

## Original Article

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# Better short-term outcomes of mini-open rotator cuff repair compared to full arthroscopic repair

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**Background:** Rotator cuff tears commonly cause shoulder pain and functional impairment, prompting surgical intervention such as mini-open and arthroscopic methods, each with distinct benefits. This study aimed to compare the clinical outcomes and complications of these two approaches.

**Methods:** A retrospective analysis was conducted on 165 patients who underwent rotator cuff repair using either arthroscopic-assisted mini-open or full arthroscopic approaches. Patient demographics, tear characteristics, clinical outcomes, and complications were assessed, with statistical analyses conducted to discern differences between the groups.

**Results:** Among the patients, 74 (53.2%) received the mini-open approach, while 65 (46.8%) underwent arthroscopic repair, with a mean follow-up of 19.91 months. The mini-open group exhibited significantly higher postoperative American Shoulder and Elbow Surgeons (ASES) scores compared to the arthroscopic group ( $P=0.002$ ). Additionally, the mini-open group demonstrated a more significant improvement in ASES scores from preoperative to postoperative assessments ( $P=0.001$ ). However, the arthroscopic method had a significantly longer operative time ( $P<0.001$ ). Complications, including anchor placement issues, frozen shoulder, infection, and re-rupture, occurred in 17.3% of patients overall. Re-rupture rates were 13.5% for mini-open and 6.2% for full arthroscopic repair, with no significant difference between the two methods ( $P=0.317$ ).

**Conclusions:** Both the mini-open and arthroscopic methods yielded favorable clinical outcomes for rotator cuff tear treatment, but the mini-open group exhibited superior results. Surgeons should consider patient characteristics, tear attributes, and surgical expertise when selecting the appropriate technique.

**Level of evidence:** III.

**Keywords:** Rotator cuff tears; Mini open rotator cuff surgery; Arthroscopic rotator cuff surgery; Complications of rotator cuff surgery; Surgical techniques of rotator cuff surgery

## INTRODUCTION

Rotator cuff tears represent a prevalent cause of shoulder pain and functional impairment, affecting a significant number of individuals globally [1,2]. The management of rotator cuff tears aims to alleviate pain, restore shoulder function, and enhance

quality of life. Over time, various surgical techniques have emerged for repairing such tears, with both the mini-open and arthroscopic approaches being employed. The mini-open approach is common due to its capacity for direct visualization and anatomical repair of the torn rotator cuff tendons [3,4]. It facilitates meticulous debridement, preparation of the tendon foot-

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print, and secure fixation of the repair. However, it may necessitate larger incisions, potential detachment of the deltoid, and extended recovery time [5,6].

Conversely, arthroscopic techniques offer the advantage of a minimally invasive approach, involving smaller incisions and reduced disruption of soft tissue [7,8]. Arthroscopy enables excellent visualization of intra-articular structures, facilitating thorough examination, debridement, and repair of the rotator cuff [9,10]. Its popularity has grown due to the potential for faster recovery, decreased postoperative pain, and improved cosmetic outcomes [11].

This article aims to present a comprehensive review and comparison of the mini-open and arthroscopic methods in the treatment of rotator cuff tears. By analyzing existing literature, the researchers aimed to evaluate and compare the clinical outcomes, complications, retear rates, and patient satisfaction associated with each technique. In this study, the hypothesis posited that mini-open repair is superior to arthroscopic repair.

## METHODS

After obtaining approval from the Ethics Committee of İzmir Bakırçay University (No. 1121-1101), a retrospective analysis was conducted on 165 patients who underwent rotator cuff repair. Requirement for informed consent was waived because of the retrospective nature of this study. The surgeries were performed using either a fully arthroscopic or arthroscopy-assisted mini-open approach by a single surgeon. Patients diagnosed with rotator cuff tears through physical examination and magnetic resonance imaging (MRI) and who had not responded to conservative treatment were included. Exclusion criteria comprised a history of ipsilateral shoulder surgery, frozen shoulder (limitation of movement), glenohumeral instability, pseudo paralysis, rheumatologic diseases, Goutallier stage 4 fatty degeneration, glenohumeral arthrosis, or cuff arthropathy.

