Combination of Superior and Posterior Capsular Release Versus Superior Capsular Release Alone in Arthroscopic Repair of Large-to-Massive Rotator Cuff Tears

Jung-Taek Hwang,[*†] MD, PhD, Yong-Been Kim,[†] MD, Min-Soo Cho,[†] MD, Su-Jung Seo,[‡] MS, and Myung Sun Hong,[§] MD, PhD
Investigation performed at the Department of Orthopedic Surgery, Chuncheon Sacred Heart Hospital, Hallym University Medical College, Chuncheon-si, Gangwon-do, Republic of Korea

Background: Superior capsular release has been used to reduce tendon tension, especially in arthroscopic repair of large-to-massive rotator cuff tears. Some clinicians have used a more extensive release of capsules in arthroscopic cuff repair for adequate reduction of torn tendons to footprints.

Purpose: To explore the effects of additional posterior capsular release for superior capsular release in arthroscopic repair of large-to-massive rotator cuff tears.

Study Design: Cohort study; Level of evidence, 3.

Methods: We compared 26 shoulders that underwent superior and posterior capsular release (group S&P) with 26 shoulders that underwent superior capsular release alone (group S) in arthroscopic repair of large-to-massive rotator cuff tears between January 23, 2013 and December 2, 2015. The visual analog scale for pain, American Shoulder and Elbow Surgeons score, Constant score, and range of motion (ROM) and muscle power were checked preoperatively and at 2 years postoperatively. Follow-up ultrasound was checked at 2 years postoperatively.

Results: In both groups, the overall mean functional outcomes improved from preoperatively to postoperatively. Patients in group S&P showed more pre- to postoperative improvement than patients in group S with regard to internal rotation ROM (mean difference, 30.0° vs 20.6°; $P < .001$) and internal rotation power (3.4 vs 1.8 kgf; $P = .001$). Patients in group S had a higher retear rate on the follow-up ultrasound than patients in group S&P, but this difference did not reach statistical significance (23.1% vs 11.5%, respectively; $P = .465$).

Conclusion: In the current study, patients who underwent superior and posterior capsular release in arthroscopic repair of large-to-massive rotator cuff tears had greater postoperative improvement in internal rotation ROM and power compared with patients who underwent superior capsular release alone.

Keywords: arthroscopic rotator cuff repair; internal rotation; internal rotation power; large-to-massive rotator cuff tear; superior and posterior capsular release

Superior capsular release has been used to reduce tendon tension and restore footprints, especially in arthroscopic repair of large-to-massive rotator cuff tears.[1,4,11,15] Some studies have reported the use of a more extensive release of capsules in arthroscopic cuff repair for adequate reduction of torn tendons to footprints.[1,15] Although previous studies reported that capsular release resulted in decreased force for repaired cuffs,[17] to our knowledge, no study has investigated additional posterior capsular release for superior capsular release in arthroscopic repair of large-to-massive rotator cuff tears.

One biomechanical study showed that capsular release significantly reduced the force experienced by repaired cuffs.[17] Hagiwara et al[4] reported that whole-joint capsular release resulted in significantly increased range of motion (ROM) of the affected shoulder in all directions. Another

The Orthopaedic Journal of Sports Medicine, 12(3), 23259671241235916
DOI: 10.1177/23259671241235916

clinical report concluded that chronic loss of internal rotation secondary to posterior capsular contracture may be an explanation for refractory pain in some patients with an initial diagnosis of impingement syndrome, which could be treated by arthroscopic posterior capsular release in conjunction with subacromial bursectomy.[16] Another study reported that additional posterior capsular release did not benefit stiff shoulders.[14]

The purpose of this study was to analyze the functional and structural outcomes of additional posterior capsular release for superior capsular release in arthroscopic repair of large-to-massive rotator cuff tears. We hypothesized that arthroscopic superior and posterior capsular release would be more effective than superior release only in arthroscopic repair of large-to-massive rotator cuff tears.

METHODS

Inclusion and Exclusion Criteria

The study protocol received institutional review board approval; written informed consent was waived because of the retrospective nature of the study. Between January 23, 2013 and December 2, 2015, we performed 57 arthroscopic repairs of large-to-massive rotator cuff tears. The first 28 patients underwent superior capsular release, alone and then sequentially, the latter 29 patients underwent superior and posterior capsular release during the surgery. We categorized a rotator cuff tear measuring 3 to 5 cm as large and a tear measuring >5 cm as massive. In addition, a massive tear was defined as a detachment of at least 2 entire tendons.[10,11]

The study inclusion criteria were as follows: (1) a preoperative magnetic resonance imaging (MRI) scan was available; (2) the patient underwent an arthroscopic rotator cuff repair of large-to-massive rotator cuff tear; and (3) no history of surgery for the affected shoulder. Patients were excluded for the following reasons: (1) refusal to undergo routine postoperative sonographic examination; (2) incomplete repairs or single-row repairs because of severe retraction or poor quality of the torn rotator cuff; (3) simultaneous labral repair for the affected shoulder, such as Bankart or superior labral anterior to posterior (SLAP) lesions; (4) simultaneous open reduction and internal fixation for the os acromiale of the affected shoulder; (5) follow-up periods <24 months; and (5) history of neurological disorders on the affected shoulder.

