Postoperative Comparative Evaluation of Patients Undergoing Surgical Treatment for Acute Versus Chronic Acromioclavicular Dislocations*

Avaliação pós-operatória comparativa dos pacientes submetidos ao tratamento cirúrgico das luxações acromioclaviculares aguda versus crônica

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Abstract

Objectives The present study evaluates and compares the surgical treatment of acute and chronic acromioclavicular dislocations (ACDs) to define the most effective therapeutic plan.

Methods A retrospective study consisting of 30 patients submitted to the surgical treatment of types III and V ACDs between 2011 and 2018; the subjects were separated according to a temporal classification in acute (< 3 weeks; subgroup I) and chronic (> 3 weeks; subgroup II) subgroups. All patients underwent a postsurgical evaluation with a standardized protocol containing epidemiological, functional, and radiological data.

Results Subgroup I presented a visual analog scale (VAS) score of 1.10, a Constant-Murley score of 92.3, and a University of California at Los Angeles (UCLA) Shoulder Rating score of 33.5. The coracoclavicular (CC) distance was of 11.0 mm, and the average increase in CC space was lower than 8.9% compared to the contralateral shoulder. In subgroup II, the VAS score was of 1.11, the Constant-Murley score was of 94.2, and the UCLA score was of 32.4. The CC distance was of 13.8 mm, with a 22.9% increase in CC space compared to the contralateral side.

Conclusion Although there was no significant difference between the evaluated items, subgroup I tended to present a lower CC distance ($p = 0.098$) and a lower

Keywords
- acromioclavicular joint/injuries
- acromioclavicular joint/surgery
- joint dislocations
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percentage increase in CC distance ($p = 0.095$) compared to subgroup II. Thus, the surgical treatment must be performed within three weeks after the trauma to try to avoid such trend. If the acute treatment is not possible, the modified Weaver Dunn technique has good clinical and functional outcomes.

Resumo

Objetivos Avaliar e comparar os resultados do tratamento cirúrgico das luxações acromioclaviculares (LACs) aguda e crônica, definindo o plano terapêutico mais eficaz.
Métodos Estudo retrospectivo realizado com 30 pacientes operados entre 2011 e 2018 para LAC tipos III e V, separados de acordo com a classificação temporal em subgrupo agudo (< 3 semanas; subgrupo I) e subgrupo crônico (> 3 semanas; subgrupo II). Todos os pacientes foram submetidos a avaliação pós-cirúrgica com protocolo padronizado composto por dados epidemiológicos, funcionais e radiográficos.
Resultados No subgrupo I, a pontuação na escala visual analógica (EVA) foi de 1,10, o escore de Constant-Murley foi de 92,3, e o escore da University of California at Los Angeles (UCLA) foi de 33,5. A distância coracoclavicular (CC) foi de 11,0 mm, e o aumento do espaço CC foi em média menor do que 8,9% em relação ao ombro contralateral. No subgrupo II, a EVA foi de 1,11, o escore de Constant-Murley foi de 94,2, e o da UCLA, 32,4. A distância CC foi de 13,8 mm, sendo o aumento do espaço CC de 22,9% em relação ao contralateral.
Conclusão Apesar de não ter havido diferença significativa entre os quesitos avaliados, houve uma tendência de o subgrupo agudo apresentar distância CC ($p = 0,098$) e percentual de aumento da distância CC ($p = 0,095$) menor do que o subgrupo crônico. Assim, é interessante que o tratamento cirúrgico seja realizado nas primeiras três semanas após o trauma, para tentar evitar essa tendência. Nos casos em que não for possível realizar o tratamento na fase aguda, a técnica de Weaver Dunn modificada apresenta bons resultados clínicos e funcionais.

