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The Role of the Evertors in Sudden Inversion and Gait

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INTRODUCTION

Ankle ligament injuries are very common in recreational sports and activities. Approximately one sprain occurs per 10,000 persons each day (1). In most cases, ankle sprains result from landing on an object that produces an unexpected torque about the ankle joint. A ligamentous injury to the ankle may occur when this torque is applied at a rate that exceeds the minimum time necessary for the neuromuscular system to respond. The purpose of this study was to describe the role of the peroneous longus and brevis muscles in sudden inversion and gait.

METHODS

Sixteen uninjured subjects (age = 27.7 yr, mass = 74.0 kg, height = 178.9 cm) volunteered to participate in this study. Surface electrodes were placed over the peroneous longus and peroneous brevis muscles of the right leg. Ten trials of: sudden inversion and treadmill walking at 3 mph were recorded. The EMG signals were recorded using a Noraxon Telemyo system at 1000 Hz. Sudden inversion was produced with an inversion platform that inverts the ankle 35°. Penny & Giles goniometers were used to monitor ankle inversion/eversion and the position of the inversion platform. The latency of the peroneous longus and brevis muscles was measured for each trial of sudden inversion. Footswitches were placed on the heel and toe of the shoe to identify heel strike and toe off during gait. The EMG data for the peroneous longus and brevis muscles during gait were normalized to isometric MVC and analyzed in 50 ms intervals beginning 50 ms before heel strike and concluding 500 ms after heel strike to quantify the preactivation and activation of the evertors during gait.

Table 1
Normalized Peroneal Activation Levels by Stance Time (%MVC)

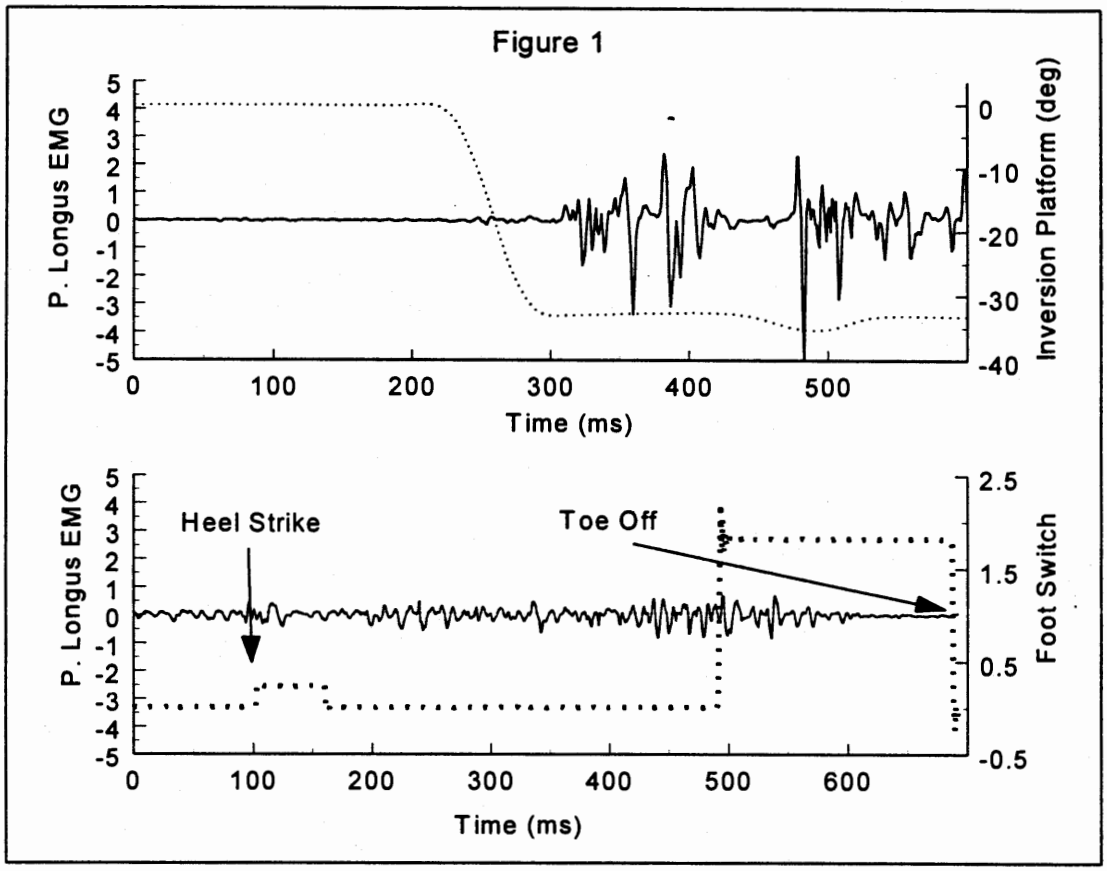
Stance Time	Peroneous Longus		Peroneous Brevis	
	Mean	SD	Mean	SD
-50 ms	27.0	13.9	24.6	15.8
50 ms	23.4	11.3	23.2	11.5
100 ms	23.7	18.1	18.1	13.2
150 ms	29.5	22.9	21.5	21.4
200 ms	26.2	24.4	21.9	19.9
250 ms	26.3	21.5	24.4	21.5
300 ms	30.1	20.9	26.9	19.4
350 ms	36.4	25.1	30.4	22.6
400 ms	46.9	28.5	38.0	26.1
450 ms	45.2	24.3	37.2	22.6
500 ms	40.5	24.0	33.1	16.0

RESULTS

A typical EMG response to sudden inversion and waking is shown in Figure 1 for the peroneous longus. Mean peroneous longus latency was 76.5 ± 13.6 ms. Mean peroneous brevis latency was 78.5 ± 11.1 ms. Mean eversion response time was 114.8 ± 39.9 ms. Eversion response time was defined as the delay between the release of the platform and the first ankle eversion following platform drop. The normalized EMG for the evertors prior to and following heel strike during treadmill walking are shown in Table 1. Prior to heel strike the peroneous longus and brevis are preactivated to 27.0 and 24.6 %MVC, respectively. Maximal myoelectric activation (46.9 and 38.0 %MVC) of the evertors in gait occurred at 400 ms after heel strike for the peroneous longus and brevis, respectively.

DISCUSSION

Ankle sprains frequently occur during sport and recreational activities. The role of the peroneal muscles in protecting the ankle joint from injury is dependent upon the amount of preactivation of



the evertors prior to ground contact and the response time of the neuro-muscular system to a stimulus. The results of this study indicated that the peroneals were pre-activated less than 30% MVC prior to ground contact in walking. This minimal peroneal pre-activation provides very little protection against injury for the ankle joint (3). Significant changes in the muscle moments due to stretch reflexes do not occur during the first 100 ms after stretch (2,4). In the ankle joint an entirely unexpected disturbing force that catches us off guard meets with very little resistance. The minimum time for the ankle joint to respond to an inversion torque was found to be 114.8 ms. This response time is due to peroneal muscle latency and electromechanical delay. In conclusion, the ankle joint evertors offer very little protection against an inversion injury due to lack of muscular preactivation prior to ground contact and the neuromuscular response time to an injury stimulus.

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