Outcomes of all arthroscopic versus open rotator cuff repair

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Background and aim
A rotator cuff injury has a significant effect on the quality of life and overall health of patients. Surgical treatment for rotator cuff disease has been found to enhance general health and shoulder discomfort. The surgical repair of rotator cuff tears can be divided into three categories: open, mini-open, and arthroscopic. Independent studies comparing the long-term success of arthroscopically repaired rotator cuff injuries in terms of cuff integrity and clinical outcomes found that arthroscopically repaired rotator cuff injuries have success rates comparable to mini-open and open operations. As a result, the goal of this study was to compare the outcomes of open versus arthroscopic rotator cuff repair operations.
Patients and methods
A prospective cohort study was performed on 40 rotator cuff repair cases over a period of 18 months from January 2019 to June 2020 after obtaining approval from the local ethics committee. All included patients were divided into two groups: group A included 20 patients who had a single raw, arthroscopic rotator cuff repair, and group B included 20 patients who had an open rotator cuff repair by anchor sutures and acromioplasty. Data of shoulder side, admission date, discharge date, hospital stay duration, postoperative analgesia, procedure duration, intraoperative and postoperative complications, visual analog scale (VAS), and simple shoulder test were obtained for all patients.
Results
There were no significant changes in pain score VAS preoperatively and postoperatively or intraoperative and postoperative complications between the groups tested.
Conclusion
Arthroscopy repair and open repair are associated with similar clinical outcomes. No statistically significant differences were found in outcomes of postoperative simple shoulder test score, pain score VAS, and complications.

Keywords:
arthroscopic, cuff repair, open repair, pain score visual analog scale, simple shoulder test

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Introduction

A rotator cuff injury has a significant effect on the quality of life and overall health of patients. Surgical treatment for rotator cuff disease has been found to improve general health and shoulder discomfort [1]. Even in asymptomatic patients in the general community, full-thickness rotator cuff injuries are rather common. Rotator cuff tears are found in 20–54% of individuals older than 60 years, and 51–80% of patients older than 80 years, according to studies on asymptomatic patients [1,2]. The surgical repair of rotator cuff tears can be divided into three categories: open, mini-open, and arthroscopic. Regardless of the surgical method used, according to Neer [3], the goals of rotator cuff repair are to preserve or carefully repair the deltoid origin; adequately decompress the subacromial space; obtain freely mobile muscle–tendon units through surgical release, as needed; fix the tendon to the greater tuberosity; and prevent postoperative adhesions and subsequent stiffness without disrupting the repair by a closely monitored resurfacing procedure [4]. Gartsman *et al.* [5] published the first report of all arthroscopic procedures for rotator cuff repair in 1998. With a 2-year follow-up on 73 patients at Texas Orthopedic Hospital in Houston, the average satisfaction score improved from 0.4 to 4.6 points, with good to excellent UCLA outcomes in 84–92%. Many categorization schemes have been used to classify randomized controlled trial based on the morphology, topography, and thickness of the rotator cuff tear. Chillemi *et al.* [6] define the randomized controlled trial as a partial-thickness tear depending on which surface is involved (articular grade 1–3/ bursal side grade 1–3) and the magnitude of the tear (3, 3–6, and >6 mm). Synder divides the partial

lesion into five subcategories and divides it into two types: (a) articular side tear and (b) bursal side tear [6]. Severity of tear is classified as follows: 0, a normal rotator cuff with synovitis or bursitis is a minimal lesion, 1, 1 cm of superficial fraying, 2, 2 cm of tendon degeneration without flap lesions which is difficult to treat, 3, tendon degeneration involving the entire tendon 3 cm, and 4, severe tendon degeneration frequently accompanied by a large flap that often involves two tendons [7]. Subcategories 0, I, and II do not require specific treatment or just a slight debridement and/or acromioplasty, whereas complex lesions (subcategories III and IV) require the repair of the lesion with the transtendon technique or arthroscopic tear completion and repair [8]. Barth *et al.* [9] developed a geometric classification of rotator cuff tears based on four types of lesions – evaluating the length (L) (medial to lateral) and width (W) (anterior to posterior) of the tear, as well as information on the possibility of repair: 'crescent tear' is the first type, which is a wide and short lesion (L<W); type II is a 'U' or 'L' form lesion, easily repairable. It has a long and narrow shape (L>W). These lesions can be moved from the front to the back and treated by bringing the margins together with 'side-to-side' sutures; type III tear is large and retracted, with repairability in parts; and type IV is a type III tear associated with glenohumeral arthropathy is very long (particularly difficult to reattach the lateral border up to the greater tuberosity) and wide (not suited for a side-to-side repair) [9]. As the subacromial space narrows, the humeral head migrates higher until it makes direct contact with the acromion's anteroinferior border. It is not possible to repair [6]. The trend has been toward all-arthroscopic repair of rotator cuff tears, thanks to recent technological breakthroughs in general arthroscopic instruments and rotator cuff repair-specific equipment [10]. Reduced immediate postoperative discomfort, reduced surgical insult to the deltoid, and reduced postoperative stiffness are all theoretical benefits of this method [11]. These effects could lead to a faster return to function and job, as well as higher patient satisfaction [12]. However, some people have been hesitant to move to all-arthroscopic repairs because of worries regarding repair integrity, functional degradation, and the difficulty of mastering this method [13]. Although studies examining the long-term success of arthroscopically repaired rotator cuff injuries in terms of cuff integrity and clinical outcomes have found success rates comparable to those of mini-open and open procedures, randomized controlled trials comparing these two approaches are lacking [14]. Therefore, the current study aimed to evaluate outcomes and complications of open and arthroscopic rotator cuff repair procedures.

