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Arthroscopic capsular release for refractory shoulder stiffness☆

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ABSTRACT

Objective: To evaluate the results of the arthroscopic treatment of refractory adhesive capsulitis of the shoulder with two to nine years of follow-up, comparing the pre- and postoperative range of motion.
Methods: This was an observational study (case series) of 18 patients who underwent arthroscopic capsular release for refractory shoulder stiffness. The mean age was of 53.6 years (range: 39 to 68), with female predominance (77.77%) and nine cases left shoulders. There were 6 primary (33.33%) and 12 secondary cases (66.67%). Arthroscopic capsular release was performed in all patients after a mean of 9.33 months of physical therapy (range: 6 to 20 months) with a minimum follow-up of two years (range: 26 to 110 months).
Results: The mean active and passive forward flexion, external rotation and internal rotation increased from 94.4°/103.3°, 11.9°/21.9°, and S1/L5 vertebral level, respectively, to 151.1°/153.8°, 57.2°/64.4°, and T12/T10 vertebral level, respectively. There was a significant difference between the pre- and postoperative range of motion ($p < 0.001$). According to the Constant-Murley functional score (ROM), the value increased from 14 (preoperative mean) to 30 points (postoperative mean). Postoperatively, all patients showed diminished shoulder pain (none or mild/15 or 10 points in the Constant-Murley score).
Conclusion: Arthroscopic treatment is an effective treatment for refractory shoulder stiffness.

Liberação capsular artroscópica para a rigidez refratária do ombro

Palavras-chave:
Ombro congelado
Liberação capsular
Artroscopia
Amplitude de movimento articular
Articulação do ombro
Dor de ombro

RESUMO

Objetivo: Avaliar os resultados do tratamento artroscópico da capsulite adesiva refratária do ombro com dois a nove anos de seguimento, comparando o arco de movimentos pré e pós-operatório.
Métodos: Foi realizado um estudo observacional (série de casos) em 18 pacientes com ombros rígidos resistentes a tratamento conservador submetidos à capsulotomia artroscópica. A idade média foi de 53,6 anos (39 a 68), com predomínio do sexo feminino (77,77%) e nove ombros esquerdos. Houve seis primários (33,33%) e 12 secundários (66,67%). A liberação capsular artroscópica foi realizada em todos os pacientes, após uma média de 9,33 meses de fisioterapia (6 a 20 meses), com seguimento mínimo de dois anos (26 a 110 meses).

☆ Study conducted at Universidade Federal de Goiás, Goiânia, Go, Brazil.

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Resultados: A média da elevação anterior, rotação lateral e rotação medial ativa e passiva aumentaram de 94,4°/103,3°, 11,9°/21,9° e S1/L5 níveis vertebrais para 151,1°/153,8°, 57,2°/64,4° e T12/T10 níveis vertebrais, respectivamente. Houve uma significativa diferença entre a amplitude de movimentos pré- e pós-operatório (p < 0,001). De acordo com o escore funcional de Constant-Murley, o valor aumentou de 14 (média pré-operatória) para 30 pontos (média pós-operatória). No pós-operatório, todos os pacientes demonstraram uma diminuição da dor no ombro (nenhuma ou leve/15 ou 10 pontos no escore de Constant-Murley).

Conclusão: O tratamento artroscópico é eficaz para a rigidez refratária do ombro.

Introduction

Adhesive capsulitis, frozen shoulder, and stiff shoulder are terms used for a common, poorly understood disorder whose hallmark is a restriction of active and passive range of motion associated with pain. Multiple etiologies of this disease have been reported. A primary idiopathic form develops with no specific cause, with a prevalence of 2%, and the secondary form arises after surgery, trauma, or systemic disease, such as diabetes and hypothyroidism[1–3].

Some authors have described the disorder as a self-limiting condition with spontaneous tendency to recover after 12 to 24 months[3]. Others, however, have demonstrated that some patients remain symptomatic and with restricted motion, even after five to seven years of follow-up[2].

Regardless of the etiology, the initial treatment of choice is always conservative, such as drugs[3,4], intra-articular steroid injections[5], manipulation under anesthesia[6], nerve block[7], and/or physical therapy[8,9]. The duration of the conservative approach has been discussed, but the authors have recommended six months[3].

However, it has been shown in multiple studies that some patients have limitation of motion and long-term residual pain, and do not respond adequately to these therapeutical modalities. They consequently require open[10] or arthroscopic surgical release[6,11,12].

