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A comparative study of arthroscopic débridement versus repair for Ellman grade II bursal-side partial-thickness rotator cuff tears

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Hypothesis: We aimed to report the clinical outcomes of arthroscopic débridement vs. repair for Ellman grade II bursal-side partial-thickness rotator cuff tears.

Methods: Patients who presented with Ellman grade II bursal-side partial-thickness rotator cuff tears from September 2015 to August 2017 were included. On the basis of preoperative findings and patient preference, 20 patients underwent débridement whereas 26 underwent arthroscopic repair. The visual analog scale (VAS), Constant-Murley shoulder, American Shoulder and Elbow Surgeons, and University of California–Los Angeles scores were assessed. Magnetic resonance imaging and B-mode ultrasonography were performed preoperatively and at 6, 12, and 24 months postoperatively.

Results: All 46 patients were available throughout follow-up. At 2 years postoperatively, the VAS score had improved from 6.42 ± 1.56 to 0.65 ± 0.51 in the débridement group and from 6.26 ± 1.32 to 0.75 ± 0.42 in the repair group. The VAS score differed significantly between the 2 groups at 6 months postoperatively. All patient-reported outcomes improved in both groups. The American Shoulder and Elbow Surgeons score (P = .009), Constant-Murley shoulder score (P = .014), and University of California–Los Angeles score (P = .030) differed significantly between the 2 groups (higher in the débridement group) at 6 months postoperatively. Finally, 44 patients having intact tendon repairs with no interval worsening of partial-thickness tears underwent postoperative scheduled magnetic resonance imaging and B-mode ultrasonography examinations.

Conclusion: Arthroscopic débridement and repair of Ellman grade II bursal-side partial-thickness rotator cuff tears achieved comparable clinical scores and low retear rates during 2 years of follow-up. However, débridement achieved better results, especially within 6 months postoperatively, and achieved a favorable prognosis up to 2 years postoperatively.

Level of evidence: Level III; Retrospective Cohort Design; Treatment Study

Keywords: Partial-thickness rotator cuff tear; bursal-side tear; shoulder; arthroscopic débridement; arthroscopic repair; clinical outcomes

A partial-thickness rotator cuff tear (PTRCT) is a common type of rotator cuff tear (RCT) and can be classified as bursal side, articular side, or intratendinous in accordance with the injury site.[9,34] The current theory is that RCTs are mainly caused by intrinsic degeneration within the rotator cuff.[21] However, many doctors also

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believe that bursal-side RCTs are caused by subacromial impingement.[1,21,29,32,34]

Which arthroscopic treatment to choose for PTRCTs is mainly based on the symptoms and tear classifications. Ellman[8] developed a system based on the location and depth of the tear to effectively classify, diagnose, and treat PTRCTs. Most authors recommend repair of PTRCTs involving ≥50% of the tendon thickness (Ellman grade III), whereas PTRCTs involving <25% (Ellman grade I) are treated conservatively rather than surgically.[4,11,19,25,27,34,35,37] However, it remains controversial whether Ellman grade II PTRCTs are better treated with débridement or repair.

Although both arthroscopic débridement and repair of Ellman grade II bursal-side PTRCTs have been extensively studied, no high-quality clinical study has evaluated whether débridement provides better results than repair treatment. The purpose of this study was to evaluate the functional results and structural outcomes of arthroscopic débridement vs. repair of Ellman grade II bursal-side PTRCTs. Our hypothesis was that the minor procedure, arthroscopic débridement of Ellman grade II bursal-side PTRCTs, would be good enough to achieve comparable clinical and structural results.

Materials and methods

Study population

This was a retrospective case-control study. From September 2015 to August 2017, 46 eligible patients with Ellman grade II bursal-side PTRCTs underwent arthroscopic débridement or repair. The inclusion criteria were (1) Ellman grade II bursal-side PTRCTs identified on preoperative magnetic resonance imaging (MRI) and intraoperative arthroscopic exploration, (2) failure of conservative treatment for ≥3 months, and (3) ≥24 months' follow-up postoperatively. The exclusion criteria were (1) previous shoulder surgery; (2) articular-side, intratendinous, or full-thickness RCTs; and (3) other shoulder conditions that would need to be addressed at the time of arthroscopic surgery, such as symptomatic biceps tendinitis, frozen shoulder, or a Bankart lesion.

