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Does the supraspinatus tear pattern affect the results of the arthroscopic repair?*

O padrão da rotura do supraespinal afeta os resultados do reparo artroscópico?

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Abstract

Objective To evaluate the influence of the supraspinal tear pattern on the pre- and postoperative functional evaluations.

Methods A retrospective cohort study comparing patients with supraspinatus crescent-shaped tears versus L- or U-shaped tears. We included patients undergoing complete supraspinatus arthroscopic repair. We did not include patients with subscapularis or infraspinatus repair, those submitted to open surgery, or those in whom only partial repair was achieved. The clinical scales used were the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment (ASES) and the Modified-University of California at Los Angeles Shoulder Rating Scale (UCLA), which were applied 1 week before and 24 months after the procedure.

Results We analyzed 167 shoulders (from 163 patients). In the preoperative period, the ASES scale was significantly higher in the crescent-shaped pattern (43.5 ± 17.6 versus 37.7 ± 13.8; $p = 0.034$). The UCLA scale followed the same pattern (15.2 ± 4.6 versus 13.5 ± 3.6; $p = 0.028$). In the postoperative period, however, there was no significant difference. According to the ASES scale, crescent-shaped tears scored 83.7 ± 18.7 points, and L- or U-shaped tears scored 82.9 ± 20.1 ($p = 0.887$). The values were 30.9 ± 4.9 and 30.5 ± 5.6 ($p = 0.773$) respectively, by the UCLA scale.

Conclusion Crescent-shaped and L- or U-shaped supraspinatus tears have similar postoperative functional results. In the preoperative period, the functional results are superior in crescent-shaped tears.

Keywords
- rotator cuff
- arthroscopy
- articular range of motion

Resumo

Objetivo Avaliar a influência do padrão da rotura do supraespinal nas avaliações funcionais pré e pós-operatória.

* Study developed at the Shoulder and Elbow Group, Instituto de Ortopedia e Traumatologia, Hospital das Clínicas, Faculdade de Medicina, Universidade de São Paulo (HCFMUSP), São Paulo, SP, Brazil.

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Métodos Estudo de coorte retrospectivo, comparando pacientes com rotura do supraespinal em crescente versus em L ou U. Incluímos pacientes submetidos ao reparo artroscópico completo do supraespinal. Não incluímos pacientes com reparo dos tendões do subescapular ou infraespinal, aqueles submetidos a cirurgia aberta, ou aqueles nos quais foi obtido apenas o reparo parcial. As escalas clínicas utilizadas foram The American Shoulder and Elbow Surgeons Standardized Shoulder Assessment (ASES) e Modified-University of California at Los Angeles Shoulder Rating Scale (UCLA), aplicadas uma semana antes e 24 meses após o procedimento.

Resultados Analisamos 167 ombros (de 163 pacientes). No pré-operatório, a escala da ASES demonstrou ser significativamente superior no padrão em crescente ($43,5 \pm 17,6$ versus $37,7 \pm 13,8$; $p = 0,034$). A escala da UCLA teve o mesmo padrão ($15,2 \pm 4,6$ versus $13,5 \pm 3,6$; $p = 0,028$). No pós-operatório, entretanto, não ocorreu diferença significativa. De acordo com a escala da ASES, roturas em crescente tiveram $83,7 \pm 18,7$ pontos, e as roturas em L ou U, $82,9 \pm 20,1$ ($p = 0,887$). Respectivamente, os valores foram de $30,9 \pm 4,9$ e $30,5 \pm 5,6$ ($p = 0,773$) pela escala da UCLA.

Conclusão As roturas em crescente e em L ou U do supraespinal apresentam resultados funcionais pós-operatórios semelhantes. No pré-operatório, os resultados funcionais são superiores nas roturas em crescente.

Palavras-chave
- manguito rotador
- artroscopia
- amplitude de movimento articular

Introduction

Rotator cuff tears affect 20% of the general population and up to 50% of patients over 80 years of age.[1] Clinical improvement after surgery occurs in most patients,[2–4] but recurrence of tears takes place in 27% of the cases.[5]

The evaluation of predictive factors is important to define the patients at risk for poor outcomes after rotator cuff repair. There are some studies that evaluate the factors that increase the risk of healing failure[6–12] and unfavorable clinical outcomes.[13–16] The risk factors for worse clinical outcomes have been described as: older patients;[14,15] the female gender;[15] worse preoperative function; previous surgery and problems at work;[16] smoking;[17] degree of fatty degeneration; and dimension of the tear.[18]

Rotator cuff tears have distinct structural patterns, which are classically described as crescent- (C), L- and U-shaped.[19] To date, few studies have evaluated the influence of the tear pattern on the postoperative clinical outcomes[20,21] without evidence of difference between the groups. These studies included in their series infraspinatus[20,21] and subscapularis tear,[20] which, although increase the external validity of the results, also increase the confounding factors. The aim of the present study is to evaluate the influence of the pattern of the supraspinatus rupture on the preoperative and postoperative functional assessments.