Patients and methods

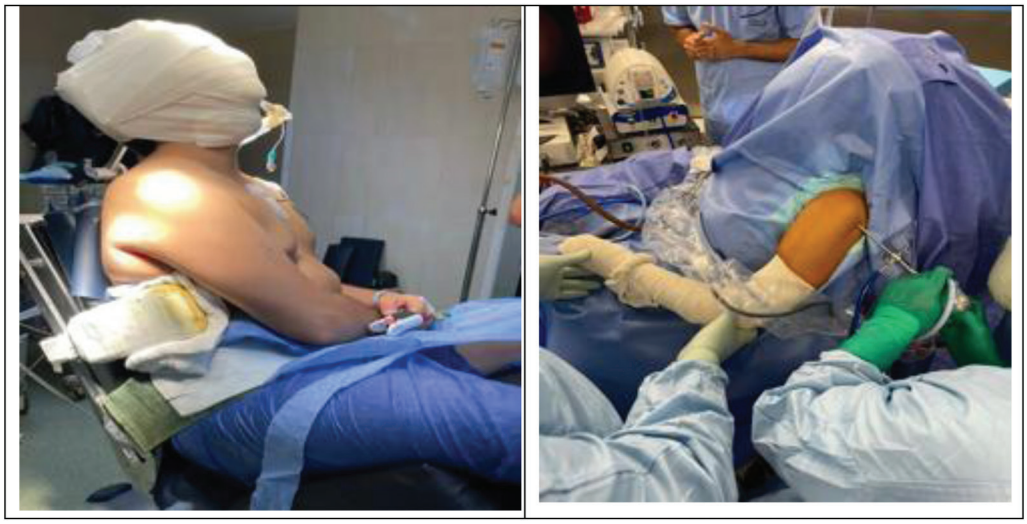
A prospective cohort study including 40 rotator cuff repair cases was performed over a period of 18 months from January 2019 to June 2020 after obtaining approval from the local ethics committee. Patients who agreed to participate gave their signed informed consent after explanation of the trial benefits and hazards. All procedures were carried out in line with the institutional and/or national research committee's ethical standards, as well as the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The trial was registered with the Helwan University Faculty of Medicine's local ethics committee.

All included patients were divided into two groups: group A (single raw, arthroscopic rotator repair) included 20 patients, who underwent the procedure in beach chair position (Fig. 1), adrenalin was added to the irrigation fluid, with low systolic blood pressure control, and a 40–60-mmHg arthroscopic pump was used.

Intra-articular shoulder structures; rotator interval, instability, or unstable SLAP lesions in the superior labrum and biceps tendon. Examination was done of the long head of the biceps tendon, the superior glenohumeral ligament, the middle glenohumeral ligament, the subscapularis tendon, the anteroinferior labrum, the inferior glenohumeral ligament complex and the axillary recess, the posterior labrum, the posterior superior labrum, the attachment of the supraspinatus tend, assess the articular surface, the bare area, capsular attachment to the humerus visualized both anteriorly and posteriorly (Fig. 2). A posterolateral viewing technique and a lateral working approach were used for subacromial decompression. Examination was done of the subacromial space, inferior acromion, undersurface of the coracoacromial ligaments, subacromial bursa, and rotator cuff with the trocar aimed under the acromion toward the anterolateral acromion edge and coracoid. A normal postoperative radiograph was taken to ensure proper anchor placement.

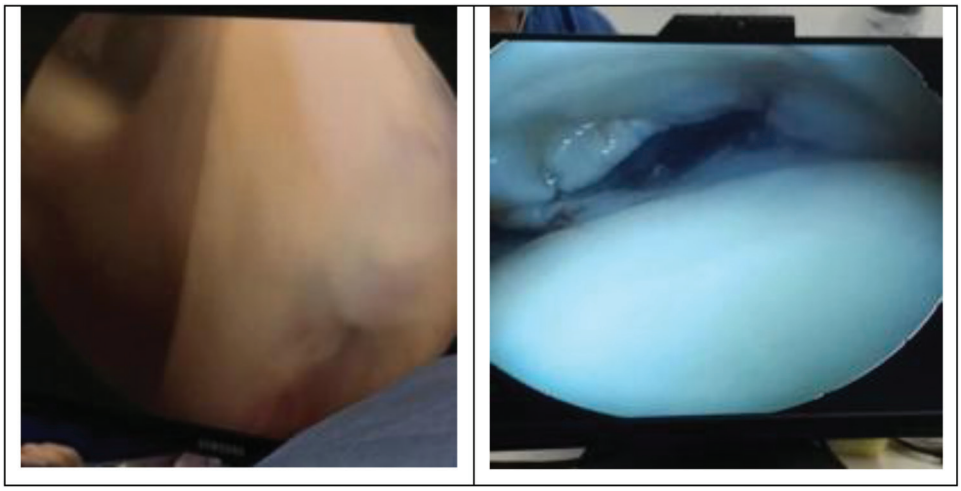
Group B included 20 patients who had an open rotator cuff repair by anchor sutures and acromioplasty. The open subacromial decompression is followed by a deltoid-splitting technique for the repair in a mini-open rotator cuff repair. Although there has been some debate regarding whether a subacromial decompression

