HUMERAL AND SCAPULAR 3D POSITION IN THROWERS AT END-RANGE INTERNAL AND EXTERNAL ROTATION DURING ACTIVE FAST AND SLOW ARM MOVEMENTS

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INTRODUCTION

Throwing athletes, as volleyball or handball players, are supose to keep their scapula stable while the arm is fastly moved from an external to an internal extremed position. Scapular stabilization could be dificult to keep when the arm motion is to fast. Therefore, an innadequate scapular position at the end-range of glenohumeral motion will lead to shoulder dysfunction and pathology. The purpose of this study was to compare throwers and non-throwing athletes with respect to changes on 3D scapular position at the end-range of glenohumeral internal and external rotation during fast and slow arm movements.

METHODS

Twenty-four subjects divided into the throwers group with 6 volleyball players (height:181± 4,7 cm; age: 22 ± 4,0 years; weight: 75 ± 7,6kg) and 6 handball players (height: 184 ± 3,7cm; age: 22 ± 0,9 years; weight: 81 ± 5,6kg); and the non-thrower group with 12 non-thrower athletes (height: 176 ± 4,7cm; age: 26 ± 2,9 years; weight: 73 ± 7,5kg). Humeral and scapular 3D positions were recorded by means of an electromagnetic tracking device (100Hz) with a four sensors set-up: thorax (on T1), arm (just below the deltoid attachment) and scapular sensor, attached to the superior flat surface of the acromion process. A 4th sensor mounted on a hand-held stylus (±6,5cm) was used on bony landmarks digitalization in order to link sensors to local anatomical coordinate systems (LCS) and subsequently calculated segments and joint rotations by combining the LCSs with the sensor motions. Segments LCSs and joint rotations definition were made according to the shoulder ISB standardization protocol [3]. Scapular position (Euler angles) with respect to the thorax, protraction (Syt), lateral rotation (Sxt) and spinal tilt (Szt), as well as thoracohumeral (HRt) and glenohumeral (HRs) axial angles were recorded at the end-range of active fast and slow (subject self-selected end of range) glenohumeral internal (IR) and external rotation ER), with subjects in a seated position and the dominant arm supported by the researcher at 90º of humeral elevation on the scapular plane. A mixed-model 2-way ANOVA was used to test the main effect of group (between-group factor) on 3 scapular (Syt, Sxt and Szt) and 2 humeral (HRt and HRs) dependent variables, as well as test for an interaction of group and speed motion (slow vs fast; within-subjects factor).

RESULTS AND DISCUSSION

No significant interaction was found between group and speed motion for any of the 3 scapular and the 2 humeral dependent variables. The throwers group had significantly (P<.05) less scapular protraction (15º difference; P=.00) and HRs amplitude (23º difference; P = .04) at the peak of ER and less scapular protraction at end-range of IR (16,8º difference; P=.00). On fast arm condition amplitude of HRt was significantly greater at end-range of IR (23º difference, P = .00) and amplitude of HRs was reduced at end-range of ER (13,6º difference; P=.04). On both groups when axial rotation velocity increases the peaks of internal HRt and external HRs decreases (Table 1). On throwers, scapula was also kept more in retraction even on ER and IR, suggested a more stable scapular pattern when arm axial motion increase.

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Table 1: The mean values (degrees) for humeral (HRt and HRs) and scapular (Syt, Sxt and Szt) dependent variables recorded at the peak of arm ER and IR separated by group and speed motion.

	External Rotation (end-range)				Internal Rotation (end-range)			
	Non-Throwers Group		Throwers Group		Non-Throwers Group		Throwers Group	
	Slow	Fast	Slow	Fast	Slow	Fast	Slow	Fast
HRt	-101.3±27.7	-96.3±26.8	-89.2±10.7	-77.5±19.2	19.2±24.0	43.3±29.5	38.4±11.5	44.2±18.1
HRs	-102.6±30.7	-90.4±29.2	-80.5±35.9	-65.6±19.5	28.7±19.9	44.9±25.6	40.6±13.4	43.7±15.4
Syt	34.2±15.8	32.5±14.0	19.6±9.4	17.4±5.6	47.8±6.1	48.4±12.7	32.1±9.2	30.5±7.2
Sxt	38.3±10.5	42.1±9.8	39.1±9.9	39.4±12.1	12.8±8.5	5.9±12.3	11.05±11.2	11.4±13.3
Szt	5.5±9.5	8.3±7.1	9.6±7.3	9.9±6.5	-4.3±6.4	-6.1±6.0	-9.3±7.0	-7.01±5.3