Methods

Design

Retrospective cohort study comparing the preoperative and postoperative functional assessments between two groups of patients according to supraspinatus rupture pattern: C-shaped versus L- or U-shaped.

Location and Dates

We analyzed patients who underwent complete arthroscopic repair of the supraspinatus, with procedures performed between November 2012 and November 2016, by one of the surgeons of the Shoulder and Elbow Group of our institution.

Surgical procedure and rehabilitation

The surgeries were performed by arthroscopy, under general anesthesia and interscalene block. The patients were positioned in the beach chair position or lateral decubitus, according to the surgeon's preference. Bursectomy, acromioplasty and distal clavicle resection were performed as needed. The rotator cuff was repaired after debridement of the greater tubercle with a single-row technique using double-loaded anchors. The long head tendon of the biceps was approached when it had subluxation or dislocation, partial lesions greater than 50%, or in the presence of type 2, 3 and 4 slap lesions. The procedure performed was tenotomy in patients aged 60 years or older, or tenodesis in younger patients. Tenodesis, when indicated, was performed either with one of the most anterior anchor, or with an anchor specifically for this purpose. Before the rotator cuff repair was started, the lesion was measured with the aid of a millimeter probe, and the pattern was evaluated according to its reducibility to the bone bed. The number of anchors and the need for tendon-tendon stitches was decided during the surgical procedure.

After the surgery, the patients remained immobilized for 6 weeks with a Velpeau sling. Finger, wrist and elbow movements were encouraged from day one. Passive shoulder range of motion was started at four weeks, and active movements, after sling removal. Strengthening was performed after three months, and complete release for work and sports activities at six months.

Magnetic resonance imaging

All patients underwent magnetic resonance imaging (MRI) prior to the surgical procedure in a 1.5-T equipment (HDxt, GE Medical Systems, Milwaukee, WI, US) and shoulder coil without intra-articular or intravenous contrast.

Participants (eligibility criteria)

We included patients who underwent arthroscopic surgery to treat isolated supraspinatus tears, with complete repair. The patients also needed to have been submitted to a preoperative MRI, a standardized collection of intraoperative findings, and have responded the pre- and postoperative (6, 12 and 24 months) questionnaires. Patients with associated or isolated rupture of the subscapular or infraspinatus tendons, those who underwent open surgery, or those who had only partial repair achieved, were not included.

Groups

The patients were divided into two groups: C-shaped versus L- or U-shaped, according to Burkhart e Lo.[19] The categorization was performed based on the arthroscopic inspection. Type-C tears are those with medial to lateral mobility. L- or U-shaped tears show mobility primarily in the anteroposterior direction, and may require tendon-tendon stitches (►**Figure 1**).

Outcomes

The clinical evaluation was made using The American Shoulder and Elbow Surgeons Standardized Shoulder Assessment (ASES)[22,23] and the Modified-University of California at Los Angeles Shoulder Rating Scale (UCLA).[24,25]

Other variables analyzed

Variables related to the patients:

- age, gender, affected side, smoking, diabetes.

Variables related to the tear and the surgery:

- supraspinatus tear pattern (C-shaped versus L- or U-shaped);
- retraction (small, medium, large or massive);
- extension (affecting the anterior, posterior, or all of the extension of the tendon);
- degree of fatty degeneration of the rotator cuff muscles; (subscapularis, supraspinatus and infraspinatus) according to Goutallier et al.;[26]
- subscapularis tear (absent or partial);
- number of anchors used in the repair;
- performance or not of acromioplasty;
- performance or not of the Mumford procedure;
- procedure performed on the long head of the biceps (none, tenotomy or tenodesis);
- repair with tense suture.

All variables related to the lesion, except for fatty degeneration, were analyzed during the arthroscopy. Fatty degeneration was measured in the oblique sagittal section T1 of the 1.5-T MRI.

Statistical analysis

We submitted the continuous variables to the evaluation of normality through the Kolmogorov-Smirnov test, and homogeneity through the test of Levene. We presented the continuous variables in means and standard deviations, and the categorical variables, in absolute and percentage values.

