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SCAPULAR THREE-DIMENSIONAL KINEMATICS IN A CASE OF STERNOCLAVICULAR INSTABILITY

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INTRODUCTION

The sternoclavicular joint (SCJ) is the only skeletal articulation between the upper extremity and the axial skeleton. The strong ligaments of the SCJ make it one of the least dislocated joints in the body [1]. Scapulothoracic motion is a combination of SCJ and acromioclavicular joint motions [2]. When the clavicle elevates, this movement results in scapular upward rotation and scapular anterior tilt. During clavicular posterior rotation, the scapula is upwardly rotated and posteriorly tilted, and when the clavicle retracts, the scapula is externally rotated. Therefore, alterations in SCJ biomechanics is supposed to affect scapular kinematics. The purpose of this study was to describe the scapulothoracic three-dimensional kinematics in a case of asymptomatic anterior SCJ instability and compare to a control group of healthy subjects in order to identify altered patterns of motion.

METHODS

A male rugby player, 21 years old, presented asymptomatic SCJ anterior subluxation on his non-dominant side. Six years ago, during a game, a player fell on him, compressing laterally the thorax and both shoulders forwardly. He referred no pain at that moment but, three days later, he felt shoulder pain during arm elevation. The pain lasted three days and, one week later, he felt a "popping" and pain on the SCJ region while washing his hair, with the shoulder abducted and externally rotated. Since then, the SCJ subluxates above 140º of shoulder abduction and during overhead shoulder abduction with external rotation movement. No pain or functional impairments were reported in activities of daily living .

Three-dimensional kinematics data were captured using the Flock of Birds electromagnetic tracking system (Ascension Technology Corporation, Burlington, VT) integrated with the Motion Monitor software (Innovative Sports Training, Chicago, IL). The receivers were attached to the sternum and acromion using adhesive tapes and to the distal humerus using a thermoplastic cuff. Anatomical coordinate systems were determined following the International Society of Biomechanics recommendation [3].

The subject was assessed in standing position and performed three shoulder elevations in the scapular plane (45º anterior to the frontal plane), each one lasting 3 seconds to reach the maximum arm elevation. Data were collected at a frequency of 100 Hz.

Nineteen healthy subjects (10 men and 9 women, mean age 24.06±2.46 years) were also evaluated, using the same methods, for comparison of the scapular motion patterns.

Data from the subject with SCJ instability and the control group were reduced using a customized MatLab program. The scapular movements were obtained and plotted at each 5º of humerothoracic elevation, from 30º to 120º. For presentation purposes, upward rotation, internal rotation, posterior tilting and humeral elevation were all considered positive values. The movement patterns of SCJ instability case and the control group were qualitatively compared.

RESULTS AND DISCUSSION

No alteration was evident in the upward rotation and posterior tilting movements comparing the subject with SCJ instability and healthy controls (Figure 1). Although the subject with SCJ instability seems to present a scapula with a slight increase in posterior tilting, the general movement pattern was preserved. This movement pattern is in accordance with previous descriptions in the literature for healthy subjects [4], and consists in an increase in scapulothoracic upward rotation and posterior tilting as the arm elevates.

Regarding scapular internal rotation, the subject with SCJ instability presented less scapulothoracic internal rotation at the initial position with an increase in its range of motion during humeral elevation (Figure 1). The normal pattern for such movement consists in a small range of motion, with a decrease in internal rotation near 120º of humerothoracic elevation, as observed in the control group and reported in the literature [4]. The scapulothoracic motion results from the movements in the SCJ and acromioclavicular joints. During arm elevation, the clavicle retracts in the SCJ. Clavicular retraction is coupled with scapular external rotation, but this movement is normally offset by the scapular internal rotation that occurs in the acromioclavicular joint [2]. Assuming that the subject presented joint kinematics alterations only in the SCJ, it can be suggested that the observed alterations in scapulothoracic internal rotation are caused by changes in clavicular retraction. An anterior SCJ instability could result in a clavicle more retracted, explaining the decreased scapular

internal rotation in the initial position, at low degrees of arm elevation. As the arm elevates, the scapula would internally rotate in the acromioclavicular joint, in order to be adjusted to the thorax curvature [5]. It is possible that the scapulothoracic internal rotation observed in this case is related to a decreased clavicular retraction movement, which would cause less scapular external rotation, leading to an increase in the resultant scapulothoracic internal rotation. A decreased clavicular retraction movement could be related to a protection mechanism for preventing the anterior SCJ subluxation [4].

CONCLUSIONS

This case study showed that SC anterior instability is related to a decrease in the scapulothoracic internal rotation in low degrees of arm elevation, followed by an increase in its range of motion during humeral elevation. This finding was suggested to be related to alterations in clavicular retraction motion. Scapulothoracic posterior tilting and upward rotation movement patterns presented no significant alterations compared to healthy subjects.

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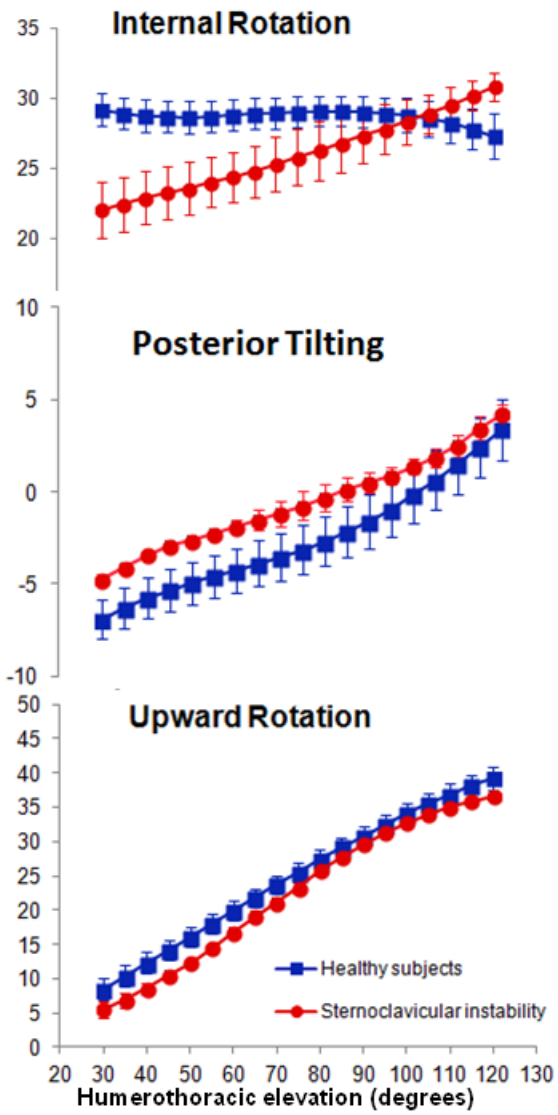

Figure 1: Data (mean and standard error) of scapulothoracic kinematics during shoulder elevation in the scapular plane, in a case o sternoclavicular anterior instability and a group of healthy subjects (n=19). For presentation purposes, the angles for such movements were considered positive values.