Figure 1



Beach chair position.

Figure 2



Intra-articular structures and rotator cuff tear.

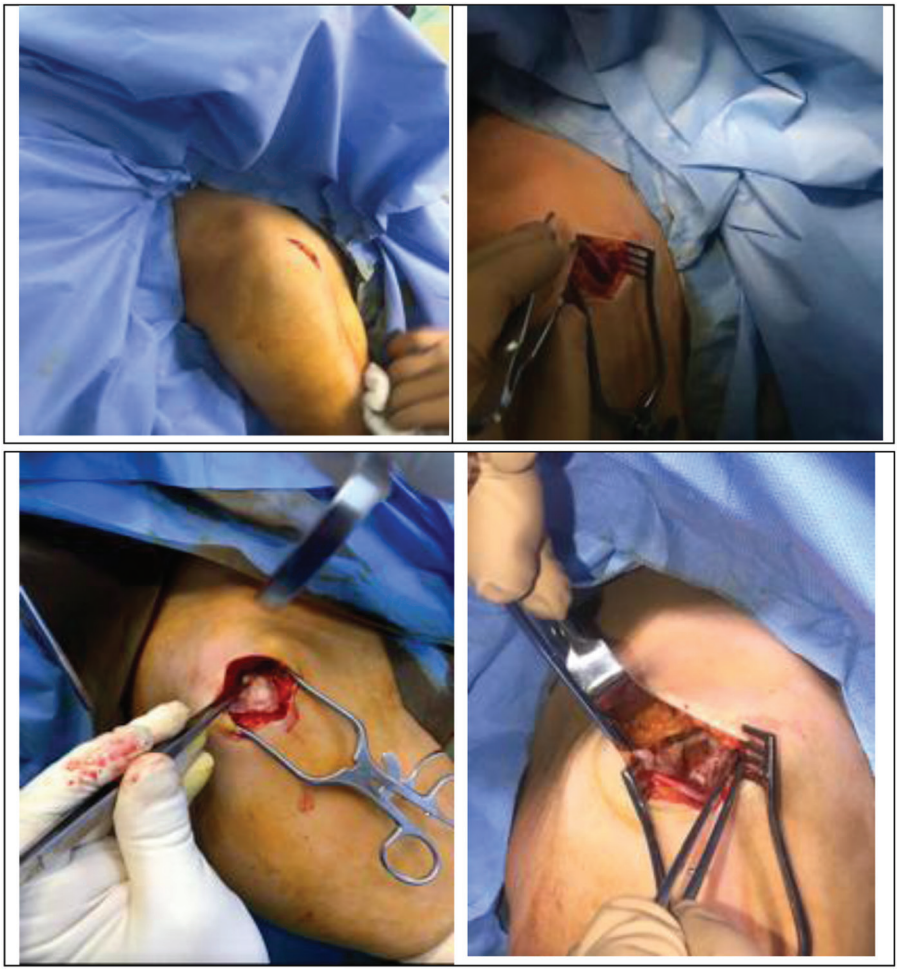
is necessary in the presence of a rotator cuff injury, we typically conduct one in our study. A 3–4-cm skin incision was made from the acromion's anterolateral edge distally, and the raphe between the anterior and middle deltoid was dissected. A stay suture was put distally to prevent the deltoid split from spreading and possibly injuring the axillary nerve. The subacromial area is entered after the deltoid is separated (Fig. 3).

Bursectomy increased visualization throughout the procedure, especially laterally. The tendon edges are debrided softly. At this stage, threading was done of the needle through the cuff's edge. The focus is shifted to exposing the rest of the tendon. Self-retaining retractors with a blunt tip can assist in keeping the deltoid fibers apart, but they should be used with caution to avoid excessive pressure and deltoid necrosis. After removing the hypertrophic bursal tissue around the split site to increase visualization, the torn tendon was tagged with traction sutures.

Transosseous anchoring fixation or osseous fixation are both options for achieving bony fixation. Anchors are placed in the cuff's footprint or anatomic insertion, and their location is chosen to enable for an equal healing of the tendon edge without putting too much strain on one part of the cuff (Fig. 4).