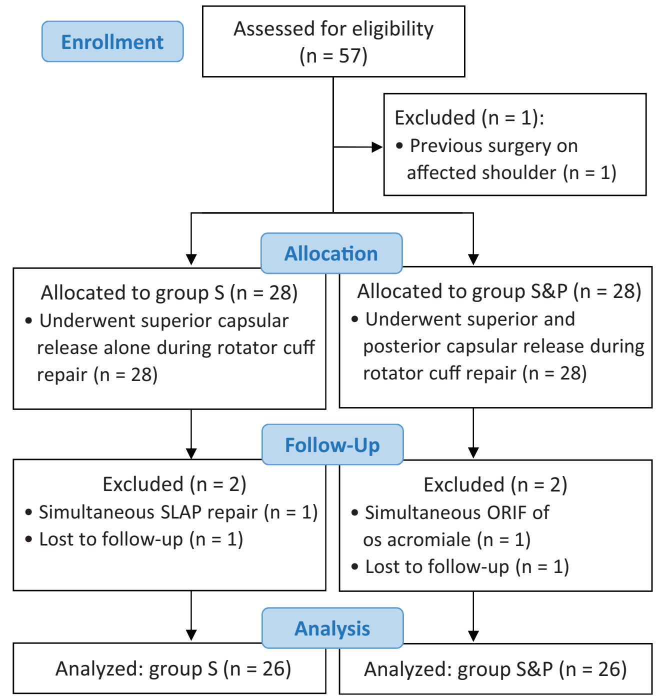

Figure 1. Flow diagram of the present study according to CONSORT criteria. CONSORT, Consolidated Standards of Reporting Trials; ORIF, open reduction and internal fixation; S, superior capsular release alone; SLAP, superior labral anterior to posterior; S&P, superior and posterior capsular release.

Baseline Characteristics

From 57 large-to-massive rotator cuff tears, 5 cases were excluded on the basis of the criteria. One patient was not included due to a history of surgery for the affected shoulder. One patient was excluded due to simultaneous SLAP repair, and another patient was excluded due to simultaneous open reduction and internal fixation for the os acromiale of the affected shoulder. Two patients were excluded because of a lack of follow-up. Therefore, 26 patients underwent superior capsular release alone (group S) and another 26 patients underwent superior and posterior capsular release (group S&P) during arthroscopic cuff repair (Figure 1).

*Address correspondence to Jung-Taek Hwang, MD, PhD, Department of Orthopedic Surgery, Chuncheon Sacred Heart Hospital, Hallym University Medical College, 77 Sakju-ro, Chuncheon-si, Gangwon-do, 24253, Republic of Korea (email: drakehjt@hanmail.net).
†Department of Orthopedic Surgery, Chuncheon Sacred Heart Hospital, Hallym University Medical College, Chuncheon-si, Gangwon-do, Republic of Korea.
‡Department of Orthopedic Surgery, Hallym University Medical College, Chuncheon-si, Gangwon-do, Republic of Korea.
§Department of Radiology, Chuncheon Sacred Heart Hospital, Hallym University Medical College, Chuncheon-si, Gangwon-do, Republic of Korea.
J.-T.H. and M.S.H. are co-corresponding authors and contributed equally to this article.
Final revision submitted July 29, 2023; accepted September 6, 2023.
One or more of the authors has declared the following potential conflict of interest or source of funding: research support was received from the Hallym University Medical Center Research Fund and the Basic Science Research Program through the National Research Foundation of Korea funded by the Ministry of Science (NRF-2016R1C1B2007014). AOSSM checks author disclosures against the Open Payments Database (OPD). AOSSM has not conducted an independent investigation on the OPD and disclaims any liability or responsibility relating thereto.
Ethical approval for this study was obtained from Hallym University Chuncheon Sacred Heart Hospital (ref No. 2021-07-007).

