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What is the optimal surgical intervention for patients with frozen shoulder and a concomitant partial-thickness rotator cuff tear?

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A R T I C L E I N F O

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Background: Patients with recalcitrant frozen shoulder traditionally undergo arthroscopic capsular release. Some patients may have a concomitant partial-thickness rotator cuff tear (PTT). There is limited evidence if these PTT require repair at the same setting. We aim to compare if patients undergoing concomitant rotator cuff repair do better than patients undergoing capsular release alone. Secondarily, we aim to determine if outcomes after arthroscopic capsular release differ for patients with and without PTT.
Methods: A retrospective review of patients with frozen shoulders undergoing arthroscopic capsular release between 2012 and 2016 was performed. Patients with partial-thickness tears and patients without rotator cuff tears were included. Clinical outcomes were collected preoperatively and at 3, 6, 12 months after operation.
Results: There were 33 patients with PTT—15 underwent capsular release without repair (CR group), whereas 18 underwent capsular release with rotator cuff repair (RCR group). A total of 62 control patients without rotator cuff tears (No Tear) underwent arthroscopic capsular release only. For patients with PTT, there were no significant differences in preoperative demographics and function between the CR and RCR group. The CR group had significantly worse preoperative pain. At 1-year follow-up, the RCR group had significantly better internal rotation, lesser pain, and better function than the CR group. For patients undergoing capsular release only, the No Tear group had better internal rotation, lesser pain, and better function at 1 year compared with the CR group.
Conclusion: Patients with a stiff, frozen shoulder and concomitant PTT do benefit from arthroscopic rotator cuff repair with capsular release. The benefit is evident at 1-year follow-up.

Frozen shoulder is a common problem typically affecting middle-aged patients. Some frozen shoulders have no clear predisposing cause, whereas others may be associated with systemic conditions like diabetes or local shoulder pathologies like rotator cuff tears.[29] Patients who remain stiff and painful after a period of conservative management are usually offered arthroscopic capsular release and manipulation under anesthesia to improve their symptoms.

There are a group of patients with frozen shoulders who have a concomitant partial-thickness rotator cuff tear. The ideal treatment in such patients is unclear and the literature is limited. Some surgeons advocate repairing this partial rotator cuff tear at the same setting as the arthroscopic capsular release.[22] Although technically feasible, such a strategy will cause conflicting rehabilitation goals—should we immobilize the shoulder after the rotator cuff repair, thereby potentially causing more postoperative stiffness, or should we mobilize the shoulder early, but risk compromising the repair? A staged approach can also be considered—first addressing the stiffness with an arthroscopic capsular release and then performing a rotator cuff repair at a second setting should the patient continue to experience pain or weakness.[33]

We aim to determine if performing a concomitant rotator cuff repair in this group of patients provides better functional outcomes.

We hypothesize that there would be no difference in functional outcomes between those who undergo concomitant rotator cuff repair and those who undergo arthroscopic capsular release alone.

This study was approved by the Singhealth Institutional Review Board (CIRB 2019/2183).

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Materials and methods

We conducted a retrospective review of patients with frozen shoulders who underwent arthroscopic capsular release at our hospital between 2012 and 2016. Our indication for surgery was persistent pain with global reduction in shoulder range of motion (ROM) affecting daily activities lasting more than 6 months despite physical therapy. Patients were included for this review if they had either a partial-thickness rotator cuff tear or no rotator cuff tear identified on arthroscopy. Patients were excluded if they had full-thickness rotator cuff tears or prior shoulder surgery. The minimum follow-up period was 1 year.

A total of 95 patients fulfilled the inclusion criteria. There were 33 patients who had a partial-thickness tear—15 patients underwent arthroscopic capsular release only (CR group) and 18 patients underwent arthroscopic capsular release with concomitant repair of the partial-thickness tear (RCR group). Patients in the CR group were then compared with a control group of 62 patients who underwent arthroscopic capsular release during the same period but had no rotator cuff tear identified (No Tear group).