Arthroscopic treatment has been proven to be very effective in shoulder stiffness, as a minimally invasive surgical option with reliably good results[11,12]. The hypothesis of the present study was that arthoscopic release, including the division of the intra-articular portion of the subscapularis tendon, would lead to a significant improvement in the shoulder range of motion.

The effectiveness of arthroscopic capsular release in refractory shoulder stiffness was evaluated.

Methods

This was a retrospective descriptive (case series) study of 18 patients who underwent arthroscopic capsular release for resistant shoulder stiffness, operated on between August of 2002 and August of 2009. All data were collected as part of a patient database.

A refractory shoulder stiffness patient was defined as an individual who presented constant and severe pain (0 points in the pain category of the Constant-Murley score)[13], with no or minimal improvement with nonoperative management for a six-month period, and limited active and passive shoulder range of motion, such as forward elevation up to 130°, external rotation up to 50°, and internal rotation up to L5 vertebral level.

The inclusion criteria were patients with stiff shoulder diagnosis; in stage II of the disease[14]; age between 35 and 70 years; operated on by the same surgeon; and who had a follow-up of at least two years. The exclusion criteria were concomitant glenohumeral osteoarthritis, partial or full-thickness cuff tear, humerus fracture or dislocation, infection, and incomplete follow-up. The abovementioned conditions were excluded by X-ray, MRI, or joint inspection.

Preoperatively, all patients underwent a supervised rehabilitation for a six-month period; 11 of them also presented suprascapular nerve blocks (mean of three), with failure to regain a functional motion with minimal or no pain; no patient received intra-articular corticosteroid injections or manipulation under anesthesia. The radiographic evaluation was performed with true anteroposterior, scapular-Y, and axillary views.

The range of motion was measured pre- and postoperatively, in accordance with the American Academy of Orthopaedics Surgeons criteria[15]. The Constant-Murley score was used to evaluate the shoulder function[13] and the criteria by Zuckerman et al. was used to classify the stiffness and its clinical severity[16]. The primary endpoint was the shoulder range of motion.

This study was approved by the Research Ethics Committee of the HGG General Hospital under Protocol No. 477- 2009.

Statistical analysis

Data analysis was performed using the Statistical Package for Social Sciences (SPSS) version 19.0. The Kolmogorov-Smirnov test was initially used to verify the normality of the values. Then, the active and passive forward elevation and external rotation pre- and postoperative values were compared by Student's parametric paired *t*-test. Internal rotation was analysed by Friedman's test, with the risk assumed by the researcher of 5% and probability of rejecting the null hypothesis < 0.05.

Surgical technique

An interscalene catheter was used for postoperative analgesia before each surgical procedure. All patients were operated upon in the lateral decubitus position. After positioning the

patient in the operating room, passive range of motion was documented while the patient was under anesthesia.

The entire upper extremity was then prepared in a sterile fashion, and the glenohumeral joint was approached from the posterior arthroscopic portal. After an articular inventory of the synovium, biceps tendon, humeral head, capsule, and rotator cuff, the anterosuperior portal was made and a cannula was inserted directly underneath the long head biceps (inside-out) and above the subscapularis tendon.

First, a synovectomy was performed. The next key step in all cases was to release the rotator interval region, which was represented as contracted capsule between the anterior edge of the supraspinatus tendon and the superior border of the subscapularis tendon, with subsequent release of the coracohumeral ligament, which was identified by probe palpation of the coracoid process. This release allowed the humeral head to move laterally away from the glenoid, and the stiff anterior capsule could then be released.

Then, a subscapularis tenotomy was performed, which is carefully separated from the middle glenohumeral ligament using a radiofrequency device. A partial tenotomy was performed in some cases (1, 2, 3, 5, 14, 15, 16); the remaining cases were submitted to total tenotomy.

The next step was the anterior capsule division. The release was made from the two o'clock positionto the five o'clock position along the glenoid rim, and continued down to the six o'clock position.

Afterwards, the arthroscope was first placed through the anterior cannula with inflow switched to that cannula, and the radiofrequency device was changed to the posterior portal to proceed with the posterior capsule release for persistent loss of internal rotation. This was perfomed along the glenoid rim, from directly behind the biceps tendon down to approximately the eight o'clock position on the glenoid. Finally, the inferior capsule was released for flexion and abduction restrictions.

There were no concomitant diseases, as verified by preoperative MRI and joint inspection. After the arthroscopic release, no manipulation was performed.

Aftercare

All patients with interscalene catheter received a bolus of 15 mL to 20 mL of 0.5% bupivacaine 30 minutes before each session of rehabilitation. The patients were admitted to the hospital for 72 hours to undergo immediate physical therapy, which consisted of passive range of motion performed twice daily.