The surgical indications were shoulder pain with or without abduction weakness for ≥3 months. First, preoperative MRI or B-mode ultrasonography (B-US) was examined to screen the most likely pathologic types of Ellman grade II bursal-side PTRCT. Then, the tear was identified and included in our research through direct intraoperative arthroscopic exploration. For the determination of surgical procedures required, doctors made a specific rule to avoid the doctors' subjective influence (age, size of tear, and so on) on choosing arthroscopic procedures. First, before the operation, it was decided whether débridement or repair would be performed according to the patient's disease conditions, advantages and disadvantages of each surgical procedure, cost, and rehabilitation time needed. Then, surgeons performed an arthroscopic exploration to evaluate the degree of cuff integrity. If a case met the criteria for an Ellman grade II bursal-side PTRCT under direct observation, the surgical procedure proceeded according to the preoperative decision of the patient; if not, this case was excluded from our research. All patients in this study provided informed consent for the use of their medical data.

Imaging studies

The routine preoperative diagnostic examinations included shoulder radiographs (anteroposterior, true anteroposterior, and axillary views), MRI, and B-US. Routine postoperative MRI and B-US were performed at 6, 12, and 24 months postoperatively. Oblique coronal, oblique sagittal, and axial views were obtained with a 3.0-T MRI unit (Siemens Medical Solutions, Erlangen, Germany) and evaluated by a radiologist.

Rotator cuff integrity was evaluated with MRI using the radiographic grading criteria of Sugaya et al.[29] Grade I and II RCTs have sufficient cuff thickness; grade III RCTs have insufficient cuff thickness without discontinuity; and grade IV and V RCTs have cuff discontinuity suggesting small tears and large tears, respectively. Rotator cuff integrity was evaluated by 3 sports medicine surgeons and was determined by a majority consensus.

Muscle atrophy and fatty degeneration were assessed with MRI performed preoperatively and at 24 months postoperatively. Muscle atrophy was evaluated on oblique sagittal images using the occupation ratio, which was measured as the ratio between the cross-sectional area of the supraspinatus muscle and that of the supraspinatus fossa on the Y-view, as described by Thomazeau et al.[31] Fatty degeneration in each muscle was evaluated using the 5-point grading system described by Goutallier et al as follows: grade 0, no fat; grade 1, thin fatty streaks; grade 2, muscle predominated with a substantial amount of fatty infiltration; grade 3, equal distribution of fat and muscle; and grade 4, more fat was present than muscle.

Cuff integrity was evaluated on B-US using the grading system proposed by Barth et al[2] as follows: grades I and II, sufficient thickness of >2 mm; grade III, insufficient cuff thickness of <2 mm without discontinuity; and grades IV and V, presence of discontinuity suggesting small and large tears, respectively.

Clinical outcome evaluation

Clinical outcomes were evaluated with the visual analog scale (VAS) score for pain, range-of-motion (ROM) assessment, Constant-Murley shoulder score, American Shoulder and Elbow Surgeons (ASES) score, and University of California–Los Angeles (UCLA) score for functional outcomes. Preoperative and postoperative scores were compared. All evaluations were performed by a single shoulder surgeon who was blinded to the surgical procedure performed. Patient satisfaction was evaluated as excellent, good, fair, or poor at final follow-up.

Conservative treatment

All patients received formal conservative treatment for ≥3 months before surgery. This treatment included appropriate rest, modification of activities, hot compression, nonsteroidal anti-inflammatory medications, ROM training, and muscle-strengthening exercises; subacromial steroid injections were performed in some patients with acute pain.

Surgical procedures

All procedures were performed with the patient in the lateral decubitus position under general anesthesia. A shoulder traction device (Spider 2 traction system; Smith & Nephew, Andover, MA, USA) was used in all patients to maintain the arm in 20° of flexion and 30° of abduction. Diagnostic glenohumeral arthroscopy was performed, and a minimal intra-articular operation, such as intra-articular irrigation or débridement of the intra-articular rotator interval, was performed.

After evaluation of the articular side, subacromial decompression was performed in the subacromial space. In accordance with the degree of attrition of the coracoacromial ligament on the acromial side, formal acromioplasty was performed to create a type I flat acromion, and subacromial débridement including bursectomy was performed in all patients. The edge of the tear was then débrided, and the exact shape and size of the tear were evaluated. The degenerated tendon and soft tissue over the surface of the tear were completely removed until normal articular-side tendon fibers inserting into the greater tuberosity were visualized. The length and thickness of the tear were then measured using a calibrated probe.