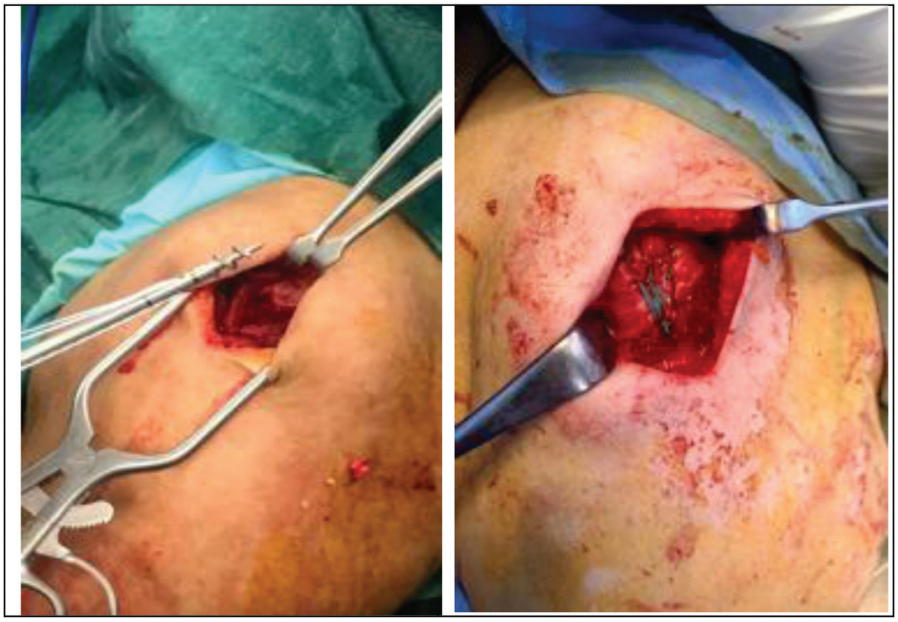
After surgery, all patients were required to wear an arm sling for 6 weeks. We employed the traditional rehabilitation protocol for the open repairs, which included early passive elevation followed by vigorous activities. In the first 6 weeks after the arthroscopic repairs, the patient was directed to do only assisted external rotation with a stick, and then elevation was started at week 7.

Figure 3



Open rotator cuff repair.

Figure 4



Open transosseous anchor fixation of rotator cuff tear.