Patients were discharged without a shoulder sling and were instructed to start supervised rehabilitation five days per week and to use their shoulder for activities of daily living.

Results

Demographic data are exhibited in Table 1. Table 2 demonstrates additional procedures and and the steps performed in each case.

The mean active and passive forward flexion, external rotation, and internal rotation increased from 94.4°/103.3°, 11.9°/21.9°, and S1/L5 vertebral level, respectively, to 151.1°/153.8°, 57.2°/64.4°, and T12/T10 vertebral level, respectively (Table 3). The mean increase was 56.7°/50.5° in the forward elevation, 45.3°/42.5° in the external rotation, and 06/07 levels. The values had normal distribution.

Regarding the range of motion assessment (40 points) with the Constant–Murley functional score, it increased 16 points; from 14 (preoperative mean) to 30 points (postoperative mean). There were no intraoperative complications or

Table 1 – Demographic data.

CASES	AGE (Y)	GEN	SIDE	DOM	FORM	SEC	ST	CS	S – S (M)	F-up (Y) (M)
1	66	W	L	NO	PRIM		II	SE	06	9Y 2M
2	56	W	R		SEC	PT	II	MO	08	8Y 6M
3	59	F	L	NO	SEC	PS	II	MO	09	8Y 5M
4	39	F	R	NO	SEC	PT	II	MO	20	7Y
5	64	M	L		SEC	DIAB	II	MO	09	6Y 9M
6	47	F	L		PRIM		II	MI	07	6Y 5M
7	45	F	R	NO	SEC	HYPO	II	MO	08	6Y 4M
8	50	F	L		SEC	DIAB	II	MO	07	6Y 2M
9	48	F	L	NO	PRIM		II	MI	08	5Y 9M
10	55	F	R		PRIM		II	SE	08	5Y 8M
11	57	M	L		PRIM		II	MO	08	5Y 2M
12	54	M	R		SEC	PT	II	SE	06	4Y 6M
13	68	F	L	NO	PRIM		II	MO	13	4Y 3M
14	48	F	L	NO	SEC	PT	II	MO	15	4Y 2M
15	50	F	R		SEC	HYPO	II	SE	07	3Y 1M
16	53	F	R		SEC	PT	II	SE	07	3Y
17	48	F	R	NO	SEC	DIAB	II	MO	09	3Y
18	58	M	R		SEC	PT	II	MO	13	2Y 2M

GEN, gender; M, male; F, female; R, right; L, left; DOM, dominance; FORM, etiology form; PRIM, primary; SEC, secondary; PS, postsurgical; PT, post-traumatic; DIAB, diabetes; HYPO, hypothyroidism; ST, disease stage; CS, clinical severity; MI, mild; MO, moderate; SE, severe; S-S, time between symptoms and surgery; F-up, follow-up; (Y), years; (M), months.

Table 2 – Types of surgical procedures in the sample.

CASES	ANTERIOR C.	SUPERIOR C.	POSTERIOR C.	INFERIOR C.	SSE TENOTOMY	ADDIT PROC
1	YES	YES	NO	NO	PARTIAL	ACROM
2	YES	YES	YES	YES	PARTIAL	NO
3	YES	YES	YES	YES	PARTIAL	NO
4	YES	YES	YES	YES	TOTAL	B. SYNOV
5	YES	YES	YES	YES	PARTIAL	NO
6	YES	YES	YES	YES	TOTAL	NO
7	YES	YES	YES	YES	TOTAL	NO
8	YES	YES	YES	YES	TOTAL	NO
9	YES	YES	NO	NO	TOTAL	NO
10	YES	YES	YES	YES	TOTAL	NO
11	YES	YES	NO	NO	TOTAL	NO
12	YES	YES	YES	NO	TOTAL	NO
13	YES	YES	YES	NO	TOTAL	NO
14	YES	YES	YES	YES	PARTIAL	NO
15	YES	YES	YES	YES	PARTIAL	NO
16	YES	YES	YES	NO	PARTIAL	NO
17	YES	YES	YES	YES	TOTAL	ACROM
18	YES	YES	YES	YES	TOTAL	ACROM

C, capsulotomy; SSE, subscapular; ADDIT PROC, additional procedure; ACROM, acromioplasty; B. SYNOV, bursal synovectomy.

instability, and no postoperative neurological injury. When the patients' range of motions means were compared, there was difference between the pre- and postoperative values ($p < 0.001$) (Table 4).