Palavras-chave
- articulação acromioclavicular/lesões
- articulação acromioclavicular/cirurgia
- luxações articulares
- ligamentos articulares

Introduction

The diarthrodial joint between the medial acromial aspect and the side of the clavicle is called acromioclavicular (AC) joint. Its anteroposterior stability is provided by the AC ligaments, which consist of thickening portions of the joint capsule, in which the upper one is the strongest. Superoinferior stability is maintained by the coracoclavicular (CC), trapezoid and conoid ligaments.[1]

Fukuda et al.,[2] identified that the AC ligaments were the main limiting factors for posterior and superior translation in minor dislocations. In larger dislocations, the conoid ligament is the primary limiting factor for upper translation, while the trapezoidal ligament provides tensile strength to the AC joint.[2]

Injuries to the AC joint typically result from direct trauma to the shoulder caused by falls and contact sports with the arm in an adducted position. Force deflects the acromion inferiorly, while the clavicle remains in its anatomical position. This results in varying degrees of damage to both the AC and CC ligaments.[3]

Williams et al.,[4] based on a study by Tossy et al.,[5] developed a widely-accepted classification system according to anatomical severity, dividing the injuries into six types. In addition, AC injuries can be divided into acute (< 3 weeks) and chronic (> 3 weeks) lesions.[6,7]

Most authors recommend the non-surgical treatment for type-I and type-II injuries.[1,8,9] The treatment for type-III lesions is controversial, since several authors have presented conservatively-treated case series with good to excellent outcomes.[10,11] However, other authors have reported cases with pain and other residual symptoms.[12,13] In an attempt to maximize the positive outcomes, many authors have advocated the surgical repair in young, active patients.[14,15]

For type-IV, type-V and type-VI lesions, the surgical treatment is established.[1,3,9,14] Multiple techniques for the surgical treatment have been described, but there is no evidence of the superiority of one when compared to the others. The only consensus is that, regardless of the approach, five key elements must be reached: anatomical reduction, CC ligament reconstruction or direct repair, CC ligament protection, deltotrapezoid fascia repair, and, in chronic lesions, distal resection of the clavicle.[3]

The present study aims to analyze the outcomes of the treatment of acute and chronic AC dislocations (ACDs) to identify the best time for surgical therapy and to define a more effective therapeutic plan.

Table 1 Clinical variables in each group

Clinical ariable	Acute subgroup (n = 21)		Chronic subgroup (n = 9)	
	Mean	Standard deviation	Mean	Standard deviation
Age (years)	40.7	13.1	42.1	14.6
Time until surgery (days)	4.5	4.0	424	462
Time until the return to work (days)[a]	73.0	49.8	78.1	49.1
Time until the return to sports (months)[b]	5.3	2.8	7.50	5.01
Laterality				
Right	15 (71.4%)		6 (66.7%)	
Left	6 (28.6%)		3 (33.3%)	

Notes: The numerical data were expressed as means and standard deviations.
[a]The time until the return to work showed loss of registration or did not apply to both acute and chronic subgroups (n = 19 *versus* n = 7).
[b]The time until the return to sports showed loss of registration or did not apply to both acute and chronic subgroups (n = 17 *versus* n = 8).

Material and Methods

A retrospective cross-sectional study was conducted with 39 cases of ACD treated surgically between 2011 and 2018 in 2 private hospitals. Due to the long follow-up and patient profile, only 30 subjects returned for evaluation. **All patients were evaluated radiographically using the anteroposterior (AP) and Zanca views, including both shoulders, as well as axillary views.** Of these patients, 28 were diagnosed at the time of surgery as ACD grade V, while 2 patients were diagnosed as ACD grade III.

Of the 30 patients, 21 had acute injuries (subgroup I) and 9 presented chronic injuries (subgroup II). The subjects in subgroup I were operated on average 4.5 days after the trauma, while the patients in subgroup II were operated on average 424 days after the trauma. Most patients (96.6%) were male. The mean age was 40.7 years in subgroup I, and 42.1 years in subgroup II. The right side was the most affected, accounting for 71.4% of the injuries in subgroup I , and for 66.7% of the lesions in subgroup II (►**Table 1**).

