Original Article

Acromioclavicular dislocation: postoperative evaluation of the coracoclavicular ligaments using magnetic resonance

Rafael Salomon Silva Faria, Fabiano Rebouças Ribeiro, Bruno de Oliveira Amin*, Antonio Carlos Tenor Junior, Miguel Pereira da Costa, Cantídio Salvador Filardi Filho, Cleber Gonçalves Batista, Rômulo Brasil Filho

Hospital do Servidor Público Estadual Francisco Morato de Oliveira, São Paulo, SP, Brazil

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ABSTRACT

Objective: To radiologically evaluate the healing of the coracoclavicular ligaments after surgical treatment for acromioclavicular dislocation.

Methods: Ten patients who had undergone surgical treatment for acromioclavicular dislocation via a posterosuperior route at least one year earlier were invited to return for radiological assessment using magnetic resonance. This evaluation was done by means of analogy with the scale described in the literature for studying the healing of the anterior cruciate ligament of the knee and for measuring the healed coracoclavicular ligaments.

Results: A scar structure of fibrous appearance had formed in 100% of the cases. In 50% of the cases, the images of this structure had a good appearance, while the other 50% were deficient.

Conclusion: Late postoperative evaluation using magnetic resonance, on patients who had been treated for acute acromioclavicular dislocation using a posterosuperior route in the shoulder, showed that the coracoclavicular ligaments had healed in 100% of the cases, but that this healing was deficient in 50%.

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LUXAÇÃO ACROMIOCLAVICULAR: AVALIAÇÃO PÓS-OPERATÓRIA DOS LIGAMENTOS CORACOCLAVICULARES POR RESONÂNCIA MAGNÉTICA

RESUMO

Objetivo: Avaliar radiologicamente a cicatrização dos ligamentos coracoclavulares após o tratamento cirúrgico para luxação acromioclavicular.

* Work developed in the Shoulder and Elbow Group of the Department of Orthopedics and Traumatology, Hospital do Servidor Público Estadual Francisco Morato de Oliveira, São Paulo, SP, Brazil.

* Corresponding author.

E-mail: bruno_amin@hotmail.com (B.d.O. Amin).

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Introduction

Acromioclavicular dislocation (ACD) is a traumatic pathological condition of the shoulder that predominantly occurs in young adults. The anatomical and biomechanical alterations caused by the tearing of the coracoclavicular ligaments are a crucial factor in deciding whether to treat the injury surgically or non-surgically.1-3

The well-established radiographic classification system described by Rockwood1 uses the contralateral shoulder as a comparison parameter, as follows: no abnormality of the coracoclavicular distance (ACD grade I); change to the coracoclavicular distance, but less than 25% (ACD grade II); coracoclavicular distance increased by 25–100% (ACD grade III); posterior displacement of the clavicle (ACD grade IV); coracoclavicular space increased by 100–300% (ACD grade V); and coracoclavicular space diminished or inverted (ACD grade VI).

The coracoclavicular ligaments are the main stabilizers of the acromioclavicular joint and the main supports for the upper limbs.1-3 Nevertheless, little is known about their healing after surgical treatment for ACD.

Materials and methods

Magnetic resonance imaging (MRI) on 10 patients aged 20 to 50 years (both men and women), with initial diagnoses of ACD grades III to V, was evaluated. These patients were selected randomly (drawn) from among our population. All of them had been operated by the same team and with the same surgical technique: binding of the clavicle to the coracoid process using two metal anchors (5 mm in diameter, with non-absorbable threads), by means of a posterosuperior access in the shoulder4 (Fig. 1A and B). The minimum postoperative follow-up was one year.

The exclusion criteria were as follows: treatment performed using a closed manner; surgical treatment in which other techniques were used (such as transfer of the coracoclavicular ligaments to the distal clavicle); and age less than 20 or more than 50 years.

The patients who were drawn were asked to come for an MRI examination using a 1.5 T machine, within the standards described in the literature for coracoclavicular ligament evaluation (Fig. 2). Slices were produced in planes parallel to a...
line that was traced out between the apex of the coracoid process and the apex of the lesser tubercle of the humerus. The slices were of thickness 3.5 mm, T1 and T2-weighted, and were produced with the patient in the neutral position. The imaging parameters were as follows: field of view from 145 mm × 145 mm to 150 mm × 150 mm; matrix size of 353 × 512 or 256 × 512; and section thickness of 3.5 mm. The examinations were evaluated jointly by an orthopedist who was a specialist in shoulder and elbow surgery and a trainee physician in the hospital’s shoulder and elbow group.

To evaluate the presence and quality of healing of the coracoclavicular ligaments, a scale previously described in the literature was used. This was a scale for evaluating the healing of grafts from the flexor tendons of the knee, which are used in reconstructions following anterior cruciate ligament injury. This scale grades the image of the ligament that was obtained using MRI, into four stages according to their size and signs of homogeneity (Table 1). Ligaments classified as grades I and II correlate with good stability and can therefore be considered to have healed, while those graded as III and IV are considered to present deficient healing or absence of healing.