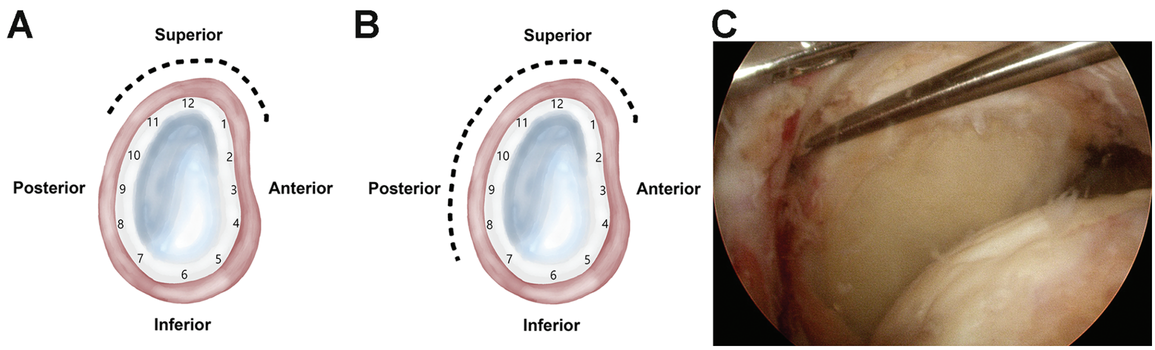

Figure 2. Diagrams of (A) S and (B) S&P on a right shoulder. The dashed line indicates the capsulotomy site. Division of the capsule on a right shoulder according to clockface position: anterior, 1:30 to 4:30; inferior, 4:30 to 7:30; posterior, 7:30 to 10:30; and superior, 10:30 to 1:30. (C) Arthroscopic view from the lateral portal on a right shoulder during S&P. A banana blade was used during the posterior capsular release through the posterolateral portal, and a grasper was used for manipulation of cuffs through the posterior portal. S, superior capsular release alone; SLAP, superior labral anterior to posterior; S&P, superior and posterior capsular release.

Operative Technique

All patients in this study underwent arthroscopic rotator cuff repair and subacromial decompression. All procedures were performed by the same surgeon (J.-T.H.), who specializes in shoulder and elbow surgery. Four routine arthroscopic portals (anterior, posterior, lateral, and posterolateral) were used in the arthroscopic surgery. After bursectomy, arthroscopic subacromial decompression was performed with acromioplasty and spur removal in all patients. The bursal side of the rotator cuff was then inspected, and the margin of the tear was debrided to obtain tendon tissues with better quality. Procedures to mobilize the tendon, such as release of the coracohumeral ligament at the base of the coracoid process and detachment of the rotator cuff from bursal and articular sides, were performed to restore an adequate footprint with an acceptable tension.[11] From the lateral viewing portal, the capsule was divided as follows for a right shoulder according to clockface position: anterior, 1:30; inferior, 4:30 to 7:30; posterior, 7:30 to 10:30; and superior, 10:30 to 1:30. In the left shoulder, the anterior and posterior capsules were in a reversed position. The first 26 patients underwent superior capsular release alone (group S) and the next 26 patients underwent superior and posterior capsular release (group S&P) during the surgery for mobilization of articular side rotator cuffs. For the capsulotomy in releasing the capsule, a banana blade (Conmed) was also used (Figure 2). The surgeon measured the tear at the time of surgery using a 5-mm-long probe.

The suture-bridge technique was used for all rotator cuff repairs, using a 5.0 mm Bio-Corkscrew suture anchor (Arthrex) and a 4.75 mm Bio-SwiveLock (Arthrex). The sutures were passed through the tendon in a mattress manner. During a transtendon suture, the surgeon held a grasper with 1 hand and a suture hook or bird beak with the other hand simultaneously while the first assistant handled the arthroscope using the 2-hand technique. Delaminated surfaces of torn rotator cuffs were debrided to obtain fresh tissue, and an arthroscopic en masse suture-bridge repair was performed by passing the suture through the whole cuff. With a view through the posterolateral portal, pilot holes for the SwiveLock device were created using an awl 2 cm distal to the lateral edge of footprint via the lateral portal. While constant tension was maintained, the SwiveLock device was inserted into the pilot hole and the sutures were cut.[11]

Depending on the concomitant conditions, debridement, tenotomy, or tenodesis of the long head of biceps (LHB); distal clavicle resection; or anterior capsulotomy were performed during the procedure. Debridement was performed for fraying (defined as LHB lesion $<50\%$) or spontaneous rupture of the LHB. Tenodesis or tenotomy was performed in patients with LHB dislocation, subluxation, or tears involving $>50\%$; tenodesis was performed using 2 strands of No. 2 FiberWire (Arthrex) at the remaining supraspinatus close to the greater tuberosity. Arthroscopic distal clavicle resection was performed for patients with symptomatic acromioclavicular joint arthritis. Patients with adhesive capsulitis, defined as passive forward elevation of $<100°$ and passive external rotation at the side of $<30°$, underwent an additional capsulotomy from the 1:30- to 6-o'clock position in the right shoulder (10:30- to 6-o'clock position in the left shoulder).