All patients were reevaluated by the same examiner using a postsurgical standardized protocol consisting of the University of California at Los Angeles (UCLA) Shoulder Rating score, the Constant-Murley score, the visual analog scale (VAS) score, as well as of epidemiological data and comparative, contralateral force assessment with a digital dynamometer. **After the evaluation, AP, Zanca and axillary radiographs were performed to determine the residual displacement of the operated shoulder by comparing its coracoclavicular distance with the contralateral shoulder.**

The experimental design was submitted to and approved by the local ethics committee under CAAE 95443218.4.0000.0023.

Statistical Methodology

Tables were developed to present the results of the descriptive analysis, with numerical data expressed as means and standard deviations, and the categorical data expressed as frequencies and percentages.

In inferential analysis, we compared the subgroups (acute and chronic) using the *Mann-Whitney test* for the numerical data and the *Fisher exact test* for the categorical data. Paired data were compared using the *Wilcoxon signed-rank test*. The *Spearman correlation coefficient* was used to analyze the association between the numerical variables.

Nonparametric methods were used since the data did not show a normal (Gaussian) distribution, due to the rejection of the null hypothesis of normality according to the Shapiro-Wilk test in at least one group and/or time point. Significance was defined at a level of 5%. The statistical analysis was processed using the SAS System statistical software (SAS Institute, Inc., Cary, North Carolina, US), version 6.11.

Surgical Technique

The treatment for acute injuries recommended by the authors uses suture anchors and transarticular fixed Kirschner wires as described by Phemister.[16] The advantages include the small incision and limited dissection above the coracoid region, with no need for any instrumentation below it, minimizing the risk of neurovascular injury.

With the patient in the beach chair position, anesthetized with an interscalene block, the arm and shoulder are prepared. A 5-cm incision is made below the clavicle, at the level of the coracoid process. The subcutaneous tissue is dissected until the deltotrapezoid fascia is exposed. A medial to lateral incision is then made following the curvature of the clavicle until bone exposure.

A blunt dissection is performed until the dorsal base of the coracoid process is exposed. After satisfactory exposure, two #5 suture anchors are used with two #2 Fiberwire (Arthrex, Naples, Florida, US) non-absorbable sutures. A 3.2-mm drill is used to make 2 holes in the collarbone, one more posterior, 3.5 cm from the AC joint, and the other more anterior, 2.5 cm from the AC joint.[17,18]

The dislocation is hyper-reduced, and a 2.0-mm Kirschner wire is transfixed by the AC joint. Its position is confirmed by arthroscopy. After the reduction, each suture is tied

separately. The deltotrapezoid fascia is repaired, and the subcutaneous tissue and skin are sutured. **The Kirschner wires are bent and kept under the skin.**

Chronic dislocations are treated using the modified Weaver-Dunn technique. The patient is positioned and prepared as in the previous procedure. Two suture anchors are placed at the coracoid process. A medial, 5 cm to 7 cm in length, incision is made at the AC joint towards the coracoid process. The deltotrapezoid fascia is identified and incised. The periosteal detachment of the trapezius and deltoid is then performed. Through blunt dissection, the coracoacromial ligament is identified and detached at its anteroinferior acromial insertion. The lateral end of the clavicle is excised about 1.0 cm to 1.5 cm from the lateral edge.

The clavicle is then reduced, and one or two Kirschner wires are passed, transfixing the AC joint. Two holes are made in the upper cortical layer of the clavicle, and the end of the coracoacromial ligament is repaired and tied through the clavicular holes, projecting the ligament into the medullary canal. Suture anchors are tied to the clavicle, the deltotrapezoid fascia is repaired, and the subcutaneous tissue and skin are closed. **As in acute cases, the Kirschner wires are bent and remain under the skin.**

Postoperative Period

In both subgroups, the arm was kept in a three-point American sling for six weeks. At the end of the sixth week, the Kirschner wire was surgically removed, and mobilization was allowed. Then, motor physical therapy was started for range of motion and stretching. Muscle strengthening was allowed after the third postoperative month, and return to sports was allowed after the fifth month.