The comparison between the supraspinatus tear pattern (C-shaped versus L- or U-shaped) and the functional results, according to the ASES and UCLA scales, was performed by the test of Mann-Whitney. For the other variables, we used the Mann-Whitney test for continuous variables, and the Chi-squared test for categorical variables.

The Statistical Package for the Social Sciences (SPSS, IBM Corp., Armonk, NY, US) software, version 21.0, was used for the data analysis, with a significance level of 5%.

Results

During the study period, we performed 341 arthroscopic rotator cuff repairs. A total of 174 cases were not included because they had undergone subscapular and/or infraspinatus repair, or because only partial repair was possible. Thus, we analyzed a sample of 167 shoulders (from 163 patients).

The variables of the patients showed that the C-shaped pattern has a lower proportion of female patients and a lower frequency of diabetic patients (►**Table 1**).

Fig. 1 Rotator cuff tear patterns (**A**) crescent-shaped lesion; (**B**) L-shaped lesion; (**C**) U-shaped lesion.

Table 1 General characteristics of the sample according to supraspinatus tear pattern

	Supraspinatus tear		
	Crescent-shaped (n = 104)	L- or U-shaped (n = 63)	*p*-value
	n (%)	n (%)	
Gender*			
Male	44 (42)	16 (25)	0.027*
Female	60 (58)	47 (75)	
Dominant side			
Yes	71 (68)	48 (76)	0.273
No	33 (32)	15 (24)	
Diabetes*			
Yes	9 (9)	14 (22)	0.014*
No	95 (91)	49 (78)	
Smoking			
No	73 (70)	42 (67)	0.175
Former smoker	21 (20)	9 (14)	
Smoker	10 (10)	12 (19)	
Age, years (mean ± standard deviation)	53.9 ± 7.9	54.7 ± 7.9	0.822

*$p < 0.05$.

The variables of the surgery showed that the C-shaped pattern has lower retraction, lower fatty degeneration of the supraspinatus, and less need for procedures in the tendon of the long head of the biceps (►**Table 2**).

Preoperatively, the ASES scale was significantly higher in the C-shaped pattern (43.5 ± 17.6 versus 37. ± 13.8; $p = 0.034$). The UCLA scale had the same behavior (15.2 ± 4.6 versus 13.5 ± 3.6; $p = 0.028$). Postoperatively, however, there was no significant difference. According to the ASES scale, the C-shaped pattern scored 83.7 ± 18.7 points, and the L-or U-shaped patterns, 82.9 ± 20.1 points ($p = 0.887$). In the UCLA scale, the values were of 30.9 ± 4.9 and 30.5 ± 5.6 ($p = 0.773$) respectively (►**Table 3**).

Discussion

The present study showed that the pattern of the supraspinatus rupture did not affect the postoperative functional scales. The C-shaped pattern scored 83.7 ± 18.7 points in the ASES scale, and 30.9 ± 4.9 points in the UCLA scale, while the L- or U-shaped pattern scored 82.9 ± 20.1 and 30.5 ± 5.6 points respectively. This result is consistent with that of other articles.[20,21] Park et al.,[20] studying large tear, compared the moving patterns (C- and L-shaped) with the U-shaped pattern, and did not observe significant differences between the groups either. Watson et al.,[21] evaluating posterosuperior tears, did not observe any differences between the groups as well. However, these authors observed that the improvement obtained compared to the preoperative period was greater in the C-shaped group, although not significantly (34.7 points versus 29.5 in the L-shaped group).

Table 2 Structural characteristics and surgical procedures according to supraspinatus tear pattern

	Supraspinatus tear		
	Crescent-shaped (n = 104)	L- or U-shaped (n = 63)	*p*-value
	n (%)	n (%)	
Retraction*			
Small	64 (62)	17 (27)	< 0.001*
Medium	37 (36)	31 (49)	
Large	2 (2)	11 (17)	
Massive	1 (1)	4 (6)	
Extension*			
Anterior supraspinatus region	57 (55)	41 (65)	0.95
Posterior supraspinatus region	28 (27)	8 (13)	
Full extension	19 (18)	14 (22)	
Supraspinatus fatty degeneration*			
0	54 (52)	18 (29)	0.004*
1	44 (42)	32 (51)	
2	6 (6)	11 (17)	
3	0 (0)	2 (3)	
Subscapularis tear			
No	66 (63)	38 (60)	0.685
Partial	38 (37)	25 (40)	
Number of anchors			
1	33 (32)	29 (46)	0.179
2	67 (64)	32 (51)	
3	4 (4)	2 (3)	
Acromioplasty			
Yes	94 (90)	56 (89)	0.757
No	10 (10)	7 (11)	
Mumford procedure			
Yes	6 (6)	1 (2)	0.191
No	98 (94)	62 (98)	
Biceps procedure*			
None	79 (76)	33 (52)	0.007*
Tenotomy	11 (11)	12 (19)	
Tenodesis	14 (13)	18 (29)	
Tense suture*			
Yes	5 (5)	2 (3)	0.61
No	99 (95)	61 (97)	

