EFFECT OF FATIGUE ON REACTION TIME OF FIBULARIS LONGUS AND FIBULARIS BREVIS MUSCLES

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ABSTRACT
The ankle sprain is a sport`s typical injury. The main factors predisposing to the development of injury are: body weight, previous history of ankle injury, gender and fatigue. Fatigue appears as a minor etiological factor in the literature. This study aimed to examine the effect of muscle fatigue on the reaction time of the Fibularis Brevis and Fibularis Longus muscles during simulation of inversion sprain. The study included 10 volunteers that had no history of ankle sprain. Was used a platform that causes abrupt inclination of 30 ° in the frontal plane at ankle-foot complex in order to simulate the sprain. The electromyographic analysis was performed, for the simulation of sprain, before and after fatigue. Muscle fatigue did not affect reaction time and muscle electromyographic signal amplitude.

INTRODUCTION
The injuries of the ankle-foot complex often occur during sports practice and sprains accounts for 75-85% of this total [7]. The association between plantar flexion and inversion, the main mechanism of injury sprains, can generate the partial or total rupture of the lateral structures of the joint, and generate change in the sensorimotor receptors present in ligaments and joint capsule. Consequently there is reduction of muscle strength in the region and changes in proprioceptive ability [3,8]. The literature suggests that factors such as height, weight, history of previous ankle injury [1], gender and fatigue [6] are risk factors for the occurrence of sprains.

The literature show inconsistent results regarding the influence of fatigue on the reaction time of the Fibularis Brevis and Fibularis Longus muscles [2,6]. Thus, due to the high rate of injuries sprained ankle-foot complex in plantar flexion and inversion [3] and the lack of consensus of the studies [2,6], this paper aims to analyze the effect of muscle fatigue, in the reaction time of Fibularis Brevis and Fibularis Longus muscles of stable ankles.

METHODS
The study included 10 healthy female subjects, aged between 18 and 30 years, height between 1.45 and 1.75 m, weigh up between 40 and 70 kg, physically active. Was used a platform of simulated ankle sprain with range of motion of 30° from the parallel to the ground position [4,5]. The platform allows the inclination of the foot in the frontal plane, in order to simulate the inversion ankle sprain. Foots were attached on the platform surface. Below the fixing belt was set a analogic/digital force transducer allowing control of the force exerted during fatigue induction (Figure 1).

To evaluate the electromyographic signal was used Power Lab / Ad Instruments system, comprising: a data acquisition system with integrated bioamplificator with two channels. In addition, the equipment has auxiliary channels that allow the connection of the platform and analysis of synchronized signals.

Before the application of experimental procedures was conducted a familiarization period where the subjects were habituated with the procedures of fatigue induction. The participants performed two training sessions on different days. Each session consisted of four training sets divided in the following sequence: 1) positioning 2) determination of maximal voluntary contraction (MVC) and 3) induction of fatigue. We opted for the analysis the right lower limb [5]. After the training sessions, data gathering was performed that was carried out in a single day. Initially, it was necessary to prepare the skin, after the electrodes were placed on the selected muscles. Then, the volunteers were positioned in standing position on the deck boards, her feet were attached through nylon and leather straps. Subjects were instructed to distribute your weight equally between the legs [3]. When the platform was triggered, the board allowed the drop of the chosen foot simulating ankle sprain.

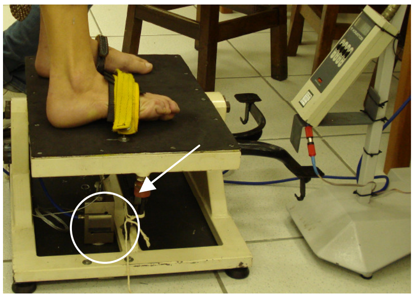

Figure 1: Induction of fatigue and position of the analogic/digital force transducer.

Were performed a total of 10 drops, 5 with each leg, randomly distributed and occurred simultaneously was performed the record of the electromyographic signal. Thereupon, was recorded maximal voluntary contraction, and fatigue was induced. For induction was asked to maintain eversion and plantar flexion at 70% MVC. The threshold was defined when the fatigue strength fall below 60% of MVC or when the volunteer give up. Shortly after induction of fatigue sprain simulation was repeated and the electromyographic signal recorded during 10 random falls.

Were analizated the following variables: muscular latency, defined by the moment when the electromyographic signal began after the fall of the platform (defined visually during mathematical processing in Matlab), and Root Mean Square (RMS) in the range of 150 ms after the fall. To compare the variables we used the non-parametric Wilcoxon test considering $p \leq 0.05$.

RESULTS AND DISCUSSION

Muscle fatigue induced by maintaining 70% MVC did not influenced the latency and amplitude of the electromyographic signal analyzed during the simulation of inversion sprain (Table 1).

To reach the proposed aims a prior period of protocol training was used. This fact propitiates a learning period that was necessary for the volunteers obtain adequate performance during the tests.

The muscle latency found in this study is consistent with a previous study that used dynamic concentric contractions of the ankle eversors controlled by an isokinetic dynamometer. However, gender was a factor that influenced the results. The amplitude of electromyographic activity decreased in males and increased in females after fatigue [6]. Possibly the differences was related to the differences in anatomic structure of men and women. Moreover physiologically the body developed many pathways to developed the fatigue process and this could affect the level of ability to generate force and could change the intensity of muscle contraction.

Eccentric contractions-induced fatigue drive to a reduction on response latency of Fibularis longus and Fibularis brevis [2]. The differences probably are relatet to the disparity between the protocols used to induce fatigue.

One hypothesis that can be raised to explain the absence of the influence of fatigue on the results refers to the procedure of familiarization with sprain simulation. Perhaps familiarity with simulation sensitized Fibularis muscles [2] even after fatigue they responded promptly to the sprain simulation.

CONCLUSIONS

Fatigue induced by an isometric contraction at 70% MVC did not change the amplitude and latency of the Fibularis Longus and Fibularis Brevis muscles activity. However, due to the small number of studies and the differences between them, we suggest new researches.

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Table 1: Mean, standard deviation (SD), median e p-value of reaction time and Root Mean Square (RMS) of Fibularis Longus and Fibularis Brevis muscles of 10 subjects in all drops with the right lower limb.

Reaction time (ms)	**Fibularis Longus**		**Fibularis Brevis**		**RMS (ua)**	**Fibularis Longus**		**Fibularis Brevis**	
	Before	**After**	**Before**	**After**		**Before**	**After**	**Before**	**After**
Mean	42	37	38	40	**Mean**	10,4	9,7	4,9	4,7
SD	23	22	30	23	**SD**	5,8	4,5	2,5	2,4
Median	36	33	31	40	**Median**	9,6	9,2	4,1	4,2
p-value	0,27		0,60		**p-value**	0,82		0,51	