Results

Regarding the functional scores, the mean VAS was of 1.10 (standard deviation [SD]: 1.61) in subgroup I, and of 1.11 (SD: 2.09) in subgroup II. The mean Constant-Murley score was of 92.3 (SD: 7.1) in subgroup I, and of 94.2 (SD: 6.9) in subgroup II. The mean UCLA score was of 33.5 (SD: 2.2) in subgroup I, and of 32.4 (SD: 4.9) in subgroup II. There were no significant differences in the functional score at the level of 5% (►**Table 2**).

As for force, in subgroup I, the average abduction in the operated arm was of 11.1 kgf (SD: 5.4), with a delta value for the relative variation comparing the operated and the contralateral shoulder of -2.94%. In subgroup II, the average abduction in the operated arm was of 11.5 kgf (SD: 3.4), with a delta value of -7.54%.

In subgroup I, the mean medial rotation force in the operated arm was of 15.9 kgf (SD: 8.9), with a delta value of -3.23%. In subgroup II, the mean medial rotation force in the operated arm was of 14.2 kgf (SD: 3.8), with a delta value of -1.37%.

Subgroup I presented an average lateral rotation force of 11.2 kgf (SD: 5.1) in the operated arm, with a delta value of -7.21%. In subgroup II, the average lateral rotation force was of 10.5 kgf (SD: 2.9) in the operated arm, with a delta value of

Table 2 Functional and force variables in each group

Variables	Acute subgroup (n = 21)		Chronic subgroup (n = 9)	
Functional	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**
VAS score	1.10	1.61	1.11	2.09
Constant-Murley score	92.3	7.1	94.2	6.9
UCLA score	33.5	2.2	32.4	4.9
CC distance (mm)	11.0	4.0	13.8	4.1
Increase in distance (%)	8.9	14.2	22.9	24.1
Force at operated shoulder	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**
Abduction force (kg)	11.1	5.4	11.5	3.4
Medial rotation force (kg)	15.9	8.9	14.2	3.8
Lateral rotation force (kg)	11.2	5.1	10.5	2.9
Force at the contralateral shoulder	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**
Abduction force (kg)	11.7	5.4	12.5	3.8
Medial rotation force (kg)	15.6	9.1	14.6	4.5
Lateral rotation force (kg)	12.2	5.7	11.4	4.4
Delta value for force (%)				
Delta value for abduction force (%)	-2.94		-7.54	
Delta value for medial rotation force (%)	3.23		-1.37	
Delta value for lateral rotation force (%)	-7.21		-4.68	

Abbreviations: CC, coracoclavicular; VAS, visual analog scale; UCLA, University of California at Los Angeles (UCLA) Shoulder Rating score.
Notes: The numerical data were expressed as means and standard deviations. The delta value for force corresponds to the relative variation comparing the operated and contralateral shoulders: (operated – contralateral shoulder) / contralateral shoulder x 100.

-4.68%. The force-related variables showed no significant difference at the level of 5% (►**Table 2**).

The mean CC distance was of 11.0 mm (SD: 4.0) in subgroup I, and of 13.8 mm (SD: 4.1 mm) in subgroup II. In subgroup I, 38.09% of the patients presented AC-joint subdisclocation, with an average increase in CC space compared to the contralateral shoulder of 8.9% (SD: 14.2); in subgroup II, 66.66% of the patients presented said subdislocation, with an average increase of 22.9% (SD: 24.1). The subjects in subgroup I tended to present a lower CC distance ($p = 0.098$) and a lower percentage increase in CC distance ($p = 0.095$) compared to subgroup II. In addition, there was no significant correlation, at the level of 5% between the percentage of increased distance with functional and force parameters, both in the total sample and in subgroups I and II.

The average time until the return to work was of 73 days for subgroup I, and of 78.1 days for subgroup II. The average time until the return to sports was of 5.3 months (SD: 2.8) in subgroup I, and of 7.5 months (SD: 5.01) in subgroup II.