Rehabilitation

Postoperatively, each patient was prescribed a shoulder-immobilizing sling with an abduction pillow with instructions to maintain the shoulder at 30° to 40° of internal rotation and 20° of abduction. Patients began gentle passive forward flexion on the second postoperative day.[9] The time required for immobilization using the abduction pillow was 6 weeks. Patients were allowed to start active-assisted ROM and stick exercises at 6 weeks after surgery. Active muscle strengthening exercises using resistance bands were permitted at 10 weeks after the surgery. Patients were allowed to perform light activities at 16 weeks postoperatively, and sports activity and heavy labor were allowed 24 weeks or 6 months postoperatively.[6,11]

Data Collection and Outcome Measurement

Symptom duration (defined as the time between symptom onset and operation) and operation time (defined as the time between skin incision and closure of the arthroscopic portal) were reported.[11] Fatty degeneration was evaluated for the supraspinatus, infraspinatus, and subscapularis on preoperative MRI scans using the global fatty degeneration index (mean value of the 3 muscles) and a 5-stage grading system: grade 0, no fatty deposit; grade 1, some fatty streaks; grade 2, more muscle than fat; grade 3, as much muscle as fat; and grade 4, less muscle than fat.[11] Each fatty degeneration grade was determined as the mean of 3 values measured by a single musculoskeletal radiologist (M.S.H.) with 20 years of experience who was blinded as to patient information. Acromiohumeral interval was determined on preoperative conventional true anteroposterior shoulder radiograph. Delamination was determined as a cuff tear with torn edge of cleavage tearing $\geq$5 mm.[7]

All patients were evaluated using the visual analog scale (VAS) pain score, American Shoulder and Elbow Surgeons (ASES) shoulder score, Constant score, ROM, and muscle power preoperatively and 2 years postoperatively. VAS pain was measured on a 10-cm scale from 0 indicating "no pain" to 10 indicating "very severe pain." ROM was measured using a goniometer. The internal rotation angle was measured at 90° of abduction to avoid a blocking due to the body of patient, while the external rotation angle was measured at neutral abduction. Muscle power, measured in kilogram-force (kgf; 1 kgf = 1 kg $\times$ 9.8 m/s^2), was checked with a portable myometer (Mecmesin) by a single laboratory technician while patients were seated upright. The muscle power of the supraspinatus was checked in the empty-can position, and the power of the external and internal rotators of the shoulder was checked in neutral abduction.[11]

The integrity of the repaired rotator cuffs was evaluated by ultrasonography at 2 years postoperatively. The evaluations were performed according to a standard protocol using the iU22 machine (Philips Health Care) with a 5- to 12-MHz linear probe by a single musculoskeletal radiologist (M.S.H.) who was blinded as to patient information. The ultrasound criteria for diagnosis of full-thickness rotator cuff tears were as follows: (1) failure to observe the supraspinatus tendon because of retraction under the acromioclavicular joint; (2) localized absence or focal discontinuity of the cuff with consequent loss of the normal anterior arc of the subdeltoid bursa; (3) loss of normal supraspinatus substance with widening of the gap between the supraspinatus and biceps tendon and exposure of a bare area of bone and cartilage; (4) hypoechoic or anechoic cleft extending through the entire substance of the cuff; and (5) fluid in the subacromial and subdeltoid bursa and/or fluid in the sheath of the long head of the biceps tendon. Partial-thickness tears were diagnosed when a focal hypoechoic or anechoic defect was observed in the tendon, involving either the bursal or the articular surface and manifesting in 2 perpendicular planes.[5,11] The data from the 2-year postoperative ultrasonography examination were evaluated 3 times by the same radiologist. If it was determined to be retear 2 or 3 times, retear was confirmed.

Statistical Analysis

An a priori power analysis indicated that a total sample size of 42 patients (21 patients in each cohort) would provide a statistical power of 99% with a 2-sided α level of .05 to detect significant differences in internal rotation, assuming an effect size of 1.4 (mean difference, 10.3 $\pm$ 7.4) and that a total sample size of 46 patients (23 patients in each cohort) would provide a statistical power of 90% with a 2-sided α level of .05 to detect significant differences in internal rotation power, assuming an effect size of 1.0 (mean difference, 1.3 $\pm$ 1.3). This was based on the mean and standard deviation of the increase in internal rotation observed in a pilot study of 20 patients.

The Wilcoxon signed-rank test or the paired t test was used to compare the overall preoperative and postoperative data between groups S and S&P according to normality. The normally distributed data between the groups were analyzed using independent-sample t tests. Otherwise, the nonparametric Mann-Whitney U test was used. A Fisher exact test was performed to analyze the correlation between additional posterior capsular release and retear. The intraclass correlation coefficient (ICC) was used to assess the intraobserver reliability for evaluating fatty degeneration of torn cuffs on MRI scans and the integrity of repaired cuffs on ultrasonography. Statistical analyses were performed using IBM SPSS Statistics Version 22 (IBM Corp). The threshold for statistical significance was set at $P < .05$.

