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Effect of Peroneal Muscles Fatigue on Repositioning Error in Athletic Females

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Abstract

Background: High rate of Lateral Ankle Sprain (LAS) occurs in high rate in athletes near the end of the matches when the fatigue is well established. Understanding the effects of fatigue on Repositioning Error (RE) in athletic persons may partially explain the increased risk of LASs in those populations.

Aim of Study: To investigate the effect of peroneal muscles fatigue on RE in volley ball female players.

Study Design: One group pretest/posttest cross section design.

Material and Methods: 25 female volleyball players with mean age (20±2 years) and mean BMI (22.8±1 .6kg/m^2) were recruited from Faculty of Physical Therapy, Cairo University. Proprioception (in the form of RE) was tested before and after induction of fatigue. Fatigue protocol and proprioception assessment were performed using Biodex System III Pro Isokinetic dynamometer. Mean error around 20 degree of inversion was calculated.

Results: There was no statistical significant difference in RE before and after peroneal muscles fatigue (p=0.904).

Conclusion: RE of ankle joint was not affected by induction of peroneal muscles fatigue.

Key Words: *Ankle – Athletes – Peroneal muscles fatigue – Repositioning error.*

Introduction

FATIGUE is a common cause of athletic injuries that occur at the end of competition [1]. Ankle injuries are the most common type of these injuries and the majority of them are LASs [2].

In volleyball, one of the most common sports at which LASs occur in high rates, females usually exposed to injury more than males because they land with more erect posture, have more range in hip and ankle joints [3,4].

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After LASs, 73% of cases exposed to persistent symptoms that may present for many years after the injury [5-7]. The consequences of this injury may lead the athletes to stop their sport and derive their teams from their roles in matches [7]. LASs have a financial burden on the society, and clubs as most of cases require clinical care and injury rehabilitation. They also can lead to production loss due to sport and work absenteeism [7,8].

The mechanism by which fatigue increases the risk of LASs is not well known. Fatigue may affect proprioception which is a main risk factor for LASs [9]. Few researches were conducted to study the effect of peroneal muscles fatigue on RE on healthy subjects [10-12]. In athletes there was only one study that was performed on male soccer players [13]. The effect of peroneal muscles fatigue was conducted neither in females nor in volleyball players in any previous study. So, this study was conducted to investigate the effect of peroneal muscles fatigue on RE of ankle in volley ball female players.

Subjects and Methods

Design: One group pretest/posttest cross section design.

Subjects: 25 volleyball female players with mean age (20±2 years) and normal BMI were selected by convenient sample from Faculty of Physical Therapy, Cairo University. This experiment was performed in the Faculty of Physical Therapy isokinetic laboratory at the period of October and November 2018.

At first, the aim and steps about the experiment were fully explained to all subjects then a consent form was signed up if subjects agreed to participate in the experiment.

Inclusive criteria were; females that participate regularly volleyball sport for at least 6 months, age from 18-25 years and BMI from 18-25kg/m^2.

Exclusion criteria were; injury or surgery in the dominant lower limb, rheumatologic disease, chronic ankle instability, limited joint motion, neurological diseases, and medications that can affect deep sensation [10,13]. Faculty of Physical Therapy Ethical Committee approved this experiment.

Instrumentations:

A Biodex System III Pro Isokinetic dynamometer was used to assess proprioception and induce peroneal muscles fatigue. It provides an objective, reliable, and valid data [14].

Procedures:

Firstly, the demographic data of the subjects (age, height, weight, and BMI) were measured, then lower limb dominance was detected by asking each subject to detect the preferred limb would be used to kick a ball [10]. Subjects were asked to warm up their dominant limb for 2 minutes [10]. RE was assessed at 20 degree before and after induction of peroneal muscles fatigue.

Ankle RE assessment:

After opening the Biodex system III pro, calibration was performed for the dynamometer. Each subject was seated on the chair with its back tilted to 70 degree. Ask subject was asked to place his dominant limb on Leg Support Pad (with T-Bar) installed in chair front receiving tube and his foot was placed on footplate, its red dot at I/E, installed to input tube which attached to dynamometer with I/E mark faced outward. The degree of dynamometer rotation was 0 and tilt was 60-70. Ensure that axis of ankle aligned with dynamometer shaft and lower leg was parallel to the floor [15]. Subjects were blindfolded to eliminate any visual information [10].

The tested angle was 20 degree of inversion. Each subject performed 3 trials as a familiarization. The device stopped at the test position for 5 seconds and the subject was asked to memorize this position (20 degree inversion). After each trial the subject was returned to the neutral position to execute real test trial [10]. The machine took the tested joint passively into inversion and the subject was asked to press on the hold button once he reached the target angle [11]. RE between recorded angle and real angle were recorded for the three trials, and then the mean error of three trials was calculated [10].

