. GRF was measured by force plate (type9281CA, KISTLER, Switzerland) at a sampling rate of 1000 Hz. Muscles to be examined were the long fibular muscle (LF), the lateral head of gastrocnemius muscle (LG), the interior head of the gastrocnemius muscle (IG), the soleus tibia muscle (ST) and the anterior tibia muscle (AT). These muscle activities were measured by surface EMG and a multi telemeter system (WEB-5000, NIHON KOHDEN Co., Ltd., Japan) was used for the recording at a sampling rate of 1000 Hz.

2. 3. Procedures

Two conditions were set, 1 with a brace (B:brace) on the right ankle and 1 without (C:control). And the physical tasks measured were landing movement from 30 cm (30) and 50 cm (50) in both conditions. All subjects performed each task three times in all conditions.

2. 4. Data analysis

GRF data was analyzed 1 second after the grounding of the foot. The EMG signals were full-wave rectified, and the maximum and mean EMG amplitudes were calculated. EMG data was

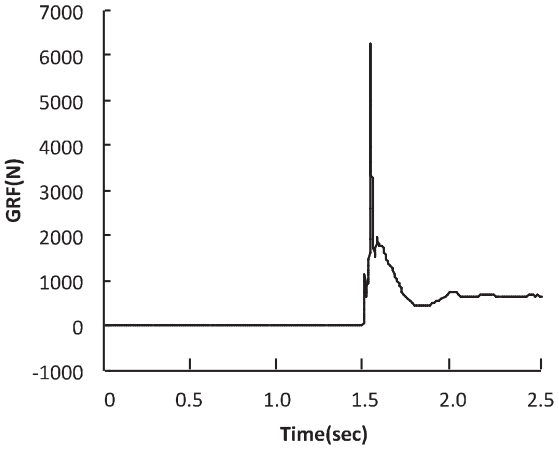

Fig. 1 Typical example of the time course data of ground reaction force.