If the patient chose arthroscopic débridement, we only refreshed the stump of the bursal-side PTRCT and performed simple débridement around the tear surface. If the patient chose formal repair, we performed a full-layer suture of the remaining rotator cuff tissue under the tear. All partial-thickness tears were converted to full-thickness tears to allow the shaver and grasper to pass through the glenohumeral joint while as much of the remnant native tissue was preserved as possible. The greater tuberosity was prepared with a burr to promote healing of the reattached cuff. About one-third of patients received a single-row repair (n = 9), whereas the others were treated by the suture bridge technique (n = 17).

Postoperative rehabilitation

In patients who underwent arthroscopic débridement, the affected arm was kept in a sling at 15° of abduction and a neutral-rotation brace for 3 weeks. Pendulum and passive ROM exercises were initiated on postoperative day 1. After 3 weeks, patients were encouraged to start self-assisted passive and active ROM exercises. Active strengthening exercises using an elastic band were started at 4-10 weeks postoperatively. Nearly full active ROM was allowed starting at 2.5 months postoperatively.

In patients who underwent RCT repair, the affected arm was kept in an abduction brace for 6 weeks. Pendulum and passive ROM exercises were initiated on postoperative day 1. Self-assisted passive exercises were started at 6-12 weeks postoperatively, and active ROM exercises were conducted starting at 12 weeks postoperatively. Active strengthening exercises using an elastic band were started at 3-6 months postoperatively. Nearly full active ROM was allowed starting at 6 months postoperatively.

Statistical analysis

All results are expressed as mean ± standard deviation. The intra- and inter-reliabilities were tested by the intraclass correlation coefficient with the 95% confidence interval, which was used to evaluate the reproducibility of measurements. An intraclass correlation coefficient of 0.80-1.00 was considered excellent agreement; 0.60-0.79, good agreement; 0.40-0.59, moderate agreement; 0.20-0.39, weak agreement; and 0.00-0.19, no agreement. Normality tests (Kolmogorov-Smirnov test and Shapiro-Wilk test) were used to determine whether all measurement data were in accordance with a normal distribution. Preoperative and postoperative clinical scores were compared by paired *t* tests. Postoperative outcome scores were compared between groups using analysis of variance, and multiple comparisons were made using an LSD (least significant difference) test. For the cuff integrity grade distribution on MRI and B-US, the R × C χ^2 test was used for statistical analysis. All statistical evaluations were performed using PASW Statistics software (version 19.0; IBM, Armonk, NY, USA). $P < .05$ was considered statistically significant.

Results

Patient demographic characteristics

A total of 46 patients were included (Table I). There were 17 men and 29 women; the mean age was 54.1 years (standard deviation, ±8.07 years; range, 36-64 years). The mean body mass index was 25.3 ± 3.6 kg/m^2. Arthroscopic débridement was performed in 20 patients (43.5%), whereas repair was performed in 26 (56.5%). The reproducibility for intra- and inter-reliabilities was excellent; the data are presented in Table II. The repair group included 9 single-row repair and 17 suture bridge cases. No significant differences were found in VAS, ASES, Constant-Murley shoulder, and UCLA scores (all comparative data are shown in Supplementary Tables S1-S4, $P > .050$) preoperatively and at 6, 12, 18, and 24 months postoperatively (Fig. 1). There were no significant differences between the débridement and repair groups regarding the demographic characteristics.

Functional outcomes

All patients were followed up at 6, 12, 18, and 24 months postoperatively. The overall postoperative scoring systems indicated significant improvements in both the débridement and repair groups at final follow-up. The mean scores in the 2 groups at the same follow-up time points are shown in Figure 2. The VAS score significantly differed between the débridement and repair groups at 6 months postoperatively ($P = .007$) but not at 12 months ($P = .309$), 18 months ($P = .361$), and 24 months ($P = .427$) postoperatively. Similarly, the ASES ($P = .009$), Constant-Murley shoulder ($P = .014$), and UCLA ($P = .030$) scores at 6 months postoperatively significantly differed between the débridement and repair groups. However, these scores did not significantly differ between the 2 groups at 12, 18, and 24 months postoperatively (all comparative data, $P > .050$; Fig. 2).