The geometry of the scar tissue encountered (neoligament) was evaluated using the Impax 6.3 client software.

The following measurements were made: length, measured along the direction of the fibers of the neoligament, from the midpoint of the origin in the clavicle to the midpoint of the insertion in the coracoid process; width, in the coronal plane in its proximal portion (origin in the clavicle) and distal portion (insertion in the coracoid process); angle, measured between the line along which the length was measured and a straight line along the lower edge of the distal clavicle (Fig. 3A–C).

### Results

It was observed that in the MRI examination, all the patients presented an image of scar tissue of fibrous appearance that connected the distal clavicle to the coracoid process. In five examinations that were classified as grade II, it was considered that good ligament healing had been achieved. The other five examinations showed deficient healing. Three were classified as grade III and two as grade IV.

Regarding the geometry of the healed coracoclavicular ligaments, no distinction was observed between the two ligaments (conoid and trapezoid). Only a single scar structure was observed, with variation in measurements between the patients (Table 2). However, in most cases, the new ligament was seen to have maintained the trapezoidal appearance of the coracoclavicular ligaments, such that their clavicular portion was wider than their distal portion at the coracoid process. The examinations on the patients classified as grade IV (two cases) did not allow effective measurements, because of their anatomical irregularities.

### Discussion

To evaluate the healing of the coracoclavicular ligaments, anatomical parameters that had previously been established for knee ligament injuries were used in the present study, given that no preestablished parameters for the coracoclavicular ligaments were encountered in the literature. The time period taken into consideration for healing to take place among the patients who were treated surgically for ACD was determined based on the minimum postoperative time needed for the anterior cruciate ligament of the knee, reconstructed using a graft from the flexor tendons, to achieve a histological state similar to the original. This ranges from 30 to 52 weeks, according to the literature consulted. In a study conducted by Clayer et al., using sequential MRI examinations on six patients who underwent surgical treatment for ACD, in which an absorbable loop was used for coracoclavicular fixation, it was observed that six months after the operation, a structure of fibrous appearance connecting the coracoid process to the clavicle could already be seen.

MRI is an efficient and accurate examination for detailed evaluations on the ligament structures of the joints of the human body, such as the shoulder and knee. Nemec et al. compared MRI to radiography for classifying ACD that occurred in 44 patients, using Rockwood’s system. The examinations were concordant for the classification of the injury in only 52.2% of the cases, which demonstrates that MRI is a more specific examination.
In our study, a structure of scar tissue characteristics was observed using MRI in 100% of the cases operated. It had a fibrous appearance, with trapezoidal format and coracoclavicular ligature. However, there were signs of deficient healing in 50% of the cases. These findings were compatible with those of the study by Clayer et al., in which formation of an anatomical structure of fibrous appearance was also observed in the regions of the coracoclavicular ligaments, which suggests that these ligaments had healed.

In an anatomical study on the coracoclavicular ligaments, Harris et al. made measurements on 24 shoulders of cadavers and found the following means: length of the conoid

| Patients | Healing classification | Longitudinal length of coracoclavicular neoligament | Width of neoligament (clavicular) | Width of neoligament (coracoid) | Angle of neoligament |
|----------|------------------------|------------------------------------------------------|----------------------------------|----------------------------------|---------------------|
| 1        | Grade II               | 23.7 mm                                              | 23.9 mm                          | 14.3 mm                          | 44°                 |
| 2        | Grade IV               | n.m.                                                 | n.m.                             | n.m.                             | n.m.                |
| 3        | Grade II               | 23.0 mm                                              | 31.9 mm                          | 22.4 mm                          | 61°                 |
| 4        | Grade III              | 10.5 mm                                              | 27.6 mm                          | 12.8 mm                          | 69°                 |
| 5        | Grade II               | 29.1 mm                                              | 34.2 mm                          | 25.4 mm                          | 48°                 |
| 6        | Grade III              | 13.3 mm                                              | 29.5 mm                          | 17.0 mm                          | 20°                 |
| 7        | Grade II               | 15.4 mm                                              | 18.6 mm                          | 17.3 mm                          | 29°                 |
| 8        | Grade IV               | n.m.                                                 | n.m.                             | n.m.                             | n.m.                |
| 9        | Grade II               | 17.0 mm                                              | 32.4 mm                          | 20.2 mm                          | 75°                 |
| 10       | Grade III              | 23.2 mm                                              | 20.1 mm                          | 12.3 mm                          | 74°                 |
| Mean     |                        | 19.3 mm                                              | 27.3 mm                          | 17.7 mm                          | 52°                 |

n.m., not measurable.
Conflicts of interest

The authors declare no conflicts of interest.

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