Clinical outcomes, including the ROM, visual analog score (VAS) for pain, Constant shoulder score (CSS), Oxford shoulder score, and University of California Los Angeles (UCLA) shoulder score, were collected by independent personnel preoperatively and at 3, 6, and 12 months after surgery. ROM in flexion and abduction was determined using an inclinometer. External rotation and internal rotation were charted according to the CSS external and internal rotation components. Strength of forward flexion was determined by manual muscle testing, with the grading according to the UCLA shoulder score section 4.

Arthroscopic capsular release was performed in a beach chair position. A posterior portal was first established to perform an arthroscopic evaluation of the glenohumeral joint. An anterior portal was next established, and the rotator interval was then released with a radiofrequency ablation device and the anterior capsule was divided down to the 6 o'clock position. The middle glenohumeral ligament and anterior capsule were also released. With an anterior viewing portal, the posterior capsule would be released. The shoulder would be manipulated with a short lever arm to ensure adequate release and good ROM.

In the RCR group, 13 patients underwent transtendon in situ repair with suture anchors. In the remaining 5 patients, the remnant tendon quality after débridement was deemed poor, and hence a formal takedown and double-row repair was performed.

Postoperatively, all our patients received appropriate oral analgesia and were discharged on postoperative day 1 after review by a physiotherapist. Patients undergoing arthroscopic capsular release only were encouraged immediate passive mobilization as much as they could tolerate on postoperative day 1. They were then encouraged to progress toward active ROM exercises once the pain subsided, followed by strengthening exercises after 4-6 weeks.

Patients in the RCR group were typically immobilized in an arm sling for the first 2 weeks. They were then allowed passive mobilization of the shoulder, but not beyond 90° of flexion or abduction. After 6 weeks, patients were allowed active ROM exercises, followed by progressive strengthening.

Statistical analysis was performed with SPSS v22 (IBM, Armonk, NY, USA) statistical software. Student's unpaired *t*-test was used to compare quantitative variables between the 2 groups, whereas Fisher's exact test was used for categorical variables. A *P* value of .05 or less was considered to be statistically significant.

Results

RCR vs. CR group

There were no significant differences in the preoperative demographics and the location of the partial-thickness tears between the CR and RCR groups (Table I). Patients in the CR group had experienced greater pain preoperatively compared with the RCR group (VAS: CR 8.05 vs. RCR 5.53; $P = .014$). There were no significant differences between both groups for preoperative ROM, forward flexion strength, and function (Table II).

At 3 and 6 months after operation, there were no significant differences between both groups in functional outcome. At 1 year after operation, patients in the RCR group had better internal rotation (CR 4.61 vs. RCR 8.22; $P = .010$). They also reported significantly lesser pain (VAS: CR 4.20 vs. RCR 0.54; $P = .023$) and had a higher CSS and ULCA shoulder score (Table III).

Considering the minimally clinically important difference (MCID) of 10.4 for the Constant score,[24] 83.3% of RCR patients attained the MCID compared with 66.6% of CR patients, but this was not statistically significant ($P = .345$). Considering the MCID of 3.0 for the UCLA shoulder score,[35] 88.9% of RCR patients managed to attain the MCID compared with 73.3% in the CR group ($P = .348$).

Control group analysis

A total of 62 patients in the No Tear group were compared against the CR group to determine if the presence of a partial-thickness rotator cuff tear would affect the outcome of arthroscopic capsular release. There were no significant differences in preoperative demographics and function between the CR group and the No Tear group (Table IV).

At 1 year after operation, patients in the No Tear group had significantly better internal rotation. They also reported lesser pain and attained a better Constant score and UCLA shoulder score (Table V).

Discussion

Patients with a partial-thickness rotator cuff tear typically present with pain that is exacerbated by overhead activities, stiffness, as well as nocturnal pain.[11] Patients with a frozen shoulder also complain of pain and decreased shoulder function, but physical examination would demonstrate a reduction in shoulder ROM in all directions.[36] Commonly, patients can present with both pathologies, and the symptoms of frozen shoulders may mask any symptoms related to partial-thickness rotator cuff tears. A trial of conservative treatment with rest, nonsteroidal anti-inflammatory medications, activity modification, and physical therapy can be attempted first. Fukuda suggests that partial-thickness tears could be “clinically cured” if the signs and symptoms of acute

Table I
Preoperative demographics (CR group vs. RCR group) (1 standard deviation)

	CR	RCR	*P* value
Age (yr)	56.7 (11.0)	56.9 (8.0)	.939
BMI (kg/m^2)	25.6 (4.9)	25.9 (6.1)	.840
Side of operation			.170
Left	6	12	
Right	9	6	
Sex			.196
Male	6	11	
Female	9	7	

BMI, body mass index.