Functional and force results are shown in ►**Table 2**.

Discussion

There is no consensus in the current literature on which is the best surgical technique to treat chronic and acute ACDs. Scientific publications have presented outcomes from several therapeutic modalities for these injuries, but few compare the techniques used in each of these cases. We evaluated the outcomes of the surgical treatment of acute and chronic dislocations and compared them.

Both groups were submitted to surgical techniques following the five key elements of surgery recommended by Li et al.[3]: anatomical reduction, CC ligament reconstruction or direct repair, CC ligament protection, deltotrapezoid fascia repair, and, in chronic injuries, distal resection of the clavicle.

Unlike Von Heideken et al.,[19] who found a statistically significant difference in the Constant-Murley score (91 for the acute group *versus* 85 for the chronic group), and Rolf et al.,[20] who also reported inferior clinical and functional outcomes in the late reconstruction group (87.17 *versus* 78.10), in the present study, there were no statistical differences between subgroup I and subgroup II regarding the Constant-Murley and UCLA scores.

Tauber et al.[21] observed a mean VAS score of 2.3 points, which is similar to that found by Hegazy et al.[22] in their series (average score: 1); these findings are in line with our VAS assessment, with an average of 1.10 points in subgroup I, and 1.11 points in subgroup II, with no statistical significance.

The mean UCLA score was of 33.5 points (SD: 2.2) in subgroup I, with good/excellent values (> 27 points) in 95.23% of the subjects. In subgroup 2, the mean UCLA score was pf 32.4 points (SD: 4.9), with good/excellent values in 88.8% of the cases. There was no statistically significant difference between the groups. These results are similar to those reported in the Brazilian literature, with 92.8% of good/excellent cases according to Molin et al.[23] and 95.2% according to Scandiuzzi et al.[24]

Complications were present in 43.3% of our patients, in a rate that is in line with that of other studies, such as those by Ferreira Neto et al.[25] (40.9%) and Neviaser[26] (39%). Superficial infection occurred in 14.21% of the cases on subgroup I, and in 11.11% of the subjects in subgroup II. All cases were treated with oral antibiotic therapy and daily dressings, with no cutaneous suture dehiscence or clinical repercussions. Another complication observed was the lateral migration of the AC Kirschner wire in a group-I patient (4.76%), which was treated with the removal of the synthesis material and no further intercurrence. Residual pain was reported by 14.28% of the subjects in subgroup I and 11.11% of the patients in subgroup II.

Clavicular prominence was reported by 4.76% of the patients in subgroup I, and by 22.2% of the subjects in subgroup 2. A radiologically-assessed increase in CC space higher than 12 mm was observed in 8.9% (SD: 14.2) of the subjects in subgroup I, and in 22.9% (SD: 24.1) of the patients in subgroup II. Although there was no significant difference at the level of 5%, the subgroup-I patients tended to present lower CC distance ($p = 0.098$) and lower percentual increase in CC distance compared to the contralateral side ($p = 0.095$) than the subgroup-II patients.

Despite the high incidence of this deviation as a complication, it had no final impact on level of satisfaction of the patients. In addition, no patient presented scapular dyskinesia, which corroborates literature reports that anatomical reduction is not always required to restore adequate shoulder function, and that the loss in reduction does not seem to significantly influence the outcomes.[12,27,28]

In total, 28 patients (93.3%) were satisfied with the treatment, with no statistically significant difference between the subgroups. This is in line with the literature,[13] suggesting that there is no relationship between the clinical and radiographic findings.

The main limitations of the present study are its retrospective nature, the relatively low number of patients, and the discrepancy between the subgroups.

Conclusion

We conclude that the surgical treatment of ACDs presents satisfactory outcomes both in acute and chronic cases. However, due to the greater trend for residual dislocation with the increased CC space in chronic cases, we should seek to treat these injuries immediately after the trauma.

Conflict of Interests

The authors have no conflict of interests to declare.

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