Table I Demographic data

	Débridement (n = 20)	Repair (n = 26)	*P* value
Age (range; SD), yr	55.4 (36-59; ±9.03)	53.1 (39-64; ±10.81)	.503
Sex: female/male	13/7	16/10	.232
Symptom duration (range; SD), mo	5.92 (7-26; ±8.40)	7.03 (4-22; ±7.54)	.296
Side of involvement: left/right	10/10	10/16	.477
Involvement of dominant arm, n (%)	12 (60)	17 (65.4)	.500
Preoperative shoulder ROM			
Forward elevation (range; SD), °	157 (145-180; ±9.75)	141 (130-180; ±10.66)	.219
External rotation (range; SD), °	71 (45-110; ±15.34)	55 (40-95; ±8.35)	.114
Internal rotation	T11 (T8-L1)	T11 (T8-L1)	—
Internal rotation in abducted position (range; SD), °	71 (55-85; ±7.42)	73 (60-90; ±7.07)	.680

SD, standard deviation; *ROM*, range of motion.

Table II Intra- and inter-reliabilities of VAS, ASES, CS, and UCLA scores

	First vs. second assessment by 1 examiner		Assessment by examiner 1 vs. examiner 2	
	ICC	95% CI	ICC	95% CI
VAS score	0.878	0.844-0.912	0.908	0.872-0.927
ASES score	0.930	0.878-0.941	0.955	0.944-0.969
CS score	0.942	0.925-0.952	0.950	0.936-0.963
UCLA score	0.890	0.847-0.914	0.857	0.821-0.880

VAS, visual analog scale; *ASES*, American Shoulder and Elbow Surgeons; *CS*, Constant-Murley shoulder; *UCLA*, University of California–Los Angeles score; *ICC*, intraclass correlation coefficient; *CI*, confidence interval.

MRI outcomes

In the débridement group, 16 cuffs were classified as grade I or II, 2 were classified as grade III, and 2 were classified as grade IV; there were no type V retears detected on MRI. In the repair group, 21 cuffs were classified as grade I or II and 5 were classified as grade III; there were no grade IV or V retears. The R × C χ^2 test revealed that cuff integrity in accordance with the Sugaya grading system did not significantly differ between the débridement and repair groups ($\chi^2 = 3.234$, $P = .199$) (Table III).

The MRI findings regarding muscle atrophy and fatty degeneration in the débridement and repair groups are shown in Table IV. These groups did not differ regarding the distributions of muscle atrophy or fatty degeneration of the muscles.

B-US outcomes

Cuff integrity evaluated on B-US in the débridement and repair groups is shown in Table V. The R × C χ^2 test revealed no significant difference between the 2 groups regarding cuff integrity in accordance with the Barth grading system ($\chi^2 = 1.355$, $P = .508$).

Complications and satisfaction

No obvious complication related to surgery occurred in either group. In 1 patient in the débridement group and 6 patients in the repair group, mild anxiety developed within 6 months postoperatively, owing to persistent acute pain that could not be effectively treated with nonsteroidal anti-inflammatory drugs; however, these symptoms gradually disappeared during follow-up. All patients rated their satisfaction with surgery as excellent or good at final follow-up. Although 2 patients had cuff retears detected on MRI or B-US, they had no symptoms such as pain, movement problems, or changes in muscle strength.

Discussion

For Ellman grade II PTRCTs, there is still controversy as to whether the best treatment choice is conservative treatment, arthroscopic débridement, or suture repair.[26,34] Our experience shows that for bursal-side PTRCTs, arthroscopic surgery involving preservation of healthy tendon tissue and removal of inflammatory synovium from the shoulder cavity yields a satisfactory clinical outcome. Our research