Table II
Preoperative function (1 standard deviation)

	CR	RCR	*P* value
Range of motion			
Forward flexion	87.8° (41.5)	94.8° (32.4)	.483
Abduction	71.8° (44.3)	80.0° (40.1)	.478
External rotation*	2.44 (4.1)	3.09 (4.4)	.603
Internal rotation*	2.63 (2.4)	3.26 (3.1)	.489
Forward flexion strength†	2.81 (1.1)	3.17 (0.9)	.251
VAS	8.05 (2.1)	5.53 (2.9)	**.014**
Functional outcome			
Constant score	28.3 (21.9)	38.0 (20.7)	.108
Relative Constant score %	35.4 (26.1)	49.7 (26.0)	.057
UCLA score	12.9 (5.8)	15.0 (5.1)	.297
OSS	39.9 (14.0)	33.9 (10.4)	.120

VAS, visual analog score; *UCLA score*, University of California Los Angeles shoulder score; *OSS*, Oxford shoulder score.
Values in bold are considered statistically significant.
* According to the Constant shoulder score.
† According to the UCLA shoulder score.

inflammation are treated and mechanical deficiencies of the torn tendon are compensated for by the residual cuff and intrinsic muscles.[14] Nonetheless, spontaneous healing of the partial tear is unlikely, and the tear may, in fact, progress over time.[13]

The surgical treatment of rotator cuff tears in the presence of a stiff shoulder is controversial. Preoperative shoulder stiffness is a known risk factor for postoperative stiffness and may lead to poorer surgical outcomes. Two-stage procedures to address preoperative stiffness before rotator cuff repair subject patients to multiple procedures and delay definitive treatment of rotator cuff tears. Several authors have found that single-stage arthroscopic capsular release with cuff repair for patients with full-thickness rotator cuff tears and preoperative stiffness enables them to attain similar postoperative ROM and outcome as patients with no preoperative stiffness.[7,16,25] These studies examined only full-thickness tears and not partial-thickness tears. In our study, patients who underwent rotator cuff repair took at least 6 months before seeing an improvement in their shoulder ROM. This is likely due to the period of immobilization postoperatively to protect the repair, but patients can be reassured that the ROM is likely to improve with time and physical therapy.

Little is known about the natural history of partial-thickness rotator cuff tears. Current literature suggests that asymptomatic partial-thickness rotator cuff tears are common in the general population, ranging from 8% to 20% in various studies.[20,31] In a study of initially asymptomatic rotator cuff tears, Keener reported a 44% tear-enlargement rate in partial-thickness tears, with 46% of patients with partial-thickness tears eventually reporting pain over a median follow-up of 5.1 years.[19] Hence, not all partial-thickness tears need to be treated if they cause minimal symptoms, but a good proportion will eventually need some form of treatment. This possibly explains why our patients who did not undergo a rotator cuff repair had poorer functional outcomes than those who did. We postulate that the symptoms from their partial-thickness rotator cuff tear became more prominent after their frozen shoulder symptoms had subsided.

There is no consensus on the ideal surgical management of partial-thickness rotator cuff tears. Broadly, débridement with or without subacromial decompression and rotator cuff repair appear to be most commonly advocated options.

Outcomes after débridement alone appear encouraging—Budoff reported 87% satisfactory outcome in 79 shoulders that underwent arthroscopic débridement,[3] and Andrews reported that 85% of his patients had good and excellent results.[1] These studies did not compare débridement against repairs. Several authors have also reported satisfactory outcome when combining arthroscopic débridement with subacromial decompression. Cordasco reported 92% success with arthroscopic acromioplasty and débridement in treating shoulders with partial-thickness cuff tears.[8] Kartus reported his 5-year follow-up of 26 patients who underwent arthroscopic acromioplasty and débridement. A total of 35% of his patients had developed a full-thickness cuff tear, but only 7% required a second operation.[18]