RESULTS

The overall demographic data were similar between patients in group S and those in group S&P (Table 1). There were also no significant differences in the operative data between the 2 groups (Table 2). The intraobserver reliability of evaluating fatty degeneration of the supraspinatus, infraspinatus, and subscapularis on preoperative MRI scan was excellent (ICCs, 0.94, 0.91, and 0.93, respectively). The intraobserver reliability of evaluating integrity of repaired cuffs on 2-year postoperative ultrasonography was also excellent (ICC, 0.92).

All clinical outcome measures improved significantly from before to after surgery for patients in both groups (Table 3). When comparing mean differences, patients in group S&P were found to have achieved greater postoperative improvement than those in group S regarding internal rotation ROM (30.0° vs 20.6°, respectively; $P < .001$) and internal rotation power (3.4 vs 1.8 kgf, respectively; $P = .001$) (Table 4). The Constant scores also showed more improvement in group S&P than group S at 2 years after surgery, but the mean difference in scores was borderline significant (13.4 vs 9.9, respectively; $P = .050$).

On the follow-up ultrasound, the retear rate was higher in group S (6 of 20 patients; 23.1%) compared with group

TABLE 1
Patient Characteristics According to Study Group[a]

Variable	Posterior Capsular Release (n = 26)	Superior and Posterior Capsular Release (n = 26)	95% CI of the Difference	*P*
Age, y	61.6 ± 10.0 (40-81)	64.5 ± 7.4 (52-78)	-7.8 to -2.0	.236
Sex, male/female	10/16	11/15	-0.1 to 0.5[b]	.169
BMI, kg/m^2	25.5 ± 2.6 (19.7-30.1)	25.0 ± 3.4 (17.3-31.5)	-1.2 to 2.2	.528
Side, dominant/nondominant	20/6	20/6	-0.2 to 0.2[c]	>.99
Symptom duration, mo[d]	20.7 ± 48.1 (1.0-240.0)	16.2 ± 28.4 (1.0-120.0)	-17.5 to 26.5	.317
Preoperative VAS pain score	6.2 ± 2.1 (1.0-10.0)	6.6 ± 2.3 (2.0-10.0)	-1.7 to 0.8	.428
Preoperative ASES score	42.4 ± 17.0 (18.3-86.7)	37.5 ± 19.5 (3.3-78.3)	-5.3 to 15.1	.336
Preoperative Constant score	53.0 ± 7.9 (37.5-66.5)	52.8 ± 9.2 (30.4-71.8)	-4.6 to 5.0	.937
AHI, mm	9.4 ± 1.6 (6.3-12.0)	9.1 ± 1.6 (5.5-11.6)	−0.6 to −1.2	.521
Preoperative fatty degeneration				
Supraspinatus	1.5 ± 0.8 (0.0-3.0)	1.5 ± 0.9 (0.0-3.0)	-0.5 to 0.5	.876
Infraspinatus	1.1 ± 1.0 (0.0-4.0)	1.5 ± 0.9 (0.0-3.0)	-0.9 to 0.2	.125
Subscapularis	0.7 ± 0.7 (0.0-2.0)	0.6 ± 0.7 (0.0-2.0)	-0.3 to 0.5	.723
GFDI	1.1 ± 0.7 (0.0-2.7)	1.2 ± 0.7 (0.0-2.3)	-0.5 to 0.3	.522

[a]Data are reported as mean ± SD (range) or No. of patients. AHI, acromiohumeral interval; ASES, American Shoulder and Elbow Surgeons; BMI, body mass index; CI, confidence interval; GDFI, global fatty degeneration index; VAS, visual analog scale.
[b]1 if male, 0 if female.
[c]1 if dominant, 0 if nondominant.
[d]Symptom duration: time between symptom onset and operation.

TABLE 2
Operative Data According to Study Group[a]

Variable	Posterior Capsular Release	Superior and Posterior Capsular Release	95% CI of the Difference	*P*
Operation time, min[b]	104.0 ± 14.4 (65.0-130.0)	97.9 ± 18.4 (70.0-155.0)	-3.1 to 15.4	.186
RCT size, cm	4.2 ± 0.8 (3.0-6.0)	4.4 ± 0.7 (3.0-6.0)	-0.7 to 0.2	.179
Delamination	11	10	-0.2 to 0.3	.780
Footprint restoration, %	87.7 ± 18.8 (40.0-100.0)	96.2 ± 9.8 (70.0-100.0)	-16.9 to 0.0	.054
SC lesion				
Debridement	7	8	-0.3 to 0.2	.762
Repair using suture anchor	2	4	-0.3 to 0.1	.390
LHB lesion				
Debridement	4	5	-0.3 to 0.2	.717
Tenotomy	0	3	-0.2 to 0.0	.077
Tenodesis	11	10	-0.2 to 0.3	.780
Arthroscopic distal clavicle resection	1	2	-0.2 to 0.1	.556
Capsulotomy	2	1	-0.1 to 0.2	.556
Coracoplasty	2	1	-0.1 to 0.2	.556

[a]Data are reported as mean ± SD (range) or No. of patients. ADCR, arthroscopic distal clavicle resection; CI, confidence interval; LHB, long head of biceps; PCA, patient-controlled analgesia; RCT, rotator cuff tear; SC, subscapularis.
[b]Operation time was the duration between the skin incision and suture.

