EVALUATION OF HUMERAL HEAD RETROVERSION IN HANDBALL PLAYERS

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SUMMARY

Objectives: To evaluate the humeral head retroversion of handball players and its relationship to shoulder's range of motion. Materials and Methods: Seventeen professional players were evaluated by physical examination and X-ray images to determine the humeral head retroversion and its relationship to the range of motion. A control group was also submitted to the same evaluations. Results: The difference between the average of the humeral head retroversion of the dominant and non dominant shoulders was 3.06°. The mean value for this angle between the athletes who had started training as early as 10 years old was 36.29°, compared to those who had started later in life, which was 26.6° ($p<0.05$). The average of the external rotation of the players whose retroversion angle was bigger than 30° was 112.27°, and for those whose angle was smaller or equal to 30°, it was 95.10° ($p<0.05$). Conclusion: There was a significant difference in the retroversion angle when comparing dominant and non-dominant shoulders. The athletes who started to play before the age of 10 presented, statistically, an increased retroversion. There is a statistical relationship between retroversion increase and shoulder's external rotation gain.

Keywords: *Shoulder; Radiography; Anatomy*

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INTRODUCTION

In athletes practicing sports involving pitching, the shoulder joint is strongly demanded, especially during pitch preparation phase, in which the athlete makes abduction and lateral rotation movements [1-3].

This makes these athletes to experience adjustments, both of soft tissues and bone structures such as: anterior capsule stretching, posterior capsule hypertrophy and shortening, and increased retroversion of humeral head.

Several studies have documented those adjustments, particularly the increased humeral head retroversion and its correlation with lateral rotation increase [2-8].

Normal humeral head retroversion values are found between 25 and 35° in adults, but it can vary a lot, ranging from -10 to 60° [9, 10]. Checchia et al.[11], in a study addressing humeral anatomy in cadavers found an average angle value of 22°, ranging from 8 to 75° .

Humeral head retroversion in children is known to be more significant than it is in adults, and, during growth phase, it experiences a de-rotation process, similarly to what happens on hip, having a progressive decrease of 65º in average, resulting in humeral head retroversion of 25 - 35°in adults [10].

The objective of this study is to assess humeral head retroversion on the dominant side of a group of professional handball athletes and compare it to the non-dominant side, as well as to a control group, in addition to evaluate its influence on lateral and medial rotation movements.

MATERIALS AND METHODS

Seventeen handball players from a professional team of São Bernardo do Campo city were assessed. The mean age of the athletes was 24 years (ranging from 19 to 40 years old); all the subjects were males, and the average sports practice time was 12 years (ranging from 4 to 30 years). The left side was dominant for five subjects, and the right side was dominant in the remaining cases (Table 1).

At baseline, a physical examination of the shoulder was provided, in which the range of motion for lifting, lateral rotation, medial rotation, as well as other maneuvers described in literature were measured in order to detect instability, internal and subacromial impact. Lateral and medial rotations were measured with the athlete laid down at supine position, with shoulder 90º abducted and flexed elbow at 20º, taking as 0° the forearm at 90° with horizontal (Figures 1 and 2).

After a thorough shoulder examination, X-ray images were taken of the humerus at semi-axial plane for measuring the humeral head retroversion angle by the method described by Öztuma et al.[12], with patient at orthostatic position, shoulder 90º flexed and 20º abducted, with forearm resting on the film and the beam projected from posterior to anterior, perpendicularly to the film. (Figure 3).

For measuring what we regard as the average for an overall normal population, we studied the X-ray images in a control group constituted of 20 individuals, all of them submitted to the same evaluations described above.

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Humeral head retroversion was measured, determining the humeral anatomical neck axis, outlining a perpendicular line to the humeral head joint surface, and a line tangent to the trochlea, the humeral head retroversion angle being the acute angle formed by the intersection of both lines (Figure 4).
We calculated the average and standard deviation values for humeral head retroversion angle on handball players and control group. We compared the results found to the range of motion on dominant and non-dominant sides.
For statistical analysis, we used the Student's t-test, where the averages collected in this study were compared, considering results as significant when $p<0.05$.

Cases	Age (years)	Sex	Time since started playing handball (years)	Dominance
01	27	Male	16	Right-handed
02	20	Male	10	Right-handed
03	19	Male	10	Right-handed
04	19	Male	10	Left-handed
05	22	Male	10	Right-handed
06	20	Male	9	Right-handed
07	23	Male	8	Right-handed
08	21	Male	9	Right-handed
09	24	Male	15	Right-handed
10	27	Male	16	Right-handed
11	29	Male	19	Left-handed
12	24	Male	6	Left-handed
13	27	Male	14	Right-handed
14	28	Male	12	Right-handed
15	40	Male	30	Left-handed
16	19	Male	10	Left-handed
17	19	Male	4	Right-handed

Source: Outpatient service of the Shoulder and Elbow Group.