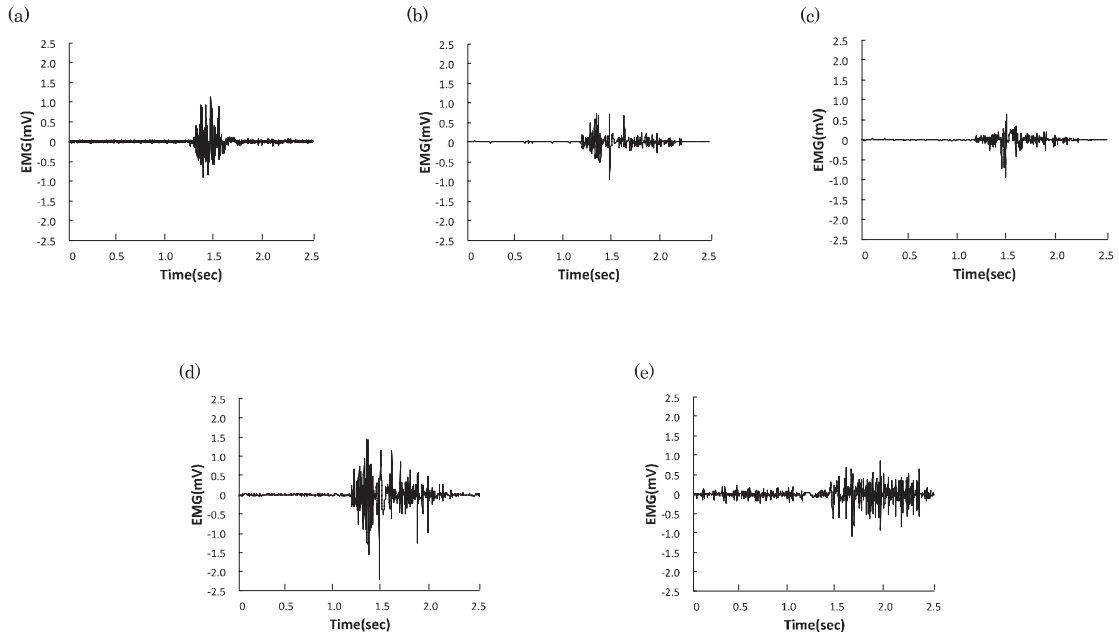

Fig. 2 Typical example of the time course data of EMGs.
(a) : the long fibular muscle
(b) : the lateral head of gastrocnemius muscle
(c) : the soleus tibia muscle
(d) : the interior head of gastrocnemius muscle
(e) : the anterior tibia muscle

analyzed from 0.2 seconds before the foot was grounded until 1 second after the grounding.

Means ± standard deviations were obtained for all the data. The differences between conditions were tested by using the paired t-test. The significance level was set at $p<0.05$ for all tests.

3. Results

On GRF, maximum vertical force during landing movement, comparing the condition of wearing a brace and without, showed no significant differences. When subjects were measured without a brace, maximum GRF from 30 cm was significantly lower than from 50 cm ($p<0.05$). On the EMG of all examined muscles during landing movement from 30 cm, comparing the condition of wearing a brace and without showed no significant differences. On the EMG of the interior head of the gastrocnemius muscle during landing movement from 50 cm, the condition of wearing a brace was significantly lower than without ($p<0.05$).

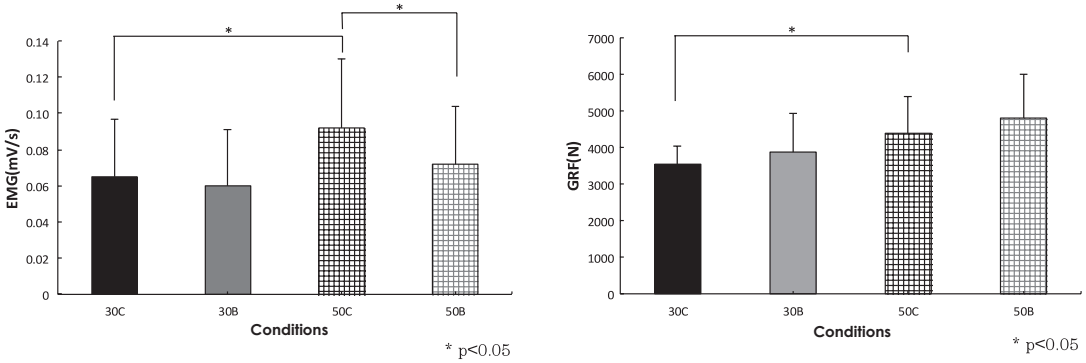

Fig. 3 The values of the EMG of IG in all conditions (left). The values of GRF (Fz) in all conditions(right). (IG : the interior head of gastrocnemius muscle, 30 : landing from 30cm, 50 : landing from 50cm, C : control, B : with a brace)

4. Discussion

This study made the effects of the new featured brace for preventing ankle injuries clear. At 30 cm, GRF when subjects wore a brace was higher than without. Subjects landed from the same place but the GRF was different. When people land on the floor, ankles pronate and supinate. Maeda [11] reported that the angle of ankles pronating and supinating landing on one foot were larger than on both. So, the greater the impact, the greater pronate and the supinate angle. From these, this brace possibly makes the angle of the ankles pronate and supinate limitarily. At 50 cm, EMG of the interior head of the gastrocnemius muscle when subjects wore a brace was lower than without. From this, muscle activity at the lateral head of the gastrocnemius muscle, and the interior head decrease with a greater angle of the knee. And this brace possibly supported buffer action during landing movement.

In the future, this study is needed to investigate the effects of this brace on motion measuring. And the effects of wearing braces need to clarify what influence the brace has on movement of the ankle.

5. Conclusion

This brace possibly makes the angle of the ankles pronate and supinate limitarily. This brace possibly supported buffer action during landing movement.

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