Arthroscopy-assisted mini-open repair was chosen for certain patients, while others underwent full arthroscopic repair, based on the surgeon's discretion. Several factors influenced the decision regarding the type of surgery for each patient. Additionally, patient-specific considerations influenced the selection of the surgical technique. Mini-open surgery was favored for individuals who were unable to tolerate prolonged surgical procedures. Conversely, the fully arthroscopic method was preferred by patients seeking cosmetically smaller scars, particularly those concerned about aesthetic outcomes. Moreover, obese patients tended to choose the fully arthroscopic approach, while thin patients were more inclined toward mini-open surgery. Throughout the course of fully arthroscopic repairs, certain patients were transitioned to mini-open surgery due to technical issues encountered

during the procedure. These technical challenges included device malfunction, camera fogging, and difficulties in controlling bleeding. Such transitions ensured the safety and efficacy of the surgical intervention, despite unforeseen technical obstacles encountered during the fully arthroscopic approach.

Demographic data, including age, sex, and affected side, were collected. Tears were considered as traumatic if the patient's complaints began and increased after trauma. Patients without trauma and who experienced gradually increasing pain were considered degenerative cases. Ruptured tendons were identified based on preoperative MRI and intraoperative evaluations. Cases in which there was a superior and posterior cuff tear in addition to a subscapularis tear were classified as a massive tear. Retraction degrees were categorized at the level of the tuberculum majus, humeral head, and glenoid according to the Patte classification [12]. Fatty degeneration grades were determined using the Goutallier classification [13]. Acromiohumeral distance was measured in the true anteroposterior (AP) position of the shoulder using direct radiographs [14]. Acromioclavicular joint arthrosis grading was conducted according to the Shubin-Stein classification [15]. Clinical evaluation using the American Shoulder and Elbow Surgeons (ASES) Score was performed before and after the operation. The preoperative clinical evaluation was conducted on the day before the surgery. Preoperative and postoperative control evaluations of the patients were made by the nurses working in the polyclinic. Only the postoperative analysis performed at the last visit were used as postoperative results. The minimum follow-up was 12 months. The change in ASES scores was calculated. The number of anchors used in patients was recorded, and the surgical duration was documented using anesthesia forms. Any complications were noted. Patients who experienced shoulder pain that did not resolve within 3 months after the operation or who had recurrent pain after initial improvement underwent an MRI to assess the possibility of re-rupture.

The surgical technique involved placing patients in the beach chair position on the operating table. Access to the shoulder joint was obtained through the posterior portal. An anteromedial portal was established, and the glenohumeral joint was inflated using a pump with 0.9% NaCl. Synovitis was addressed using a shaver and radiofrequency. The site of the tear was identified and prepared for repair through debridement. Biceps tenotomy was conducted in patients older than 50 years if there was pathology, followed by an incision in the lateral portal to access the subacromial region. Subacromial bursectomy and acromioplasty were performed using the shaver. In the group that continued with arthroscopy, anterolateral and posterolateral portals were opened. The tear was repaired using an anchor based on the size of the

tear. A single- or double-row repair was performed using a footprint anchor placed between the articular surface of the humeral head and the tuberculum majus. For patients undergoing mini-open repair, the subacromial region was accessed through an incision over the lateral portal. Repair principles were consistent with the arthroscopic approach.

Following surgery, patients were encouraged to start wrist-elbow movements immediately, followed by pendulum movements for the shoulder. Physical therapy commenced in the second week postoperatively, once swelling and pain subsided. Active shoulder movements were allowed during the 4th week of follow-up, and strengthening exercises were initiated between the 6th and 8th weeks after surgery.

During postoperative follow-up, patients experiencing persistent shoulder pain, limited motion, or wound site issues were evaluated for potential complications. Persistent pain and limited motion were expected to resolve within 3 months, while wound healing was anticipated within 10–15 days. Patients with ongoing shoulder symptoms underwent MRI after 3 months to assess for re-rupture. If shoulder motion remained limited after the 3rd month, frozen shoulder was considered. Wound discharge was monitored for signs of infection, and any anchor displacement or loosening observed on radiographs or MRI scans was considered an anchor placement issue.

### Statistical Analysis

IBM SPSS Statistics software version 22.0 (IBM Corp.) was utilized for this study. Mean and median values represented numerical data, while percentages conveyed categorical data. The Shapiro-Wilk test assessed data normality. Parametric tests analyzed normally distributed data, and nonparametric tests were applied for non-normally distributed data. Categorical data were evaluated using the chi-square test. A significance level of  $P < 0.05$  at a 95% confidence interval was deemed significant.

## RESULTS

Adequate clinical follow-up was achieved in 139 of the 165 patients included in the study. Among these patients, 74 (53.2%) underwent mini-open repair, while 65 (46.8%) underwent the arthroscopic method. The mean age of the patients was 55.93 years (ranging from 22 to 86 years), with there were 83 (59.7%) women and 56 men (40.3%). Ninety-seven patients (69.8%) had the right shoulder affected, and 42 patients (30.2%) had the left shoulder affected. The mean follow-up period was 19.91 months (ranging from 12 to 60 months). Degenerative tears were observed in 115 patients (83.1%), while 24 (17.3%) patients had traumatic tears.