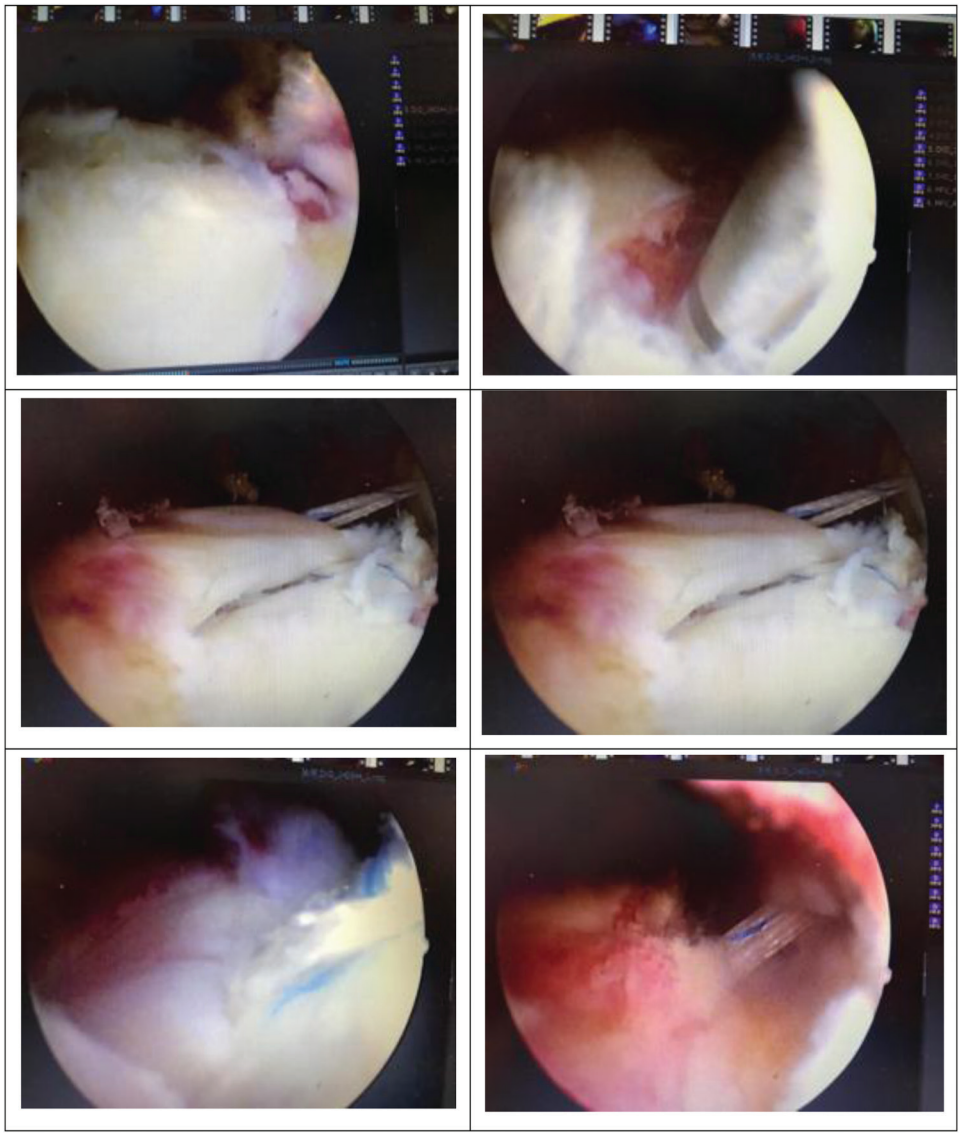
Surgical technique

All of the patients were operated on while sitting in a beach chair. A diagnostic arthroscopy was always performed first to evaluate the extent of the lesion and the number of tendons implicated. Following debridement, the size of the cuff rim was measured with a 5-mm calibrated probe and categorized according to its largest diameter, as indicated by DeOrio and Cofield [15]. We used braided polyester sutures for all cuff repairs (No. 2 or 3 Ethibond; Ethicon, Somerville, New Jersey, USA).

In group A (arthroscopic repair), in a beach chair position, we utilized 3 kg of anterior traction. A traditional open cuff repair with open acromioplasty and tendon restoration employing Mason-Allen sutures passed via bone channels in the tuberosity was performed on 20 shoulders in group B (open repair).

The posterolateral viewing and lateral working portals, the latter with an 8.25-mm cannula, were the most essential portals into the subacromial area [16]. We employed radiofrequency to reduce bleeding, added adrenalin to the irrigation solution, and urged the anesthesiologist to keep the systolic blood pressure below 90 mmHg if possible. An arthroscopy pump was used to maintain 40–60-mmHg fluid pressure, which could be temporarily increased on demand. Swelling is more likely when the fluid pressure is high. Mattress sutures were passed through the edge of the cuff with the use of the curved and straight suture hooks after clearing the subacromial space by bursectomy, debriding the cuff, and preparing the tuberosity with a shaver (Linvatec, Largo, Florida, USA). Depending on the size of the tear, one to five suture anchors (Mitek super; Mitek, 325 Paramount Drive Raynham, MA, USA) were employed (Fig. 5). On the articular and bursal

Figure 5



Arthroscopic transosseous anchor fixation of rotator cuff tear.

aspects of the cuff tendons, releases were performed when needed. The notion of margin convergence was used to combine intratendinous side-to-side and tendon-to-bone restoration in big U-shaped injuries (Fig. 5) [17].

An acromioplasty was performed at the end of the procedure to remove anterior and lateral bone spurs. The coracoacromial ligament was routinely freed at the start of the procedure, but bone resection was postponed until the conclusion, allowing us to better manage bleeding.

Outcome measurement

Preoperatively and at 1, 3, and 6-month follow-up visits, a visual analog scale (VAS) was used to assess pain (0, no pain and 10, maximum pain). Sex, shoulder side, admission date, release date, length of stay in hospital, postoperative analgesia, operation time, and intraoperative and postoperative problems are among the variables.

Simple shoulder test (SST) by Matsen *et al.* [18] contains 12 questions and serves as a realistic patient-based shoulder evaluation tool. The SST consists of 12 yes/no questions: two questions about pain, four questions about mobility, three questions about strength, and three questions about function. The affirmative has to be unequivocal in our evaluation; duplicate or intermediate crosses in the yes/no situation did not count. In general, a healthy shoulder should receive 12 yes responses. Some patients, on the contrary, stated that they could not throw a softball 20 m overhand with their healthy nondominant shoulder. This may in part explain the lower scores for question number 10 (Table 1).

Statistical analysis

Results were tabulated and statistically evaluated using a standard computer program (Microsoft Excel 2019 and SPSS V.25 for Microsoft Windows 10) (Version 25.0. Armonk, NY: IBM Corp., IBM Corp. Released 2019. IBM SPSS Statistics for Windows). There were two sorts of statistics used: descriptive statistics, such as mean±SD for quantitative data and frequency and proportion for qualitative data, were used to describe the data. χ^2 test (t), independent t test, paired t test, Mann–Whitney U test, Fisher's exact test, and Spearman correlation are examples of analytical statistics. The significance was determined using a P value of 0.05.

Flowchart of the studied patients under arthroscopic and open rotator cuff repair.

Results

A total of 40 patients were included in this study, with 20 undergoing arthroscopic rotator cuff repair and 20 undergoing open rotator cuff repair. Patients' ages ranged from 30 to 70 years old, with the majority of them being men. In terms of age, sex, hospital stay, and SST (X/12), there were no significant differences between the two groups (P>0.05). However, the surgery took significantly longer in group A (97.37 ± 28.59 min) than in group B (75.24 ± 21.48 min) (P<0.05) (Table 2).