S&P (3 of 23 patients; 11.5%), although this difference did not reach statistical significance (P = .465). None of the 52 study patients underwent any additional surgery during the 24-month follow-up period.

DISCUSSION

In the present study, retear occurred in 11.5% of patients who underwent superior and posterior capsular release and 23.1% of those who underwent superior capsular release alone at 2 years postoperatively; this difference did not reach statistical significance between the 2 groups (P = .276). Overall postoperative functional outcomes improved for patients in both groups, irrespective of the presence of a retear ($P < .001$ for all). Patients who underwent superior and posterior capsular release had greater pre- to postoperative improvement in internal rotation ROM ($P < .001$) and internal rotation power (P = .001) compared with those who underwent superior capsular release alone.

Superior capsular release has been used for reducing tendon tension and restoring footprints, especially in arthroscopic repair of large-to-massive rotator cuff

TABLE 3
Pre- and Postoperative Outcomes of the Study Groups[a]

Variable	Preoperative	2-years Postoperatively	95% CI of the Difference	*P*
Superior capsular release				
VAS pain score	6.2 ± 2.1 (1.0-10.0)	1.7 ± 1.1 (0.0-4.0)	3.6 to 5.3	<.001
ASES score	42.4 ± 17.0 (18.3-86.7)	80.1 ± 12.0 (56.7-100.0)	-44.2 to -31.1	<.001
Constant score	55.1 ± 7.7 (40.1-68.6)	65.0 ± 4.7 (54.6-73.6)	-12.4 to -7.4	<.001
Forward elevation ROM, deg	130.0 ± 16.2 (90-150)	144.6 ± 7.6 (130.0-150.0)	-18.6 to -10.6	<.001
External rotation ROM, deg	55.0 ± 13.0 (30.0-70.0)	68.8 ± 5.9 (60.0-80.0)	-18.3 to -9.4	<.001
Internal rotation ROM, deg	45.8 ± 8.3 (30.0-60.0)	66.3 ± 9.6 (40.0-80.0)	-23.2 to -18.0	<.001
Abduction power, kgf	2.5 ± 2.0 (0.4-7.5)	5.2 ± 1.5 (2.5-8.5)	-3.3 to -2.2	<.001
External rotation power, kgf	4.3 ± 1.7 (1.0-7.1)	6.7 ± 1.6 (3.5-9.5)	-3.0 to -1.9	<.001
Internal rotation power, kgf	5.1 ± 1.7 (2.5-9.8)	6.9 ± 1.5 (3.5-9.5)	-2.3 to -1.3	<.001
Superior and posterior capsular release				
VAS pain score	6.6 ± 2.3 (2.0-10.0)	1.7 ± 1.3 (0.0-4.0)	4.1 to 5.7	<.001
ASES score	37.5 ± 19.5 (3.3-78.3)	81.9 ± 12.6 (55.0-100.0)	-50.4 to -38.4	<.001
Constant score	54.8 ± 9.1 (33.1-73.9)	68.2 ± 4.9 (56.7-77.7)	-16.0 to -10.8	<.001
Forward elevation ROM, deg	135.4 ± 16.5 (70-150)	147.3 ± 6.0 (130-150)	-16.6 to -7.2	<.001
External rotation ROM, deg	57.7 ± 14.5 (20-70)	74.2 ± 8.6 (60-90)	-20.3 to -12.8	<.001
Internal rotation ROM, deg	47.9 ± 7.6 (33.0-55.0)	77.9 ± 12.7 (45.0-90.0)	-33.7 to -26.3	<.001
Abduction power, kgf	1.8 ± 1.8 (0.1-7.8)	4.9 ± 1.2 (2.5-7.5)	-3.7 to -2.5	<.001
External rotation power, kgf	4.1 ± 2.8 (0.7-10.3)	6.7 ± 1.7 (4.0-11.5)	-3.3 to -1.9	<.001
Internal rotation power, kgf	4.4 ± 2.1 (0.8-12.0)	7.8 ± 1.8 (5.2-12.5)	-4.1 to -2.6	<.001

[a]ASES, American Shoulder and Elbow Surgeons; CI, confidence interval; kgf, kilogram force (1 kgf = 1 kg × 9.8 m/s^2); ROM, range of motion; VAS, visual analog scale.