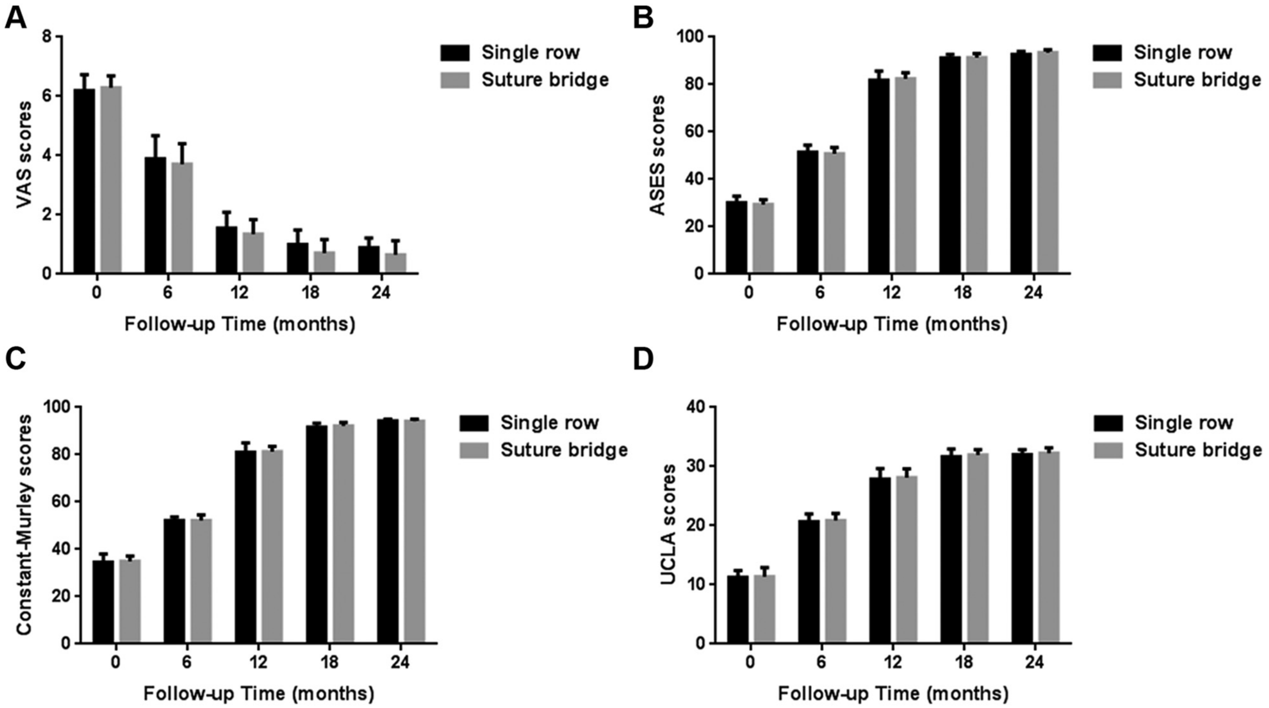

Figure 1 Visual analog scale *(VAS)* (**A**), American Shoulder and Elbow Surgeons *(ASES)* (**B**), Constant-Murley shoulder (**C**), and University of California–Los Angeles *(UCLA)* (**D**) scores preoperatively and at 6, 12, 18, and 24 months after single-row vs. suture bridge repair in repair group. No statistically significant differences were found.

