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DECREASED SHOULDER TORQUE STEADINESS IN ATHLETES WITH SLAP LESION

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INTRODUCTION

The natural intricate balance of shoulder joint ligaments and muscles are constantly challenged in sports activity, specially those with trauma, contact and overhead movements [1]. Among young athletes involved in those sports, shoulder lesions such as instability and superior labrum anterior posterior (SLAP) [2,3] are frequent.

Shoulder joint injuries frequently compromises sports activity and muscle strength, but can also alter sensorimotor system [4]. The integrated action of sensory, central and efferent mechanism can be assessed during steady muscle contractions [5], and the output of the motor neuron pool during a voluntary contraction results in a muscle force that fluctuates [6]. Since the control of force requires afferent detection of fluctuations in force or position in the limb, force/torque steadiness test can evaluate integrated sensory-motor control [5].

In injured athletes, proprioceptive deficits are present in athletes with anterior shoulder instability [7,8], while no studies have been found in SLAP lesion. So, the aim of this study was to investigate possible alterations in shoulder rotators torque steadiness in athletes with instability and SLAP lesion compared with matched controls.

METHODS

Four groups of male athletes were evaluated: instability group; control group paired with instability group; SLAP group and control group paired with SLAP group. The athletes of the control groups were matched with instability or SLAP group for age, weight, height, sport and length of time training (Table 1). All athletes agreed to participate in the study on a voluntary basis and provided written informed consent approved by the University's Ethics in Human Research Committee.

Athletes were evaluated in a shoulder orthopedic clinical attendance. The diagnosis of SLAP lesion or instability lesion was established by a shoulder orthopedic surgeon with clinical examination and magnetic resonance image.

Torque steadiness evaluation were performed using a Biodex Multi Joint System 3 dynamometer (Biodex Medical System Inc., New York). All athletes were evaluated in a seated position, with the arm positioned at 90° of abduction, 90° of external rotation of the shoulder, and 90° of elbow flexion. Isometric maximal and submaximal tests of shoulder internal and external rotation were performed. For each movement, 3 maximal voluntary isometric contractions of 5 seconds with an interval of 1 minute between them were performed to determine the peak torque, which was used to determine the target torque during submaximal tests (35% of peak torque). The target torque was displayed as a horizontal line on the computer screen. The participants were instructed to maintain the exerted torque line at the target torque line and keep it there as steadily as possible for 10 seconds while receiving visual feedback. The participants performed one familiarization trial. After that, five trials were performed for each movement with 1minute of rest between them.

Data were collected with a sampling frequency of 100Hz, exported and reduced using MatLab® software (version 7.0.1, MathWorks Inc., Natick, USA). The torque steadiness variables standard deviation (SD) and coefficient of variation (CV= SD/mean torque x 100) were calculated for submaximal tests. The SD of torque is an absolute measure of the amplitude while the CV of torque is a measure of the relative fluctuations. The first two seconds of contraction were discarded to avoid the initial phase and adjustment phase.

The statistical analyses were carried out with SPSS (version 13.0). As data did not present normal distribution (Shapiro-Wilk test), variables were compared between each injured group (SLAP and instability groups) and their matched control groups using the Mann-Whitney test, considering a significance level of $\alpha \leq 0.05$.

RESULTS AND DISCUSSION

SLAP group presented a higher CV of shoulder internal rotation compared with its matched control (Table 1). This increase in torque fluctuations represents a reduced ability to exert a precise force, influencing the athletes' capacity to achieve a desired force and produce an intended limb trajectory [6].

This is the first study to evaluate torque steadiness in athletes with SLAP lesion and shoulder instability. A previous study found that healthy athletes present higher torque fluctuation of internal rotation compared with non-athletes [9]. This result was considered an adaptation from sports practice, which could have helped to prevent shoulder injuries. Although a higher variability can be considered a positive aspect in overuse prevention, too much variability can be considered pathologic [10]. Since injured athletes

were compared with matched controls, i.e., with the normal pattern with respect to their sports activities, we believe that an increase in torque fluctuation in this case can be harmful.

Regarding instability athletes, no alterations were found in torque steadiness. Although studies have reported that athletes with shoulder instability present proprioception deficits [5,6], Hung & Darling [11] found that individuals with anterior shoulder dislocation did not exhibit joint position sense deficits in active repositioning, whereas had great errors during passive repositioning. The authors suggested that individuals with unstable shoulders may be able to exert proper shoulder muscle activation to stabilize the glenohumeral joint when moving toward vulnerable positions, like the one used in our study. Since torque steadiness test is considered an integrated sensory-motor control evaluation [5], it is possible that our volunteers presented deficits in static proprioceptors, but they were compensated by active stabilizers in the steadiness evaluation.

Based on these results, we suggest that rehabilitation for SLAP athletes should focus on functional exercises that require internal rotation force control.

CONCLUSIONS

Athletes with instability and SLAP lesion presented different behaviors regarding sensory motor control. While athletes with instability lesion presented similar submaximal strength control compared with matched healthy athletes, SLAP athletes presented altered shoulder internal rotation force control.

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Table 1: Characteristics of the evaluated groups, maximal isometric peak torque, standard deviation and coefficient of variation during submaximal isometric contractions of shoulder external and internal rotations in athletes with instability and SLAP lesion compared with their paired controls. Data are median (minimum – maximum).

	Instability Group (n=10)	Instability Control Group (n=10)	SLAP Group (n=10)	SLAP Control group (n=10)
Age (years)	21.5 (19-28)	21.5 (18-30)	27 (19-36)	25.5 (21-37)
Height (m)	1.80 (1.72-1.92)	1.84 (1.7-1.97)	1.77 (1.67-1.83)	1.75 (1.7-1.88)
Mass (kg)	85 (74-99)	83.55 (77-98)	72.1 (65.5-112)	78.5 (66-100)
Sports experience (years)	5 (2.5-14)	6 (3-15)	11 (2-20)	9 (3-19)
Isometric peak torque (Nm)				
External rotation	23.5 (19-47)	29.5 (23-43)	28.5 (14-39)	26 (16-35)
Internal rotation	41.5 (26-78)	41.5 (30-70)	35 (24-70)	37 (19-63)
Standard deviation (Nm)				
External rotation	0.36 (0.16-0.68)	0.39 (0.22-0.59)	0.43 (0.2-1.05)	0.36 (0.23-0.43)
Internal rotation	0.51 (0.24-0.95)	0.59 (0.38-1.71)	0.54 (0.35-1.18)	0.48 (0.28-1.17)
Coefficient of variation (%)				
External rotation	4.07 (2.28-7.56)	3.89 (2.26-5.77)	4.62 (3.36-8.55)	4.22 (2.16-5.73)
Internal rotation	3.55 (2.06-5.05)	4.48 (3.0-7.05)	4.6 (2.94-8.43)*	3.72 (2.33-6.45)

* significant difference from SLAP control group (p=0.003)