All patients showed substantial gains in shoulder range of motion, as well as diminished shoulder pain (none to mild/15 to 10 points in the Constant-Murley pain score) ($p < 0.001$).

Discussion

Adhesive capsulitis is a common disease and remains an enigmatic condition despite many attempts to elucidate the underlying pathologic process[17]. Inflammatory and fibrous modifications of the joint capsule and synovial sheath of the shoulder are responsible for the obliteration of the axillary recess and capsule adhesions to the humeral head. These changes cause capsular retraction, with reduced volumetric capacity and shoulder stiffness[1,2,18].

Ozaki et al. reported that the contracted coracohumeral ligament and rotator interval appear to be the main lesions in the stiff shoulder. The pathological findings of these structures are extremely important when treating such patients[19].

The disease occurs more predominantly between the ages of 40 and 60 years, in females, in their non-dominant side, without any racial preference[2,3,9]. The present study showed a mean age at the time of capsular release of 53.6 years, and 77.77% of the patients were female, which coincides with the literature data, although ten of the 18 patients presented the disease on the dominant side.

Stiff shoulder responds well to nonsurgical treatment in 70% to 90% of patients[4,9,20]. A therapeutic option is the suprascapular nerve block, which is an efficient method when compared to placebo and intra-articular injections[21–23]. The procedure is justified, since this nerve is responsible for 70% of the shoulder capsule sensitivity, which is retractable and has its volume decreased in the case of shoulder stiffness[3,7,22,23]. However, 11 patients of the sample underwent this method associated with rehabilitation, without any efficacy. Some authors reported good results with manipulation under anesthesia, but this does not allow for a controlled release of the pathological tissue, with increased risk of humerus fractures[3,5,6,24,25].

Surgical capsular release should be performed in patients unresponsive to conservative treatment for at least six months[3], which is in agreement with this study with regard to the same minimum time from onset of symptoms to the proposed surgery, after unsuccessful conservative measures.

The coracohumeral ligament exploration demonstrates that this is the thickest and abnormal part of the stiff capsule[10]. As an extra-articular anatomical structure, its arthroscopic release is only possible after opening of the rotator interval and exposure of the lateral and inferior coracoid surface. The main objective of the procedure is to restore external rotation[19]. In this study, all patients had the coracohumeral ligament released, and the mean active increase of external rotation was 45.3°, unlike the study by Beaufils et al., who performed this procedure in only one of 26 patients, and concluded that the capsular release was of little benefit in primary frozen shoulder with long recovery time, without pain relief[26].

Subacromial fibrosis with hypertrophic synovium was observed in several studies, and both debridement and acromioplasty were performed[27,28]. Chen et al. reported that 86% of the patients underwent subacromial decompression, and that the procedure contributed to the pain relief of the shoulder[29].

Capsular release was performed in the present study, with two additional procedures (cases 1, 4, 17, 18), and with a substantial improvement of pain in all cases. However, it is not possible to conclude that acromioplasty has contributed to the improvement of the variable pain, since the present study was not of association.

Beyond the anterior capsulotomy, there is much controversy whether the inferior and posterior capsule should be released. Ogilvie-Harris et al. reported that the release should

Table 3 – Active and passive pre- and postoperative values of the shoulder range of motions.

CASES	A. pre FE	A. pre ER	A. pre IR/level	P. pre FE	P. pre ER	P. pre IR/level	A. post FE	A. post ER	A. post IR/level	P. post FE	P. post ER	P. post IR/level
1	70°	5°	S1	80°	10°	L5	180°	40°	T12	180°	50°	T12
2	90°	30°	L5	100°	40°	L5	120°	40°	L3	130°	50°	L1
3	90°	10°	S1	90°	20°	L5	180°	50°	T12	180°	60°	T12
4	90°	0°	GT	100°	10°	GT	170°	40°	T12	170°	50°	T12
5	100°	10°	S1	110°	20°	S1	120°	20°	L3	130°	30°	L2
6	120°	40°	L5	120°	40°	L5	170°	50°	L1	170°	70°	T12
7	100°	0°	S1	110°	10°	L5	170°	40°	T12	170°	50°	T10
8	90°	10°	S1	100°	20°	S1	120°	50°	L3	120°	50°	L1
9	110°	0°	L5	120°	10°	L4	170°	40°	T12	170°	50°	T11
10	60°	0°	L5	80°	10°	L5	90°	30°	L3	110°	50°	L3
11	100°	-10°	S1	110°	0°	S1	150°	90°	T10	150°	90°	T10
12	90°	10°	S1	90°	20°	L5	130°	70°	T11	140°	80°	T10
13	110°	30°	L4	120°	45°	L3	150°	70°	T11	150°	80°	T10
14	110°	20°	S1	120°	40°	L5	160°	90°	T10	160°	90°	T10
15	80°	0°	S1	90°	10°	S1	160°	80°	L1	160°	80°	T12
16	80°	-10°	GT	90°	0°	GT	160°	90°	T10	160°	90°	T10
17	100°	30°	S1	110°	40°	L5	160°	70°	T12	160°	70°	T11
18	110°	30°	L5	120°	40°	L5	160°	70°	T11	160°	70°	T10
Mean	**94.4°**	**11.9°**	**S1**	**103.3°**	**21.9°**	**L5**	**151.1°**	**57.2°**	**T12**	**153.8°**	**64.4°**	**T10**

