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## RESTING SCAPULAR POSTURE IN HEALTHY OVERHEAD THROWING ATHLETES

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### SUMMARY

The purpose of the study was to compare the symmetry on resting posture between both scapulae, in two groups of overhead athletes (volleyball players and team-handball players) and a control group composed by non-athletes. Bilateral 3D scapular kinematics with the arm at rest was measured using by means a 6DOF electromagnetic tracking device. In team-handball athletes the scapula was more internally rotated and anteriorly tilted than in volleyball players, in the dominant side. Scapula was more anteriorly tilted in athletes than non-athletes, also in the dominant side. Asymmetry found in resting scapular posture between dominant and non-dominant limb in healthy overhead athletes may not be a problem but an adaptation due to sports practice. These asymmetries due to sports must be further analyzed to be better understood.

### INTRODUCTION

Scapular position and orientation at rest is one of the components of shoulder physical examination [1]. Alterations in scapular position regarding to the contralateral side have been found in athletes [2] suggesting that they could affect the normal scapulohumeral rhythm and shoulder artrokinematics leading shoulder dysfunction [3]. It is still not clear how much these scapular postural asymmetries may be related with abnormalities [4] or it should be considered as a sport adaptation.

The purpose of the study was to compare the symmetry on resting posture between both scapulae, in two groups of overhead athletes (volleyball players and team-handball players) and a control group composed by non-athletes.

We hypothesized that the asymmetry would be present in both overhead athletes group due to the repetitive use of the dominant shoulder.

### METHODS

An experimental group of 30 overhead athletes divided in 15 volleyball players (27.6 ± 1.6 years, 189.4 ± 2.7 cm, 24.3 ± 0.5 kg/m<sup>2</sup>; 15 right-hand dominant) and 15 competitive team-handball players (23.8 ± 0.8 years, 185.8 ± 1.5 cm, 25.4 ± 0.5 kg/m<sup>2</sup>; all right hand dominant), was compared to a control group with 30 non-athletes (29.6 ± 1.1 years, 178.1 ± 1.2 cm, 25.0 ± 0.7 kg/m<sup>2</sup>; 30 right-hand dominant). The dominant limb was identified as the arm that would be used to throw a ball or to wright. Only men were recruited for this study avoiding gender effects. An

electromagnetic tracking device (Hardware: “Flock of Birds system” Ascension Technology; Software: Motion Monitor v 7.0) was used to assess 3-dimensional scapular resting position with a 5 sensors set-up: thorax sensor over the spinous process of the 7<sup>th</sup> cervical vertebra; the scapulae sensors, attach to the flat portion of the acromion processes bilaterally; the humerus sensor attach to the midshaft of the posterior aspect of the dominant arm. All receivers were secured on the skin using double-sided adhesive disks, prewrap, athletic tape, and a hook-and-loop strap to minimize skin-sensor artifact.

A 5<sup>th</sup> sensor mounted on hand-held stylus (6.5cm) was used on shoulder bony landmark digitalization with the participants in a seated position and the arm along the body. Thorax, scapula and humerus local coordinate systems were calculated using the digitized bony landmarks and converting the sensor axes following the ISG protocol [5]. The scapula’s coordinate system was defined with the x-axis pointing forward, the y-axis pointing upward and the z-axis pointing from internal to external, i.e. from left to right in the right scapula and from right to left in the left scapula. Scapular position was described with respect to the thorax using ISG [5] recommended YX’Z’ Euler sequence. The first rotation was defined as scapular protraction (positive)/retraction (y-axis); the second rotation (x-axis) as scapular upward/downward (positive) rotation; and the third rotation (z-axis) as scapular anterior/posterior (positive) tilting.