There were no significant variations in pain score VAS preoperatively and postoperatively between the groups tested (P>0.05) (Table 3).

Between the two groups studied, there was a highly significant improvement in pain score VAS postoperatively (after 1, 3, and 6 months) compared with preoperatively (P>0.001). When compared with preoperative scores (9.37 ± 0.68 and 9.62 ± 0.49), VAS scores reduced considerably after 1 month (5.89 ± 1.8 and 5.76 ± 1.34), 3 months (3.37 ± 1.97 and 3.19 ± 1.81), and 6 months (1.32 ± 2.19 and 1.24 ± 2.19) in groups A and B, respectively (Table 4, Fig. 2).

Figure 2 shows VAS postoperative changes compared with preoperative scores among the two groups.

Table 1 Simple shoulder test according Matsen *et al*. [18]

	Yes	No
1. Is your shoulder comfortable with your arm at rest by your side?		
2. Does your shoulder allow you to sleep comfortably?		
3. Can you reach the small of your back to tuck in your shirt with your hand?		
4. Can you place your hand behind your head with the elbow straight out to the side?		
5. Can you place a coin on a shelf at the level of your shoulder without bending your elbow?		
6. Can you lift .5 kg (bag of sugar) to the level of your shoulder without bending the elbow?		
7. Can you lift 4 kg (a full gallon container) to the level of the top of your head without bending your elbow?		
8. Can you carry 10 kg (a bag of potatoes) at your side with the affected extremity?		
9. Do you think you can toss a softball underhand 10 m with the affected extremity?		
10. Do you think you can throw a softball overhand 20 m with the affected extremity?		
11. Can you wash the back of the opposite shoulder with the affected extremity?		
12. Would your shoulder allow you to work fulltime at your regular job?		

Table 2 Demographic data among the two groups

Variables	All studied patients		*t*	*P* value	95% CI	
	Group A (*N*=20)	Group B (*N*=20)			Lower	Upper
Age (year)						
Mean±SD	53.16±10.17	55.19±15.02	0.496	0.623	−10.33	6.27
Range	30.00–70.00	30–70				
Sex	*n* (%)	*n* (%)				
Male	11 (55.0)	14 (70.0)	χ^2=0.327	0.567	–	–
Female	9 (45.0)	6 (30.0)				
Side						
Right	14 (70.0)	17 (85.0)	χ^2=0.302	0.583	–	–
Left	6 (30.0)	3 (15.0)				
Postoperative angle						
50×1=50	7 (35.0)	1 (5.0)	FE=18.763	<0.001*	–	–
50×2=100	13 (65.0)	7 (35.0)				
50×3=150	0	12 (60.0)				
Stay in hospital (days)						
Mean±SD	1.32±0.48	1.52±0.51	1.325	0.193	−0.526	0.11
Range	1–2	1–2				
Procedure duration (min)						
Mean±SD	97.37±28.59	75.24±21.48	2.785	0.008*	6.041	38.22
Range	60–140	45–120				
SST (X/12)						
Mean±SD	12.05±3.66	10.48±3.53	*U*=1.386	0.174	−0.726	3.88
Range	4–19	3–20				

CI, confidence intervals; FE, Fisher exact test; SST, simple shoulder test; *t*, independent *t* test; *U*, Mann–Whitney test; χ^2, χ^2 test. *Significant.

Table 3 Pain score visual analog scale preoperatively and postoperatively among the two groups

Pain score VAS	All studied patients		*U*	*P* value	95% CI	
	Group A (*N*=20)	Group B (*N*=20)			Lower	Upper
Preoperative						
Mean±SD	9.37±0.68	9.62±0.49	1.334	0.19	−0.631	0.129
Range	8.00–10.00	9.00–10.00				
Postoperative						
1 month						
Mean±SD	5.89±1.8	5.76±1.34	0.267	0.791	−0.873	0.1.139
Range	3.00–8.00	4.00–8.00				
3 months						
Mean±SD	3.37±1.97	3.19±1.81	0.297	0.768	−1.033	1.389
Range	1.00–7.00	1.00–8.00				
6 months						
Mean±SD	1.316±2.19	1.24±2.19	0.12	0.905	−1.237	1.39
Range	0.00–7.00	0.00–6.00				

CI, confidence intervals; *U*, Mann–Whitney test; VAS, visual analog scale; χ^2, χ^2 test.

In terms of intraoperative and postoperative complications, there were no significant differences between the groups evaluated (*P*>0.05) (Table 5).

Except for the ability to wash the back of the opposite shoulder with the affected extremity, which was considerably increased in group B compared with group A, there was a significant difference between the analyzed groups for all outcomes (*P*<0.05) (Table 6).

Moreover, SST was also associated with sex, postoperative analgesia, and surgical complications (*P*<0.05). On the contrary, no significant link between shoulder side and intraoperative problems was discovered (*P*>0.05) (Table 7).