Statistical evaluation revealed no significant difference between the two groups regarding age, sex, affected side, duration of control, and type of tear occurrence ( $P > 0.05$ ) (Table 1).

Supraspinatus tear was observed in 51.8% of cases, while supraspinatus and infraspinatus tears occurred in 35.3%, and massive tears were present in 12.9% of patients. Retraction of the tear was noted at the tuberculum major in 51.1% of cases, at the humeral head in 8.6%, and at the glenoid level in 40.3% of patients. According to MRI examination, 12.2% of patients had Goutallier stage 0, 14.4% had stage 1, 33.8% had stage 2, and 39.6% had stage 3 fatty degeneration. The mean acromiohumeral distance measured on direct radiographs was 8.29 mm ( $\pm 2.71$  mm). Acromioclavicular joint arthrosis grading is presented in Table 1. No significant difference was found between the two groups in terms of torn tendons, retraction degree, fatty degeneration, acromiohumeral distance, and acromioclavicular joint arthrosis degrees distribution ( $P > 0.05$ ) (Table 1).

In the clinical evaluation, preoperative ASES scores were 39.73 in the mini-open group and 41.92 in the arthroscopy group, with no statistically significant difference between the two groups ( $P = 0.056$ , t-test). Postoperative ASES scores were 92.47 in the mini-open group and 88.54 in the arthroscopy group, showing a statistically significant difference ( $P = 0.002$ , t-test). The difference between preoperative and postoperative ASES scores was 52.74 in the mini-open group and 46.62 in the arthroscopy group, with a significant difference between the two groups ( $P = 0.001$ , t-test). Comparing preoperative and postoperative ASES scores within each group revealed a positive improvement ( $P < 0.001$ , paired samples t-test). The mean operation time was 74.84 minutes in the mini-open group and 116.18 minutes in the arthroscopy group, with a statistically significant difference ( $P < 0.001$ , t-test).

Complications occurred in a total of 24 patients (17.3%). Among these, 11 (7.9%) were associated with anchor placement, defined as protrusion of the proximal end of the anchor from the bone on postoperative film or MRI. Secondary frozen shoulder (restriction of movements for more than 3 months) developed in six patients (4.3%). Infection occurred in two patients (1.4%), re-rupture in 14 patients (10.1%), and synovitis reaction in one patient (0.7%). A total of 36 patients underwent postoperative control MRI, revealing re-rupture in 14 and anchor placement problems in 11. There was no significant difference in complication rates between the two groups ( $P > 0.05$ ) (Table 2).

In the correlation analysis, age, preoperative and postoperative ASES scores, and acromiohumeral distance showed significant correlations. Specifically, acromiohumeral distance correlated with preoperative ASES scores, the difference between preopera-

**Table 1.** General demographic and radiological data of the patients

Variable		Mini-open	Arthroscopic	Total	P-value
Treatment modality		74 (53.2)	65 (46.8)	139	-
Age (yr)		56.89 ± 10.22	54.83 ± 9.91	55.93 ± 10.12	0.231 <sup>a)</sup>
Sex	Male	26 (35.1)	30 (46.2)	56 (40.3)	0.186 <sup>b)</sup>
	Female	48 (64.9)	35 (53.8)	83 (59.7)	
Side	Right	51 (68.9)	46 (70.8)	97 (69.8)	0.813 <sup>b)</sup>
	Left	23 (31.1)	19 (29.2)	42 (30.2)	
Follow-up (mo)		20.39 ± 9.34	19.35 ± 6.85	19.91 ± 8.26	0.462 <sup>a)</sup>
Formation	Degenerative	61 (82.4)	54 (83.1)	115 (82.7)	0.920 <sup>b)</sup>
	Traumatic	13 (17.6)	11 (16.9)	24 (17.3)	
Torn tendons	SS	35 (47.3)	37 (56.9)	72 (51.8)	0.377 <sup>b)</sup>
	SS+IS	30 (40.5)	19 (29.2)	49 (35.3)	
	Massive	9 (12.2)	9 (13.8)	18 (12.9)	
Reaction degree	Tuberculum majus	24 (32.4)	32 (49.2)	56 (40.3)	0.098 <sup>b)</sup>
	Humeral head	44 (59.5)	27 (41.5)	71 (51.1)	
	Glenoid	6 (8.1)	6 (9.2)	12 (8.6)	
Fatty degeneration (Gouttaliér)	0	9 (12.2)	8 (12.3)	17 (12.2)	0.759 <sup>b)</sup>
	1	9 (12.2)	11 (16.3)	20 (14.4)	
	2	24 (32.4)	23 (35.4)	47 (33.8)	
	3	32 (43.2)	23 (35.4)	55 (39.6)	
Acromiohumeral distance (mm)		8.41 ± 2.63	8.15 ± 2.82	8.29 ± 2.71	0.589 <sup>a)</sup>
AC joint arthrosis (Shubin-stein)	1	9 (12.2)	5 (7.7)	14 (10.1)	0.443 <sup>b)</sup>
	2	31 (41.9)	36 (55.4)	67 (48.2)	
	3	26 (35.1)	18 (27.7)	44 (31.7)	
	4	8 (10.8)	6 (9.2)	14 (10.1)	