Several methods of rotator cuff repairs have been described for the treatment of partial-thickness tears. Takedown and repair involves completing a partial-thickness tear to a full-thickness tear, followed by repair. The advantage of this technique allows complete removal of devitalized tissue and the use of standard rotator cuff repair techniques. Many authors have reported good outcomes with this method, with patient satisfaction ranging from 83% to 98%.[9,17,27]

The transtendon repair allows for the preservation of intact tendon. Transtendon repairs have been shown to be biomechanically superior to takedown followed by double-row repair.[15] Several randomized controlled trials have been performed to compare the 2 methods. Castagna and Franceschi reported no significant differences when done for articular-sided partial tears.[4,12] Shin found that patients who underwent transtendon repair had greater pain and poorer function at 3 months, but by 6 months, there were no significant differences between both types of repair.[32] For both bursal- and articular-sided partial-thickness tears, Kim also

Table III
Postoperative outcome at 3 months, 6 months, and 1 year (1 standard deviation)

	3 mo			6 mo			1 yr		
	CR	RCR	*P* value	CR	RCR	*P* value	CR	RCR	*P* value
Range of motion									
Forward flexion	109.4° (35.7)	94.5° (25.6)	0.235	105.4° (34.0)	115.8° (21.5)	0.452	119.7° (33.4)	133.8° (9.8)	.286
Abduction	105.9° (43.9)	83.8° (26.5)	0.122	92.7° (42.7)	109.4° (22.5)	0.296	104.0° (38.5)	131.7° (12.7)	.07
External rotation*	5.03 (4.9)	2.24 (3.2)	0.076	5.96 (4.0)	5.50 (3.7)	0.781	6.42 (4.5)	8.61 (3.1)	.18
Internal rotation*	4.32 (3.8)	3.16 (2.5)	0.300	3.59 (3.0)	5.74 (2.3)	0.061	4.61 (2.9)	8.22 (1.4)	**.010**
Forward flexion strength†	3.27 (1.1)	3.28 (0.8)	0.983	3.56 (1.1)	3.71 (0.8)	0.714	3.81 (1.2)	4.36 (0.5)	.187
VAS	4.74 (3.0)	2.79 (2.4)	0.055	3.27 (3.4)	1.53 (1.4)	0.119	4.20 (3.3)	0.54 (1.8)	**.023**
Functional outcome									
Constant score	46.5 (24.9)	39.0 (10.7)	0.316	58.1 (23.6)	52.1 (11.7)	0.476	53.9 (29.5)	73.1 (9.0)	**.023**
Relative Constant score %	54.6 (30.4)	47.9 (10.9)	0.467	62.0 (26.9)	68.8 (10.9)	0.509	63.6 (31.5)	91.5 (14.1)	**.042**
UCLA score	20.7 (7.9)	21.4 (5.7)	0.785	23.5 (7.9)	25.1 (3.5)	0.538	23.3 (9.3)	31.0 (3.5)	**.042**
OSS	29.8 (17.9)	29.1 (7.8)	0.879	25.4 (16.2)	18.1 (4.2)	0.131	22.7 (15.1)	15.1 (7.1)	.126

VAS, visual analog score; *UCLA score*, University of California Los Angeles shoulder score; *OSS*, Oxford shoulder score.
* According to the Constant shoulder score.
† According to the UCLA shoulder score.

Table IV
Preoperative demographics and function (CR vs. No Tear group) (1 standard deviation)

	CR	No Tear	*P* value
Age (yr)	56.7 (11.0)	53.5 (8.4)	.214
BMI (kg/m^2)	25.6 (4.9)	23.6 (3.9)	.113
Range of motion			
Forward flexion	87.8° (41.5)	82.0° (23.9)	.328
Abduction	71.8° (44.3)	62.6° (26.1)	.211
External rotation*	2.44 (4.1)	1.28 (2.5)	.171
Internal rotation*	2.63 (2.4)	3.22 (2.5)	.410
Forward flexion strength†	2.81 (1.1)	2.95 (0.9)	.585
VAS	8.05 (2.1)	6.91 (2.1)	.140
Functional outcome			
Constant score	28.3 (21.9)	26.5 (11.2)	.563
Relative Constant score %	35.4 (26.1)	34.3 (15.4)	.826
UCLA score	12.9 (5.8)	13.5 (4.2)	.776
OSS	39.9 (14.0)	38.2 (9.9)	.551