TABLE 4
Comparison of Overall Functional Outcomes Between the Study Groups[a]

Difference	Superior Capsular Release	Superior and Posterior Capsular Release	95% CI of the Difference	*P*
Δ VAS score	4.5 ± 2.0 (0.0-8.0)	4.9 ± 1.9 (1.0-8.0)	-1.6 to 0.6	.445
Δ ASES score	37.6 ± 16.2 (3.3-70.0)	44.4 ± 14.9 (13.3-76.7)	-15.5 to 1.9	.122
Δ Constant score	9.9 ± 6.2 (-2.2-21.3)	13.4 ± 6.4 (3.8-28.7)	-7.0 to 0.0	.050
Δ Forward elevation ROM, deg	14.6 ± 9.9 (0.0-40.0)	11.9 ± 11.7 (0.0-60.0)	-3.3 to 8.7	.154
Δ External rotation ROM, deg	13.8 ± 11.0 (0.0-40.0)	16.5 ± 9.4 (10.0-40.0)	-8.4 to 3.0	.257
Δ Internal rotation ROM, deg	20.6 ± 6.4 (5.0-35.0)	30.0 ± 9.2 (10.0-50.0)	-13.8 to -5.0	<.001
Δ Abduction power, kgf	2.7 ± 1.4 (0.3-5.4)	3.1 ± 1.5 (-0.3-6.2)	-1.2 to 0.4	.343
Δ External rotation power, kgf	2.4 ± 1.4 (0.2-5.2)	2.6 ± 1.7 (-1.0-5.2)	-1.0 to 0.7	.710
Δ Internal rotation power, kgf	1.8 ± 1.3 (-1.3-4.0)	3.4 ± 1.8 (-0.3-6.9)	-2.5 to -0.7	.001

[a]Data are reported as mean ± SD (range). Δ, difference between preoperative and 2-year; ASES, American Shoulder and Elbow Surgeons postoperative values; kgf, kilogram force (1 kgf = 1 kg × 9.8 m/s^2); VAS, visual analog scale;.

tears.[1,4,11,15] A more extensive release of capsules in arthroscopic cuff repair could be used for adequate reduction of torn tendons to footprints.[1,15] One biomechanical study reported that capsular release significantly reduced the force for repaired cuffs.[17] Especially for large tears, abduction of ≥30° with lateral rotation and extension consistently produced the lowest tension.[17] Capsular release resulted in 30% less force at 0° of abduction with a statistical significance in the study.[17] One clinical study showed that whole-joint capsular release resulted in significantly increased ROM of the affected shoulder in all directions.[17] Another clinical study for refractory posterior capsular contracture of 9 shoulders reported that, at an average of 19 months' follow-up (range, 11-35 months), internal rotation at 90° of abduction improved from 10° preoperatively to 47° postoperatively after arthroscopic posterior capsular release.[16] One systemic review and meta-analysis suggested that addition of a posterior release offers increased early internal rotation, which was not sustained over time, but provides early and sustained flexion improvements.[13] On the other hand, studies have reported that additional posterior capsular release did not provide any benefits in stiff shoulders.[8,14] Because the present study included only 2 patients with concomitant stiff shoulder in group S and 1 patient in group S&P, we could not conduct a meaningful group comparison.

The retear rate for arthroscopic large-to-massive rotator cuff repairs varies widely.[2,3,5,6,11,12,15] One report published in 2013 included a retrospective case series of 36 patients with massive rotator cuff tears repaired using a suture-bridge technique, with an overall retear rate was 25% on 2-year postoperative ultrasonography.[11] Four retears larger than the initial tears occurred and had some adverse effects on functional outcome, whereas patients with smaller retears did not significantly differ in functional outcome from the healed group.[11] In 2007, another prospective series including 106 patients with rotator cuff tears repaired using a double-row technique showed that, although the overall retear rate was 17%, the retear rate in large-to-massive rotator cuff tears was 40% on MRI scans.[15] A group reported a retear rate of 14% for the repair of large-to-massive tears using the suture-bridge technique in 2010.[12] Another group reported a retear rate of 51% for that technique in 2011.[3]

Posterior capsular release may provide a benefit in terms of increased range of internal rotation.[13,16,17] In the present study, the increased internal rotation ROM seen in group S&P could have aided in early rehabilitation and consequently enhanced internal rotation power for those patients, which could be a reason for the borderline significant increase in Constant scores of group S&P compared with group S. The retear rate was higher in group S versus group S&P, although the difference did not reach statistical significance (23.1% vs 11.5%, respectively; $P = .276$). There is a possibility that reduced tension of the repaired cuff by additional posterior capsular release in group S&P could have helped decrease the retear rate.

Limitations and Strengths

The present study had several limitations. First, the number of patients was small. Second, ultrasonographic evaluations are somewhat examiner dependent. Ultrasonography has a lower accuracy than MRI. Third, this study was a retrospective study without randomization. Fourth, the symptom duration ranged from 1 to 240 months, and therefore traumatic and chronic rotator cuff tears could have been included in the same cohort. However, because there was no statistically significant difference in the mean symptom duration between the 2 groups, the results could be acceptable.