Moreover, sex, shoulder side, and SST did not exhibit any association with rotator cuff detection, according to the results of multiple logistic regression analysis (*P*>0.05) (Table 8).

Moreover, SST was also associated with sex, preoperative and postoperative VAS scores, and postoperative morbidity (*P*<0.05). Although there

Table 4 Visual analog scale postoperative in comparison with preoperative among the two groups

Follow-up	Group A (*N*=20)			Group B (*N*=20)		
	VAS score	*t*	#*P* value	VAS score	*t*	#*P* value
Preoperatively						
Mean±SD	9.37±0.68	–	–	9.62±0.49	–	–
Range	8.00–10.00			9.00–10.00		
1st month postoperatively						
Mean±SD	5.89±1.8	10.59	<0.001	5.76±1.34	13.07	<0.001
Range	3.00–8.00			4.00–8.00		
3rd months postoperatively						
Mean±SD	3.37±1.97	17.54	<0.001	3.19±1.81	16.32	<0.001
Range	1.00–7.00			1.00–8.00		
6th months postoperatively						
Mean±SD	1.32±2.19	17.93	<0.001	1.24±2.19	19.33	<0.001
Range	0.00–7.00			0.00–6.00		

VAS, visual analog scale. #Paired *t* test used to compare VAS score after 1, 3, and 6 months postoperatively compared with preoperatively.

Table 5 Intraoperative and postoperative complications among the two groups

Variables	Group A (*N*=20) [*n* (%)]	Group B (*N*=20) [*n* (%)]	χ^2	*P* value
Intraoperative complications				
No	17 (85.0)	19 (95.0)		
Extravasation	3 (15.0)	0	4.021	0.134
Deltoid splitting prop	0	1 (5.0)		
Postoperative complications				
No	16 (80.0)	17 (85.00)		
Stiffness	4 (20.0)	2 (10.0)	1.221	0.543
Superficial skin infection	0	1 (5.0)		

χ^2, χ^2 test.

was no significant link between SST and procedure length or intraoperative problems, there was a link between SST and VAS preoperatively, 1 month postoperatively, 3 months postoperatively, 6 months postoperatively, and complications postoperatively (P>0.05) (Table 9).

Discussion

Rotator cuff injury has a profound effect on patients' quality of life and overall health. The surgical repair of rotator cuff tears can be divided into three categories: open, mini-open, and arthroscopic [19]. According to Neer [3], the goals of rotator cuff repair are to preserve or carefully repair the deltoid origin; adequately decompress the subacromial space; obtain freely mobile muscle–tendon units through surgical release, as needed; fix the tendon to the greater tuberosity; and prevent postoperative adhesions and subsequent stiffness without disrupting the repair through a closely monitored rehabilitation program [3]. As a result, the goal of this study was to compare the outcomes and risks of open versus arthroscopic rotator cuff repair operations. This is a prospective cohort study that included 40 rotator cuff repair cases performed over a period of 18 months from January 2019 to June 2020. All cases were divided into two groups: group A (single raw, arthroscopic rotator repair), which included 20 patients, who underwent the procedure in beach chair position, adrenalin was added to the irrigation fluid, with low systolic blood pressure control, and 40 mmHg arthroscopic pump was used, and group B, which included 20 patients who had an open rotator cuff repair by anchor sutures and acromioplasty.

There were no significant differences between the two groups in terms of age, sex, hospital stay, or SST, according to the current study. The process took much longer in group A (97.37±28.59 min) than in group B (75.24±21.48 min). Lindley and Jones [13] observed no statistically significant differences in the number of patients in all arthroscopic or mini-open repair groups, as well as sex, mean age, mean preoperative duration of symptoms, or tear size between groups of patients. Verma *et al.* [20] also discovered that the average age of patients at the time of surgery was 60.0 years (range, 37.0–75.0 years). In terms of age, sex, rip size, surgical side, or SST score, no statistical differences were seen between groups. Pearsall *et al.* [21] also studied 31 girls and 21 males. The average age of the two groups was similar [arthroscopic x=55 years (range, 38–78), P=0.7] [mini-open x=58 years (range: 41–76)]. A total of 27 patients had their knees repaired arthroscopically, whereas 25 had their knees repaired with a mini-open