Table 1 - *Group of handball players in the study*

Figure 1 - *Method employed to measure maximum lateral rotation of the shoulder, with shoulder 90º abducted, with patient laid down at supine position with the aid of a goniometer.*

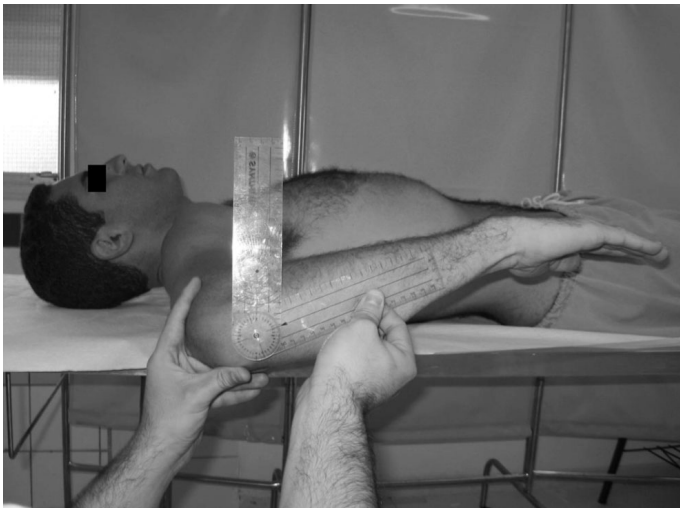

Figure 2 - *Method employed to measure maximum medial rotation of the shoulder, with shoulder 90º abducted, with patient laid down at supine position with the aid of a goniometer.*

Figure 3 - *Patient positioned to X-ray image test of the humerus at semi-axial plane by the method described by Öztuma*

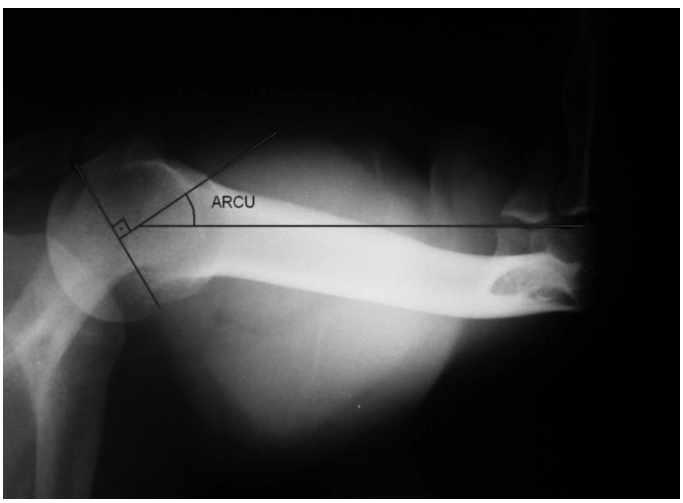

Figure 4 - *X-ray image of the humerus at semi-axial plane, showing a method for measuring humeral head retroversion angle.*

RESULTS

At physical examination, we found seven players presenting with ligament laxity.
The average range of motion of athletes on dominant limb was 174.88° (ranging from 140 to 230°), while on the non-dominant limb, this was 173.41° (ranging from 146 to 225°) (Table 2).

Lateral rotation of athletes' dominant limb was averaged at 104.82° (ranging from 85 to 155°), and the average for the non-dominant side was 100.53° (ranging from 80 to 140°). When we compare the dominant limb to the non-dominant one, we found no statistically significant difference (p=0.104) (Table 2).

	Limb		significance
	Dominant	Non-dominant	
Lateral rotation	104.82	100.53	P=0.104
Medial rotation	70.06	72.88	P=0.237
Range of Motion	174.88	173.41	p=0.355

Source: Outpatient service of the Shoulder and Elbow Group.

Table 2 - *Range of motion for dominant and non-dominant limbs of handball players, in degrees.*

The average for humeral head retroversion angle was 30.59° on the dominant side (ranging from 12 to 50°), and 27.53° on the non-dominant side (ranging from 8 to 40°), that difference was shown to be statistically significant (p=0.018) (Table 3). On control group, that average was 24.9° on the dominant side (ranging from 4 to 44°), and 23.1 on contralateral side (ranging from 2 to 40°). No statistically significant difference was found when comparing the averages of humeral head retroversion angles on the dominant side of athletes to control group (p=0.064) (Table 4).

	limb		significance
	dominant	non-dominant	
Humeral head retroversion	30.59	27.53	p=0.018

Source: Outpatient service of the Shoulder and Elbow Group.