Values are presented as number (%) or mean ± standard deviation.

SS: supraspinatus, IS: infraspinatus, AC: acromioclavicular.

<sup>a)</sup>t-test; <sup>b)</sup>Pearson chi-square.

**Table 2.** Complications

Complication	Mini-open	Arthroscopic	Total	P-value
Total complication	15 (20.3)	9 (13.8)	24 (17.3)	0.317 <sup>a)</sup>
Anchor placement problem	5 (7.7)	6 (8.1)	11 (7.9)	0.928 <sup>a)</sup>
Frozen shoulder	2 (2.7)	4 (6.2)	6 (4.3)	0.418 <sup>b)</sup>
Infection	1 (1.4)	1 (1.5)	2 (1.4)	1.000 <sup>b)</sup>
Re-rupture	10 (13.5)	4 (6.2)	14 (10.1)	0.150 <sup>a)</sup>

Values are presented as number (%).

<sup>a)</sup>Pearson chi-square test; <sup>b)</sup>Fisher's exact test.

tive and postoperative ASES scores, and the number of anchors used (Pearson correlation test) (Table 3).

## DISCUSSION

The treatment of rotator cuff tears poses a significant challenge for orthopedic surgeons, who strive to relieve pain, restore shoulder function, and enhance patients' quality of life. Among the surgical options available, the mini-open and arthroscopic ap-

proaches stand out as commonly used techniques. The mini-open method provides direct visualization and precise repair of the torn rotator cuff tendons, whereas the arthroscopic approach offers minimally invasive surgery characterized by smaller incisions and less soft tissue disturbance.

The mini-open approach has long been preferred for its ability to offer a clear surgical field, meticulous debridement, precise preparation of the tendon footprint, and secure fixation of the repair. Previous studies have demonstrated favorable clinical out-

comes associated with the mini- open technique, particularly for larger tears and cases involving retracted tendons [3,16]. However, this method may necessitate larger incisions and potential deltoid detachment, which can result in longer recovery periods [5,17]. In this study’s patient cohort, the researchers observed superior clinical outcomes in the mini-open group, as evidenced by the more significant improvement in both preoperative and post-operative ASES scores (Table 4).

Arthroscopic techniques have gained in popularity owing to their minimally invasive nature, resulting in smaller incisions, decreased postoperative discomfort, and enhanced aesthetic outcomes. Arthroscopy enables exceptional visualization of intra-articular structures, facilitating thorough examination, debridement, and rotator cuff repair [10,18]. While the arthroscopic approach has shown favorable clinical outcomes, particularly for smaller and less complex tears [7,19], this study revealed a significant disparity in clinical scores between the arthroscopic and mini-open groups, despite similar demographic characteristics such as tear retraction, torn tendons, and acromiohumeral distance (Tables 1 and 4). Nonetheless, complication rates were comparable between the two groups (Table 2).

Several studies have undertaken comparisons between the clinical outcomes and complications linked to mini-open and arthroscopic methods. For instance, Nho et al. [20] examined 113 patients who underwent either mini-open or arthroscopic repair and found no notable disparity in clinical outcomes, range of motion, or retear rates between the two techniques. Similarly, Barnes et al. [21] conducted a study yielding comparable results, with no significant discrepancies observed in clinical outcomes or complication rates between the two groups.

Operative time is a critical consideration, impacting both surgeons and patients. In this study, the arthroscopic method exhibited a significantly longer operative duration compared to the mini-open approach (Table 4). This aligns with prior research, where arthroscopic repair often necessitates more time due to its complexity [3,4,21,22]. Surgeons should consider this factor when selecting the surgical approach, as prolonged operative times may elevate complication risks and potentially affect healthcare expenses [22].