BMI, body mass index; *VAS*, visual analog score; *UCLA score*, University of California Los Angeles shoulder score; *OSS*, Oxford shoulder score.
* According to the Constant shoulder score.
† According to the UCLA shoulder score.

reported no significant difference in functional outcome at 1 year after operation between both techniques. However, he found higher re-tear rates in bursal-sided tears—23% in takedown and repair compared with 3% for in situ repair.[21] Patients in our study underwent a mixture of both methods, but it is unlikely to have an effect on the functional outcome at 1 year based on existing literature. Our results suggest that repair, with either method, combined with capsular release, has a better outcome than capsular release alone.

Another area that has been widely studied is whether early or delayed mobilization after rotator cuff repair results in a better outcome. It is known that early mobilization increases ROM after repair but increases the risk of re-tear.[6] Conversely, immobilization results in stiffness of the shoulder that causes pain, functional limitation, and a poorer quality of life.[26] Several meta-analyses have been performed on this topic—it appears that for small and medium rotator cuff tears, early mobilization improves early postoperative ROM[28,30] and does not appear to negatively affect re-tear rates.[5,23] Arndt's randomized study of 100 patients, which included 24 patients with partial-thickness tears, found that early passive motion resulted in better function with no significant difference in healing.[2] Our patients in the RCR group had a short duration of immobilization after rotator cuff repair, and this could have affected outcomes.

Table V
One-year postoperative function (CR vs. No Tear group) (1 standard deviation)

	CR	No Tear	*P* value
Range of motion			
Forward flexion	119.7° (33.4)	127.4° (15.0)	.08
Abduction	104.0° (38.5)	121.3° (20.9)	.118
External rotation*	6.42 (4.5)	8.04 (3.1)	.236
Internal rotation*	4.61 (2.9)	7.11 (2.1)	**.005**
Forward flexion strength†	3.81 (1.2)	4.30 (0.5)	.121
VAS	4.20 (3.3)	1.91 (2.3)	**.019**
Functional outcome			
Constant score	53.9 (29.5)	67.9 (13.2)	**.023**
Relative Constant score %	63.6 (31.5)	91.6 (37.1)	**.008**
UCLA score	23.3 (9.3)	27.9 (4.8)	**.02**
OSS	22.7 (15.1)	17.7 (7.3)	.151

VAS, visual analog score; *UCLA score*, University of California Los Angeles shoulder score; *OSS*, Oxford shoulder score.
* According to the Constant shoulder score.
† According to the UCLA shoulder score.

Despite partial-thickness tears being common in frozen shoulders, reported to be up to 15%,[34] limited data is available on the outcomes of capsular release in this group of patients. Elhassan found no difference after arthroscopic capsular release between idiopathic and post-traumatic stiffness, but patients in his post-traumatic group included patients with shoulder fractures and dislocations.[10] Our results suggest that outcomes after arthroscopic capsular release are superior in patients who have no rotator cuff tear compared with those who have a partial-thickness tear.

To our knowledge, there has been no prior literature on surgical treatment of partial-thickness rotator cuff tears in stiff shoulders. The strength of our study is the independent collection of patient-reported outcome measures by trained assessors. Our study has several limitations. First, we had a relatively small sample size in the CR and RCR group. But this is likely due to the fact that most patients with frozen shoulders and small partial rotator cuff tears can be treated successfully with conservative measures alone. Secondly, the method of rotator cuff repair was not standardized but was left to the surgeon's preference, and the sample size was not large enough to determine if there was any difference between the methods used. Finally, our patients did not have postoperative imaging to determine if there were any re-tears that may have affected the outcome.

Conclusion

Our results suggest that our null hypothesis should be rejected. Patients suffering from frozen shoulder with a concomitant partial-thickness rotator cuff tear appear to benefit from an arthroscopic capsular release together with rotator cuff repair in the same setting. However, the benefit is not evident in the early postoperative period but only at 1 year after operation. Patients with a partial-thickness rotator cuff tear have poorer functional outcomes after arthroscopic capsular release than those with an intact rotator cuff.

Disclaimer

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