Table 3 - *Difference between humeral head retroversion angle averages among dominant and non-dominant limbs of handball players*

	Players	Control	significance
Humeral head retroversion	30.59	24.9	p=0.064

Source: Outpatient service of the Shoulder and Elbow Group.

Table 4 - *Difference between humeral head retroversion angle averages among dominant limbs of players and control group individuals.*

Lateral rotation in athletes presenting with a humeral head retroversion angle below or equal to 30° was, in average, 95.10°, while in those presenting an angle >30°, that average was 112.27°, and this difference was considered as statistically significant (p=0.0009).

When medial rotation of the dominant limb was assessed, we found it reduced in handball players when compared to control group, of 8.64°, and this correlation was shown to be statistically significant (p=0.020) (Table 5). However, this was not seen when the average of medial rotation on dominant limb was compared to the non-dominant side of athletes (p=0.237) (Table 2).

	Players	Control	significance
Medial rotation	70.06	78.70	p=0.020

Source: Outpatient service of the Shoulder and Elbow Group.

Table 5 - *Comparison of medial rotation of dominant limbs between athletes and control group.*

Of the study athletes, seven had started playing handball before the age of 10, while 10 athletes had started it later in life.

By comparing the athletes who started playing handball before the age of 10 to those who started later in life, we noticed a difference of 9.69° on the averages of humeral head retroversion angle on the dominant side, and that difference was statistically significant (p=0.025). We also evidenced a greater lateral rotation in these athletes, and also, a wider range of motion, but these differences were not regarded as statistically significant (p=0.156 and p=0.057, respectively).

DISCUSSION

In literature, several studies can be found describing a lower humeral de-rotation in pitcher athletes, resulting in a greater humeral head retroversion on the dominant side when compared to the non-dominant side[2-4,7,8,12].

According to some authors, this would be an adaptive process in order to avoid the impact of humeral head on glenoidal cavity [13]. Indeed, some authors suggest osteotomy in patients with internal impact, intending to increase humeral head retroversion for treating it[14].

Furthermore, that increased retroversion predisposes to a higher lateral rotation at the moment of pitch preparation, which may result in a pitch speed gain.

In this study, the average humeral head retroversion angle was consistent to the results achieved by Checchia et al.[11] in a study on cadaver humerus; however, we didn't find a significant difference between humeral retroversion angle on the dominant side of the professional handball players in this study when they are compared to the overall population; such fact was found by Pieper in 38 of 51 handball players in his study[6]. Nevertheless, in our study, a significant difference was found when we compared retroversion on dominant side to the non-dominant side (p=0.018).

It seemed to us that, due to the large variability of the humeral head retroversion in the overall population, it is difficult to compare retroversion in athletes and a control group and that it would be more sensible to compare retroversion on the dominant limb to the contralateral one, because this would show us the differences in terms of upper limbs development in a same person, where one side is frequently submitted to, the forces that act during the various phases of a pitch movement, while the contralateral remains unchanged.

Osbahr et al.[3] , in their study with 19 baseball players, suggest that the development of an increased humeral head retroversion would occur after the age of 11, because a larger portion of this bone growth occurs at the proximal epiphysis after that age, a finding also reported by Levine et al.[2] in a study with 298 small league players. Those authors state that the age when bone adjustments are first seen is between 13 and 16 years, but they do not address the age of those athletes when they started playing.

When we compare the results of players who started practicing sports before the age of 10 to the others, we find an average humeral head retroversion angle with a statistically significant difference, both when compared to athletes who started playing later in life (p=0.025), and when compared to the control group (p=0.0170). This can be explained by the study by Edelson, who reports humeral head retroversion within normal adult parameters at the age of eight, ranging from four to eleven years old, this process occurring slowly after that period until about the age of 16[10,15].

We found a correlation between increased humeral head retroversion and increased lateral rotation, as many other authors did [2-4,6-8,16]. In our study we found that in cases where the humeral head retroversion angle is above 30º, the athletes present a statistically superior lateral rotation average (p=0.0009).

CONCLUSION

Humeral head retroversion on handball players' dominant side was shown to be statistically superior when compared to the non-dominant side. However, no statistical difference was found in the comparison with control group.

According to our data, the age at which sports practice was initiated influenced the increase of humeral head retroversion angle on the dominant side.

Athletes with a humeral head retroversion angle above 30º presented a statistically significant lateral rotation average, superior to the average of those with angles below or equal to 30°.

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