The present study also had some strengths. First, to our knowledge, this study is the first comparative study of the clinical and structural outcomes of additional posterior capsular release for superior capsular release in arthroscopic repair of large-to-massive rotator cuff tears. Second, although the patients in this study did not undergo randomization, the first 26 patients underwent superior capsular release alone and the latter 26 patients underwent superior and posterior capsular release, sequentially. Moreover, there were no significant group differences in the overall demographic data. This could enhance the reliability of the present study. Third, although the number of patients was small, the a priori power analysis indicated sufficient statistical power.

CONCLUSION

In the current study, patients who underwent superior capsular release and posterior capsular release in arthroscopic repair of large-to-massive rotator cuff tears were found to have greater postoperative improvement in internal rotation ROM and power compared with patients who underwent superior capsular release alone.

REFERENCES

1. Cho CH, Jang HK, Bae KC, et al. Clinical outcomes of rotator cuff repair with arthroscopic capsular release and manipulation for rotator cuff tear with stiffness: a matched-pair comparative study between patients with and without stiffness. *Arthroscopy*. 2015;31(3):482-487.
2. Cho NS, Lee BG, Rhee YG. Arthroscopic rotator cuff repair using a suture bridge technique: is the repair integrity actually maintained? *Am J Sports Med*. 2011;39(10):2108-2116.
3. Choi S, Yang H, Kang H, Kim GM. Treatment of large and massive rotator cuff tears: does infraspinatus muscle tear affect repair integrity? *Clin Shoulder Elb*. 2019;22(4):203-209.
4. Hagiwara Y, Kanazawa K, Ando A, et al. Effects of joint capsular release on range of motion in patients with frozen shoulder. *J Shoulder Elbow Surg*. 2020;29(9):1836-1842.
5. Kim DY, Hwang JT, Lee SS, Lee JH, Cho MS. Prevalence of rotator cuff diseases in adults older than 40 years in or near Chuncheon city, Korea. *Clin Shoulder Elb*. 2020;23(3):125-130.
6. Kim SJ, Kim SH, Lee SK, Seo JW, Chun YM. Arthroscopic repair of massive contracted rotator cuff tears: aggressive release with anterior and posterior interval slides do not improve cuff healing and integrity. *J Bone Joint Surg Am*. 2013 21;95(16):1482-1488.
7. Kim YS, Lee HJ, Jin HK, Kim SE, Lee JW. Conventional en masse repair versus separate double-layer double-row repair for the treatment of delaminated rotator cuff tears. *Am J Sports Med*. 2016;44(5):1146-1152.
8. Kim YS, Lee HJ, Park IJ. Clinical outcomes do not support arthroscopic posterior capsular release in addition to anterior release for shoulder stiffness: a randomized controlled study. *Am J Sports Med*. 2014;42(5):1143-1149.
9. Lee JJ, Kim DY, Hwang JT, et al. Effect of ultrasonographically guided axillary nerve block combined with suprascapular nerve block in arthroscopic rotator cuff repair: a randomized controlled trial. *Arthroscopy*. 2014;30(8):906-914.
10. Park JY, Lhee SH, Oh KS, Kim NR, Hwang JT. Is arthroscopic coracoplasty necessary in subcoracoid impingement syndrome? *Arthroscopy*. 2012;28(12):1766-1775.
11. Park JY, Lhee SH, Oh KS, Moon SG, Hwang JT. Clinical and ultrasonographic outcomes of arthroscopic suture bridge repair for massive rotator cuff tear. *Arthroscopy*. 2013;29(2):280-289.
12. Park JY, Siti HT, Keum JS, Moon SG, Oh KS. Does an arthroscopic suture bridge technique maintain repair integrity?: a serial evaluation by ultrasonography. *Clin Orthop Relat Res*. 2010;468(6):1578-1587.
13. Sivasubramanian H, Chua CXK, Lim SY, et al. Arthroscopic capsular release to treat idiopathic frozen shoulder: how much release is needed? *Orthop Traumatol Surg Res*. 2021;107(1):102766.
14. Snow M, Boutros I, Funk L. Posterior arthroscopic capsular release in frozen shoulder. *Arthroscopy*. 2009;25(1):19-23.
15. Sugaya H, Maeda K, Matsuki K, Moriishi J. Repair integrity and functional outcome after arthroscopic double-row rotator cuff repair. A prospective outcome study. *J Bone Joint Surg Am*. 2007;89(5):953-960.
16. Ticker JB, Beim GM, Warner JJ. Recognition and treatment of refractory posterior capsular contracture of the shoulder. *Arthroscopy*. 2000;16(1):27-34.
17. Zuckerman JD, Leblanc JM, Choueka J, Kummer F. The effect of arm position and capsular release on rotator cuff repair. A biomechanical study. *J Bone Joint Surg Br*. 1991;73(3):402-405.