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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**Level of evidence:** Level III; Retrospective Cohort Comparison; Treatment Study

**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.

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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 scale (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 debridement 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 88.5% 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.26 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 (8.8)    | .939      |
| BMI (kg/m²) | 25.6 (4.9)             | 25.9 (6.1)    | .840      |
| Side of operation | 6               | 12           | .170      |
| Left     | 6                       | 12           | .196      |
| Right    | 9                       | 6            |           |
| Sex      |                          |              |           |
| Male     | 6                       | 11           |           |
| Female   | 9                       | 7            |           |

BMI, body mass index.
inflammation are treated and mechanical deficiencies of the torn tendon are compensated for by the residual cuff and intrinsic muscles. Nonetheless, spontaneous healing of the partial tear is unlikely, and the tear may, in fact, progress over time. 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. 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. 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. 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, debridement with or without subacromial decompression and rotator cuff repair appear to be the most commonly advocated options.

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

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%. 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. Shin found that patients who underwent transtendinous repair had greater pain and poorer function at 3 months, but by 6 months, there were no significant differences between both types of repair. For both bursal- and articular-sided partial-thickness tears, Kim also

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**Table II**
Preoperative outcome (1 standard deviation)

| Range of motion | CR | RCR | P value |
|-----------------|----|-----|---------|
| 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 |
| 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.

1 According to the Constant shoulder score.

2 According to the UCLA shoulder score.

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

| Range of motion | 3 mo | 6 mo | 1 yr |
|-----------------|------|------|------|
| Forward flexion |      |      |      |
| Abduction       |      |      |      |
| External rotation |   |      |      |
| Internal rotation |   |      |      |
| Forward flexion strength |   |      |      |
| VAS             |      |      |      |

Values in bold are considered statistically significant.

1 According to the Constant shoulder score.

2 According to the UCLA shoulder score.

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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. 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. Conversely, immobilization results in stiffness of the shoulder that causes pain, functional limitation, and a poorer quality of life. 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, and does not appear to negatively affect re-tear rates. 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. Our patients in the RCR group had a short duration of immobilization after rotator cuff repair, and this could have affected outcomes.

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

| CR | No Tear | P value |
|----|---------|---------|
| Age (yr) | 56.7 (11.0) | 53.5 (8.4) | .214 |
| BMI (kg/m²) | 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 rotation¹ | 2.44 (4.1) | 1.28 (2.5) | .171 |
| Internal rotation¹ | 2.63 (2.4) | 3.22 (2.5) | .410 |
| Forward flexion strength¹ | 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 | 39.3 (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.
¹ According to the Constant shoulder score.
² According to the UCLA shoulder score.

Despite partial-thickness tears being common in frozen shoulders, reported to be up to 15%, 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. 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
The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

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