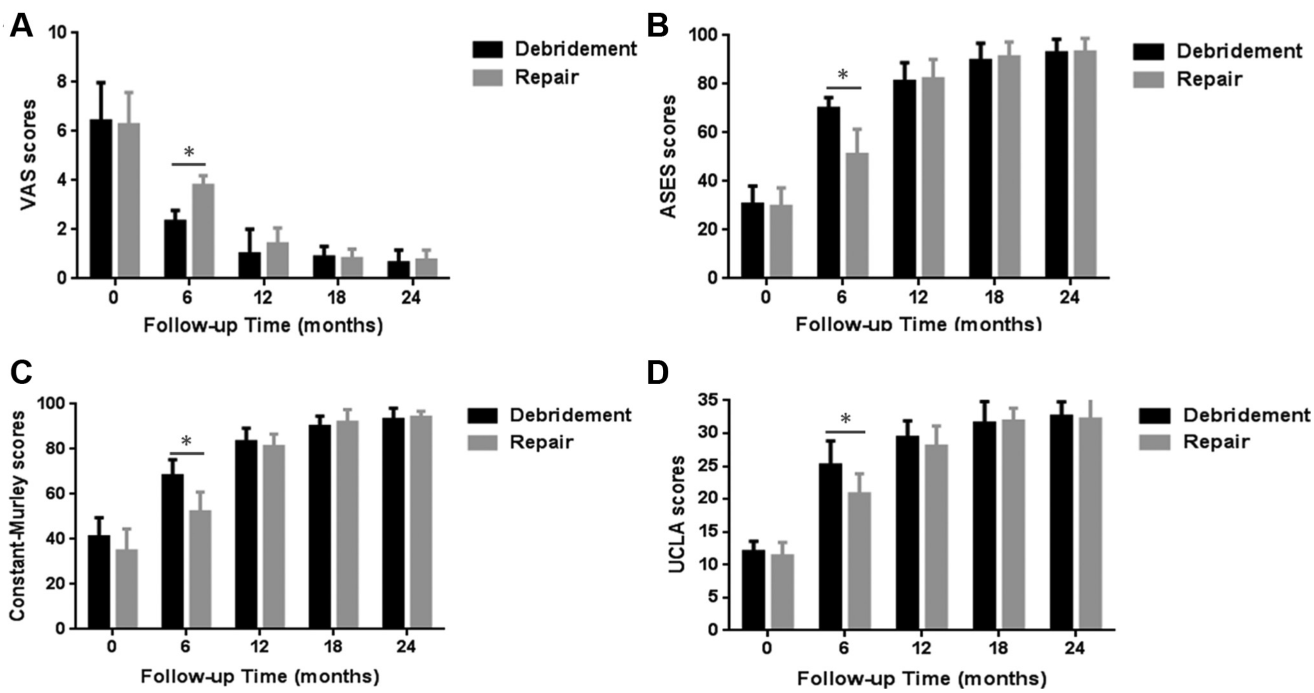

Figure 2 Visual analog scale *(VAS)* (**A**), American Shoulder and Elbow Surgeons *(ASES)* (**B**), Constant-Murley shoulder *(CS)* (**C**), and University of California–Los Angeles *(UCLA)* (**D**) scores preoperatively and at 6, 12, 18, and 24 months after débridement vs. repair. *Significant difference ($P < .05$).

Table III Cuff integrity grade distribution between débridement and repair

	Sugaya MRI grade			Total
	I or II	III	IV or V	
Débridement	16	2	2	20
Repair	21	5	0	26
Total	37	7	2	46

MRI, magnetic resonance imaging.
Grade I and grade II were both classified as repaired cuffs with sufficient thickness, whereas grades IV and V were classified as cuff tears. The R $\times$ C χ^2 test was used for statistical analysis.

Table V Cuff integrity grade distribution between débridement and repair

	Barth B-US grade			Total
	I or II	III	IV or V	
Débridement	15	4	1	20
Repair	20	6	0	26
Total	35	10	1	46

B-US, B-mode ultrasonography.
Grade I and grade II were both classified as repaired cuffs with sufficient thickness, whereas grades IV and V were classified as cuff tears. The R $\times$ C χ^2 test was used for statistical analysis.

Table IV Muscle atrophy and fatty degeneration in patients with PTRCTs treated via débridement or repair

Variable	Débridement	Repair	*P* value
Atrophy (SSP)			
Preoperative	1.58 ± 0.66	1.55 ± 0.52	.733
Postoperative	1.67 ± 0.49	1.56 ± 0.69	.368
Fatty degeneration			
SSC			
Preoperative	0.89 ± 0.62	0.83 ± 0.93	.492
Postoperative	0.96 ± 0.81	1.07 ± 0.56	.439
SSP			
Preoperative	0.81 ± 0.75	0.81 ± 0.61	.920
Postoperative	0.89 ± 0.42	0.93 ± 0.77	.655
ISP			
Preoperative	0.98 ± 0.85	1.00 ± 0.53	.736
Postoperative	1.14 ± 0.62	1.17 ± 0.86	.794

PTRCT, partial-thickness rotator cuff tear; *SSP*, supraspinatus muscle; *SSC*, subscapularis muscle; *ISP*, infraspinatus muscle.
The Wilcoxon rank sum test was used for statistical analysis. The Goutallier score was used to assess fatty degeneration.
No statistically significant differences were found.

did not show any significant differences in the clinical outcomes between single-row and suture bridge treatment in the repair group for Ellman grade II bursal-side PTRCTs. However, the postoperative scoring systems and adjunctive examination findings showed that the débridement procedure achieved results comparable to or even better than those of suture repair.