*$p < 0.05$.

Table 3 Pre- and postoperative functional assessment according to tear pattern

	Supraspinatus tear		
	Crescent-shaped (n = 104)	L- or U-shaped (n = 63)	*p*-value
American Shoulder and Elbow Surgeons Standardized Shoulder Assessment			
Preoperatively (mean ± standard deviation)	43.5 ± 17.6	37.7 ± 13.8	0.034
24 months postoperatively (mean ± standard deviation)	83.7 ± 18.7	82.9 ± 20.1	0.887
Modified-University of California at Los Angeles Shoulder Rating Scale			
Preoperatively (mean ± standard deviation)	15.2 ± 4.6	13.5 ± 3.6	0.028
24 months postoperatively (mean ± standard deviation)	30.9 ± 4.9	30.5 ± 5.6	0.773

We observed that the C-shaped pattern presented statistically higher values preoperatively according to the ASES (43.5 ± 17.6 versus 37.7 ± 13.8; $p = 0.034$) and UCLA (15.2 ± 4.6 versus 13.5 ± 3.6; $p = 0.028$) scales. Although the clinically significant minimum difference was not reached,[27] this finding differs from that of other studies.[20,21] Similarly to Watson et al.,[21] C-shaped lesions presented a smaller size, but unlike these authors, our sample showed a significantly lower number of women and diabetics with C-shaped tears. In addition, we observed greater fatty degeneration and greater need for the biceps procedure in the L- or U-shaped patterns, a set of data not analyzed by these authors.

The functional improvement with the procedure was greater in L- or U-shaped lesions, starting from a worse functional state and reaching the same level as patients with C-shaped lesions. This occurred despite the fact that L- or U-shaped lesions had greater retraction and greater fatty degeneration. A possible explanation for this is the fact that we evaluated a predominant sample of patients with degeneration classified up to grade 2 according to Goutallier in both groups. Only 3% of L- or U-shaped group were classified as grade 3, and there were no patients classified as grade 4 in either group. In addition, the tears were restricted to the supraspinatus. Fatty degeneration, especially in the infraspinatus, is known to generate worse structural results,[9] although the effect on the clinical outcome is not statistically significant.[14,15] The size of the tear, in turn, is a risk factor for worse clinical outcomes.[14] Our data demonstrate that the tear pattern influenced the degree of fatty degeneration, but not the postoperative functional outcome.

The rotator cable is important to transmit force from the supraspinatus to the humerus, even in the presence of a tear.[19] This structure is usually preserved in C-shaped tears, which may explain the worse preoperative function in L- or U-shaped lesions, and the greater functional gain after its anatomical restoration. Similarly, we consider that this may be the reason for the higher degree of preoperative fatty degeneration in L- or U-shaped tears.

The present study has some limitations. First, we analyzed only the supraspinatus, excluding repairs involving the subscapularis and/or infraspinatus. Although this option decreases the external validity, it was chosen as a means of increasing the internal validity and reducing the confounding factors. The retrospective cohort design, although similar to that of previous studies,[20,21] is also a possible source of bias. The intraoperative analysis by only one surgeon adds subjectivity to the classification. Finally, we did not perform a structural analysis of the repair, unlike Park et al.[20] However, it is known that the structural integrity does not correlate with clinically significant functional outcomes after repair of the rotator cuff,[28] and clinical analysis alone has been already performed by other authors.[21]

As favorable points, we highlight the standardized analysis of supraspinatus tears in a large sample, which was superior to that of previous studies,[20,21] and the demonstration that, although it does not influence the postoperative results, the pattern of the rupture may influence the preoperative evaluation.

Conclusions

Crescent- and L- or U-shaped tear of the supraspinatus have similar postoperative functional results. Preoperatively, C-shaped tears have a statistically superior function.

Conflicts of Interest
The authors have none to declare.

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