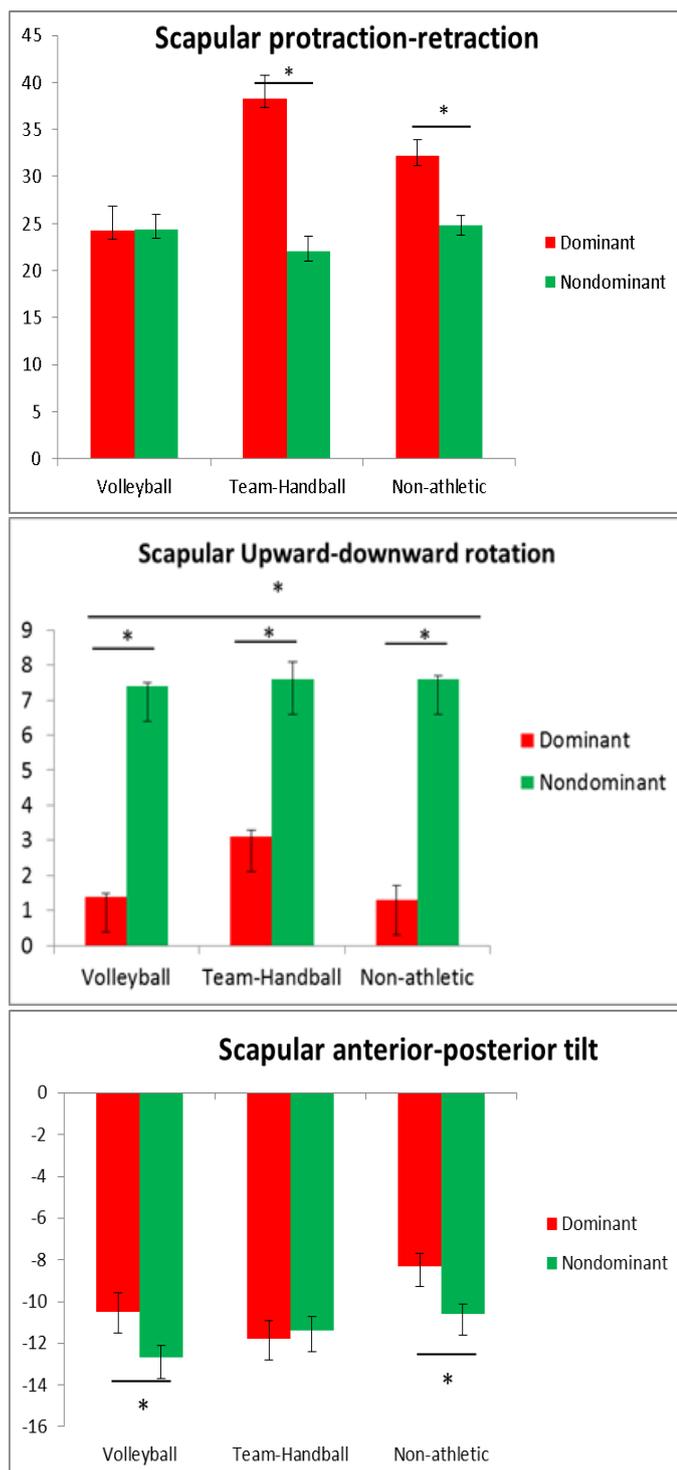
The natural and self-balanced upright posture of the subjects was obtained following a standardized protocol [6].

Between-limbs and between-groups differences in each scapular variable were analyzed using separate within-subjects, between-subjects factor analyses of variance. Tukey HSD post hoc analysis was conducted when the interaction was significant. Statistical analysis was performed using specific software (SPSS; Version 20; SPSS Inc., Chicago, IL) with the significance level set to .05.

### RESULTS AND DISCUSSION

Significantly differences were found between athletes and non-athletic groups with respect to scapular tilt in dominant (P=0.002) and non-dominant limb (P=0.04). The 3D scapular position demonstrated a limb-by-group interaction for protraction-retraction (P<0.001), scapular

anterior-posterior tilt ( $P=0.04$ ) and scapular upward-downward rotation ( $P<0.01$ ) (Figure 1).



**Figure 1:** Mean (SEM) for scapular internal-external rotation; Scapular anterior-posterior tilt and scapular upward-downward rotation for dominant and nondominant limbs (\*) significantly different.

The results of our study demonstrated an asymmetry on resting scapular posture between dominant and non-dominant sides in healthy overhead athletes. The dominant shoulder of handball players was more anteriorly tilted and internally rotated than volleyball players or even than non-athletic group. Because the demands placed on shoulders

of volleyball or team-handball players are different, we expected to see differences in scapular posture among groups. Increased moment of inertia of the upper extremity from holding a ball may result in greater stress at the shoulder, for the team-handball group.

Only non-pathological male subjects participated in this study. The presence of this postural asymmetry may be normal in the population of overhead athletes. Therefore our results confirm that during clinical trial the assumption, which symmetry will be found, could induce reasoning problems. In fact, clinicians should be aware, that this asymmetry may exist and it is not necessarily a problem.

Despite differences found, non-athletic group demonstrated a similar scapular orientation (also internally rotated and anteriorly tilted), this could be due to hand dominance, and if so, this is not unique to overhead throwing athletes. How much these asymmetries are due to sports is not understood yet, so athletes and non-athletes should be further analyzed.

## CONCLUSIONS

Asymmetry found in resting scapular posture between dominant and non-dominant limb in healthy overhead athletes may not be a problem but an adaptation due to sports practice. These asymmetries due to sports must be further analyzed to be better understood.

## ACKNOWLEDGEMENTS

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