Almost all patients in this study underwent acromioplasty for bursal-side tears. Although most doctors believe that intrinsic cuff degeneration is the principal reason for bursal-side PTRCTs, the cause may also be extrinsic factors, especially subacromial impingement. In this study, most patients had symptoms of impingement or subacromial bursitis, and preoperative radiologic examinations showed that >80% of patients had a type II or III acromion.[34] Furthermore, arthroscopy revealed obvious attrition or inflammation of the coracoacromial ligament in almost all patients. A previous cadaveric study also found an association between bursal-side tears and structural changes on the acromial undersurface.[24] Similarly, a clinical study suggested that subacromial impingement may be the main cause of bursal-side tears,[10] and other studies indicated that a protruding spur on the acromial undersurface is related to bursal-side tears.[15,22,34]

Our study demonstrated that arthroscopic débridement with acromioplasty is suitable for the treatment of Ellman grade II bursal-side PTRCTs. At 2 years of follow-up, there were no significant clinical differences between the débridement and repair groups in terms of functional scoring, MRI or B-US examination findings, and complications. We had expected the tendon repair would be the most effective method for treating bursal-side PTRCTs, especially when the subtype of a PTRCT is unclear on preoperative examination. However, débridement has at least 3 benefits for rehabilitation: (1) Effective removal of inflammatory tissue in the subacromial bursa reduces local pressure and reduces the symptoms of impingement or subacromial bursitis. (2) Freshening of the residual tendon tissue by débridement without destroying the integrity of the articular cuff creates a local environment that is conducive to tendon healing. (3) Postoperative pain caused by tendon imbalance after suturing is avoided, and the rest time for postoperative rehabilitation is reduced. Evidence from a randomized, placebo-controlled surgical trial has shown that only intraoperative irrigation effectively resolves subacromial shoulder pain.[3]

Many clinical and biomechanical studies have shown good results and discussed the mechanism of arthroscopic débridement in Ellman grade II bursal-side PTRCTs.[4,7,11,13,14,16-20,28,37] In many reports and conference speeches, the repair threshold has been lowered to recommend treatment of all tears that extend through >25% of the tendon thickness[6,12,33,35]; however, this remains controversial, and other authors have reported good or excellent outcomes after treating PTRCTs of <50% with débridement with or without subacromial decompression. Clinical studies have reported good outcomes of arthroscopic débridement and selective acromioplasty in patients with bursal-side PTRCTs of <50% tendon thickness.[7] However, a biomechanical study showed that the stress acting on the remaining normal tendons increases significantly when the tear depth exceeds 50%, which does not support the suture repair of Ellman grade II tears.[36] Although some reports have shown that débridement leads to a much higher rate of dissatisfaction or to progression into full-thickness RCTs,[6,12] we did not find an excessive rate of dissatisfaction during 2 years of follow-up, and there was no significant correlation between the surgical method and progression to full-thickness tears in our study.

Postoperative MRI and B-US were used in our study to determine the integrity and state of healing. In accordance with the Sugaya grading system for MRI and the Barth grading system for B-US, most of the repaired tendons were intact, and no obvious postoperative symptoms were observed in our study. Some articles have reported that the structural outcomes using the Sugaya MRI system range from 77.8% to 90.5% after arthroscopic repair of bursal-side PTRCTs.[14,18,23] Ultrasonography is also valuable in diagnosis and postoperative evaluation. A previous study reported that ultrasonography and MRI have comparable accuracy in the diagnosis of partial- and full-thickness RCTs.[30] Furthermore, ultrasonography is reportedly 80% sensitive and 98% specific for the detection of rotator cuff healing compared with MRI as the reference standard.[5]

This study has several limitations. First, this was a retrospective study with a relatively small sample size and short follow-up duration. Second, some concomitant procedures such as acromioplasty, synovectomy, or operations in the articular cavity were performed in combination with rotator cuff repair, which may have influenced the results. However, we do not think that these concomitant procedures would have affected the healing status. Third, bias cannot be excluded even though the MRI and B-US measurements and classification were performed twice by the most experienced experts in our department. Finally, the clinical results might have been affected by the increase in the experience and skills of the surgeons over time.

Conclusion

All 46 patients with Ellman grade II bursal-side PTRCTs were assessed for 2 years after arthroscopic surgery. The comparison of clinical scores and MRI and B-US examination findings showed that both débridement and repair achieved good clinical scores and low retear rates during 2 years of follow-up. However, compared with repair, débridement achieved better results during the early postoperative stage ($\leq$6 months postoperatively), caused less pain, and enabled a faster recovery. In summary, we do not consider rotator cuff repair to be essential in the treatment of Ellman grade II bursal-side PTRCTs. Arthroscopic débridement alone achieves comparable clinical outcomes during the first 2 years postoperatively.

Disclaimer

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Supplementary Data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jse.2020.03.006.

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