Complication rates are pivotal considerations in surgical procedures. In this study, complications occurred in 17.3% of patients, with no significant difference between the mini-open and ar-

**Table 3.** Correlations

Correlation	Preoperative ASES score	Postoperative ASES score	Preoperative difference	Number of anchors	Acromiohumeral distance
Age	0.007	0.015	0.957	0.150	<0.001
	-0.228	-0.206	-0.005	0.123	0.139
Preoperative ASES score	-	0.536	<0.001	<0.001	<0.001
		-0.053	-0.682	-0.439	0.393
Postoperative ASES score	-	-	<0.001	0.228	0.284
			0.766	-0.103	0.092
Preoperative difference	-	-	-	0.014	0.029
				0.207	-0.186
Number of anchors	-	-	-	-	0.001
					-0.272

ASES: American Shoulder and Elbow Surgeons.

**Table 4.** Preoperative and postoperative clinical results of the patients, the number of anchors used, and the duration of surgery

Clinical result	Mini-open	Arthroscopic	Total	P-value <sup>a)</sup>
Preoperative ASES score	39.73 ± 6.41	41.92 ± 6.94	40.76 ± 6.73	0.056
Postoperative ASES score	92.47 ± 7.74	88.54 ± 7.06	90.63 ± 7.66	0.002
Pre- and postoperative ASES score difference	52.74 ± 9.39	46.62 ± 10.72	49.88 ± 10.46	0.001
Number of anchors used	1.35 ± 0.58	1.54 ± 0.61	1.44 ± 0.60	0.069
Surgical time (min)	74.84 ± 8.92	116.18 ± 12.18	94.17 ± 23.23	<0.001

Values are presented as mean ± standard deviation.

ASES: American Shoulder and Elbow Surgeons.

<sup>a)</sup>t-test.

throscopic groups (Table 2). The most frequent complications included re-rupture, anchor placement issues, secondary frozen shoulder, infection, and synovitis. These results align with prior research, which has reported similar complication rates across techniques [3,4,22]. However, the researchers in the present study did not routinely conduct postoperative shoulder MRI or ultrasound on all patients; MRI was only performed on symptomatic patients. This approach may have led to a type II error, as asymptomatic re-rupture cases could have been missed. Nonetheless, the clinical significance of asymptomatic re-ruptures remains controversial [23,24].

The clinical significance of acromiohumeral distance remains elusive, with decreased distance often associated with impingement and rotator cuff tears. While some studies have suggested a correlation between clinical findings and acromiohumeral distance [25,26], debates persist regarding its role in determining prognosis following repair. The present study found a clinical correlation between preoperative evaluation and distance, but no positive relationship was found with postoperative clinical scores. Additionally, the findings revealed a negative relationship between postoperative clinical score progression and distance; namely, shorter distances were associated with greater changes in clinical scores.

It is essential to consider several factors when selecting the surgical approach for rotator cuff repair, including tear size, tissue quality, surgeon expertise, and patient characteristics. Larger tears, retracted tendons, and cases with poor tissue quality may benefit from the mini-open technique as it offers superior visualization and enables more extensive repair. Direct access to the rotator cuff in the mini-open method facilitates easier anchor placement, particularly for second-row anchors, which can be confirmed visually. Palpation allows assessment of knot stability, which may contribute to a more stable repair compared to arthroscopic techniques. The technical challenges associated with arthroscopic repair may result in less predictable knot stability, potentially influencing clinical outcomes.

While this study offers valuable insights into mini-open and arthroscopic methods for rotator cuff tears, it is essential to acknowledge several limitations. First, its retrospective design introduced inherent biases, such as selection bias and lack of randomization. Additionally, the absence of routine MRI or ultrasound follow-up in all patients may have led to underestimation of re-rupture rates. Furthermore, the relatively short minimum follow-up period of 12 months may not capture the long-term outcomes and potential complications associated with the surgical techniques. Future research should address these limitations by employing prospective designs and longer follow-up periods to enhance the validity and generalizability of the study findings.

## CONCLUSIONS

Both the mini-open and arthroscopic methods have demonstrated favorable clinical outcomes in treating rotator cuff tears. The mini-open approach, with its direct visualization and anatomical repair capabilities, is suitable for more retracted and complex tears. Despite a significant difference favoring the mini-open group, the ASES scores of the arthroscopic group remained high. Conversely, arthroscopic techniques offer the benefits of minimally invasive surgery, smaller incisions, and reduced soft tissue disruption. The choice of technique should consider tear characteristics, tissue quality, surgeon expertise, and patient preferences. Future research, including prospective randomized controlled trials, may offer further insights into the long-term outcomes and comparative effectiveness of these surgical approaches.

## NOTES

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### Conflict of interest

None.

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### Data availability

Contact the corresponding author for data availability.

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