A, active; P, passive; FE, forward elevation; ER, external rotation, IR, internal rotation; pre, preoperative; post, postoperative; GT, greater trochanter.

Table 4 – Paired samples test.

		Paired Differences Std. Error Mean	test	p-value
Pair1	ApreFE - ApostFE	5.717	−9.913	0.000*
Pair2	ApreER - ApostER	6.343	−7.226	0.000*
Pair3	PpreFE - PpostFE	5.330	−9.484	0.000*
Pair4	PpreER - PpostER	5.257	−8.190	0.000*

* $p < 0.001$.

be performed in the inferior, but not in the posterior capsule[30]. Jerosch described his technique performing both releases[27]. Chen et al., in 74 randomized patients, where the first group received only the anterior capsulotomy, while in the second group the release extended to the inferior and posterior capsule, concluded that shoulder function and range of motion were similar in six months[29]. Snow et al. also observed no differences when adding posterior capsulotomy into the procedure[11]. The patients of the present study increased their range of motion with the posterior (except cases 1, 9, 11) and inferior release (except cases 1, 9, 11, 12, 13, 16), regardless of whether the adhesive capsulitis was primary or secondary.

There is also concern of the axillary nerve injury in the inferior capsulotomy performance. As it is closer to the humeral insertion of the capsule, the release should be close to the glenoidal edge[27]. None of our 12 of 18 patients presented axillary nerve palsy, as in the study by Jerosch[27]; however, Harryman et al. had one case, with spontaneous resolution[31].

Pearsall et al.[28] and Ogilvie-Harris et al.[30] reported the release of the intra-articular portion of the subscapularis tendon, lateral to the musculotendinous junction, although most studies showed excellent results without this procedure[27,29,32]. This portion represents only 25% of the cephalocaudal length of the subscapularis muscle[28]. For this reason, and because it is an external rotation restrictor, this tenotomy was added to the presented technique with good results. It was performed partially in some cases (1, 2, 3, 5, 14, 15, 16) and totally in the others. Increased range of motion and decreased pain was observed in all patients, regardless of which tenotomy was performed ($p < 0.001$).

The performance of the tenotomy allowed for the avoidance of any type of joint manipulation in the postoperative period, which can be an advantage of the presented technique. It is important to note that no recurrence occurred postoperatively.

Did the subscapularis tenotomy contribute to this absense? Since this was not a randomized clinical trial, this question remains unanswered. It is important to understand whether this section of the subscapularis undermines the anterior shoulder stability. Pearsall et al. observed 97% of patients with minimal or no sign of instability[28]. Comparing the results of this study with partial or total subscapularis tenotomy, there were no cases of anterior instability after arthroscopic surgery.

Berghs et al.[33] presented their results on the arthroscopic treatment of shoulder stiffness, and the mean of the forward elevation improved from 73.7° to 163° (89.3°); the external rotation improved from 10.6° to 46.8° (36.2°), and internal rotation improved nine levels. Elhassan et al.[34], in the analysis of the averages in the three directions, observed that they increased by 38°, 24°, and six levels, respectively, a finding similar to that of the present study, which showed improvement in forward elevation of 56.7°, 45.3° in external rotation, and six levels in internal rotation ($p < 0.001$).

The limitations of this study include its retrospective design, with a small sample size without comparison group, since frozen shoulder is a disease with predominantly nonsurgical treatment, with few cases progressing to surgery. This study, however, has importance in that the same surgical technique was performed in all patients, regardless of the etiology of the shoulder stiffness, but the insufficient number of patients does not allow for conclusions in this regard. The other issue that needs to be highlighted is that internal rotation strength was not measured. It can be a subject of further research.

Conclusion

Arthroscopic treatment is effective in shoulder stiffness unresponsive to conservative treatment.

Conflicts of interest

The author declares no conflicts of interest.

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