Fatigue protocol:

Firstly, several submaximal repetitions of inversion-eversion movements were performed as a warming up then subject performed 3 maximal concentric repetitions at a speed of 30º/s to calculate peak torque of peroneal muscles. The subject was asked to perform continuous inversion-eversion movements, until the force production of the peroneal muscles decrease below the half of maximal peak torque. At this point the subject was fatigued and we stop the exercise [11,12].

Statistical analysis:

Statistical Package for Social Sciences (SPSS) was used for statistical analysis. Numerical data included means, standard deviations, median and range. Paired *t*-test was done to assess the effect of peroneal muscles fatigue on mean error of RE. *p*-value was considered significant if *p*-value <0.05.

Results

Demographic data of the subjects were as follows; the mean age was 20±2 years and ranged from 18 to 24 years old, the mean weight was 61 ±6 kg and ranged from 50 to 7 1kg, the mean height was 1 63±5cm and ranged from 151 to 170cm, and the mean BMI was 22.8± 1.6kg and ranged from 18.4 to 24.8kg/m^2.

The effect of peroneal muscles fatigue on the mean error of RE at angle of 20 degree of inversion was calculated. After fatigue, there was no statistical significant difference in the mean error of RE regarding the angle of 20 degree of inversion (p= 0.904).

Table (1): Paired *t*-test for mean error of RE at 20 degree inversion before and after peroneal muscles fatigue.

Angle	Pre		Post		MD	95% CI of MD			% change	*p*
	M	SD	M	SD		Lower	Upper	*t*		
20º inversion	2.32	1.46	2.29	1.33	0.04	–0.58	0.66	0.12	1.7%	0.904

M : Mean. CI : Confidence Interval. $p \leq 0.05$ is significant.
SD : Standard Deviation. MD : Mean Difference.

Discussion

The experiment was conducted to investigate the effect of peroneal muscles fatigue on RE of ankle joint in volley ball female players. The results of the current experiment revealed that RE was not affected by peroneal muscles fatigue at 20 degree of ankle inversion.

The result of this experiment is consistent with the result of a previous experiment done by Lin and his collages **[11]**, on the other hand, Sandrey and his collages found a significant result **[10]**.

Lin et al., found similar results regarding the effect of peroneal fatigue on passive RE in healthy population and in patients with ankle proprioception deficits. Lin et al., used the same device and the same protocol to asses RE and induce fatigue **[11]**. On the other hand, Sandrey et al., noticed a decline in active RE around four angles of ankle eversion and inversion. They executed their experiment on 40 healthy college-aged subjects of both sex and assessed active RE using a specially designed goniometer with an electronic digital display while the fatigue induced by isokinetic protocol consisted of concentric-eccentric eversion exercises at speed of 60º/s **[10]**.

The results of the current experiment can be explained by the following mechanisms; (1) The ankle joint may depend on capsular input as well as cutaneous and ligamentous feedback more than the muscle spindles **[11]** (2) Muscles other than the peroneal muscles, around the ankle, were not fatigued and were able to relay sensory information and compensate for fatigue in the peroneal muscles **[12]**.

The experiment was limited by the psychological factor which interfered with the subject's performance and response (e.g. Anxiety or stress or concentration).

Conclusion:

Peroneal muscles fatigue doesn't affect RE of the ankle joint at 20 degree of inversion.

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تآثير إجهاد العضلات الخارجية للقدم على معدل الخطآ فى الرجوع للوضع المحدد سلفا فى الرياضيين الإناث

يهدف هذا البحث لدراسة مدى تآثير إجهاد العضلات الخارجية للقدم على معدل الخطآ فى الرجوع للوضع المحدد سلفا فى لاعبى كرة الطائرة الإناث. وقد آجريت هذه الدراسة على ٢٥ لاعبة تتراوح آعمارهم بين ١٨ و٢٥ سنة. إستخدام جهاز الإيزوكينيتك – لقياس معدل الخطآ فى الرجوع للوضع المحدد سلفا وكذلك لإحداث الإجهاد للعضلات الخارجية للقدم. تم قياس متوسط معدل الخطآ عند الزاوية ٢٠ قبل وبعد إحداث الإجهاد. نتائج الدراسة آثبتت إن إجهاد العضلات الخارجية للقدم لا تؤثر تآثيرا سلبيا على معدل الخطآ عند الزاوية ٢٠ فى لاعبات كرة الطائرة.