Table 6 Outcomes in comparison between the two groups

Variables	Group A (*N*=20) [*n* (%)]	Group B (*N*=20) [*n* (%)]	χ^2	*P* value
Shoulder rest and arm at side				
Yes	20 (100.00)	20 (100.00)	NA	–
No	0	0		
Sleep comfortably				
No	3 (15.0)	3 (15.00)	0.00	1.00
Yes	17 (85.0)	17 (85.00)		
Ability to reach the small part of back				
No	3 (15.0)	3 (15)	0.00	1.00
Yes	17 (85.0)	17 (85.00)		
Ability to place your hand behind head				
No	3 (15.0)	3 (15.00)	0.00	1.00
Yes	17 (85.0)	17 (85.00)		
Ability to place a coin on a shelf at the level of shoulder without bending elbow				
No	3 (15.0)	3 (15.00)	0.00	1.00
Yes	17 (85.0)	17 (85.00)		
Ability to lift 5 kg to the level of shoulder without bending the elbow				
Yes	20 (100.00)	20 (100.00)		
No	0	0	NA	–
Ability to lift 4 kg to the level of the top of head without bending elbow				
No	1 (5.0)	0	1.026	0.311
Yes	19 (95.0)	20 (100.0)		
Ability to carry 10 kg at side with the affected extremity				
No	6 (30.0)	7 (35.0)	0.114	0.736
Yes	14 (70.00)	13 (65.0)		
Ability to toss a softball underhand 10 m with the affected extremity				
No	4 (20.0)	4 (20.0)	0.00	1.000
Yes	16 (80.0)	16 (80.0)		
Ability to throw a softball overhand 20 m with the affected extremity				
No	14 (70.0)	13 (65.0)	0.114	0.736
Yes	16 (30.0)	7 (35.0)		
Ability to wash the back of the opposite shoulder with the affected extremity				
No	9 (45.0)	3 (15.00)	4.286	0.038*
Yes	11 (55.0)	17 (85.00)		
Work full time at regular job				
No	1 (5.0)	1 (5.0)	0.00	1.00
Yes	19 (95.0)	19 (95.0)		

χ^2, χ^2 test. *Significant.

Table 7 Relation between simple shoulder test and other parameters

Variable	SST			*U*	*P* value	95% CI	
	Mean±SD	Range	Median (IQR)			Lower	Upper
Sex							
Male	10.21±3.58	3.00–19.00	11.00 (3.00)	2.313	0.023*	–3.27	–0.24
Female	11.97±2.97	4.00–20.0	11.00 (1.00)				
Shoulder side							
Right	10.63±3.41	3.00–20.00	11.00 (2.00)	–1.529	0.130	–3.28	0.43
Left	12.06±3.38	9.00–19.00	11.00 (5.00)				
Postoperative analgesia							
50×1=50	10.89±4.07	4.00–20.00	11.00 (3.50)	FET=6.413	0.003*	–	–
50×2=100	12.08±2.70	9.00–19.00	11.00 (2.00)				
50×3=150	9.04±3.31	3.00–12.00	11.00 (8.00)				
Complications intraoperative							
No	10.73±3.33	3.00–20.00	11.00 (2.00)	FET=2.389	0.098	–	–
Extravasation	14.50±5.20	10.0–19.0	14.50 (9.00)				
Deltoid splitting prop	11.33±0.58	11.00–12.00	11.00 (1.00)				
Complications postoperative							
No	11.70±2.16	9.00–20.00	11.00 (1.00)	14.722	0.001*	–	–
Stiffness superficial	7.33±5.77	4–19	4.00 (5.00)				

CI, confidence intervals; FET, Fisher's exact test; SST, simple shoulder test; *U* test, Mann–Whitney *U* test. *Significant.

Table 8 Multinomial logistic regression analysis using the studied variables for detection of rotator cuff

Variables	OR	SE	*P* value	Exp (OR)	95% CI	
					Lower bound	Upper bound
Age	0.062	0.039	0.109	1.064	0.986	1.148
Sex	0.612	0.872	0.483	1.844	0.334	10.193
Shoulder side	0.327	0.988	0.741	1.387	0.20	9.622
Procedure duration	–0.051	0.019	0.008*	0.951	0.916	0.987
SST	0.154	0.125	0.217	0.857	0.671	1.095

CI, confidence interval; OR, odd ratio; SST, simple shoulder test. *Significant.

Table 9 Correlation between simple shoulder test and visual analog scale score and complications

	SST (X/12)	
	r	*P* value
Sex	0.173	0.285
Procedure duration	–0.255	0.112
VAS preoperatively	–0.314	0.048*
VAS 1 month postoperatively	–0.454	0.003*
VAS 3 months postoperatively	–0.391	0.013*
VAS 6 months postoperatively	–0.341	0.031*
Complications intraoperatively	0.121	0.457
Complications postoperatively	–0.427	0.006*

r, correlation coefficient; SST, simple shoulder test; VAS, visual analog scale. *Significant.

incision. Symptoms lasted on an average of 5.7 months (range, 3–16 months).

There were no significant variations in pain score VAS preoperatively and postoperatively between the groups tested in this study. According to Verma *et al.* [20], there were no statistically significant variations in postoperative functional or VAS pain across groups after a long-term follow-up. In contrast, Kang *et al.* [22] observed that patients with arthroscopically repaired rotator cuff injuries had lower VAS pain assessed postoperative at 6 months than those who had mini-open repair. In addition, Liu *et al.* [23] found that the preoperative VAS scores of the AA and MO groups were equal. The VAS score in the MO group was considerably higher than that in the AA group on postoperative day 1 (6.50.6 vs. 6.10.6, $P<0.01$). The difference between the two groups resurfaced at 1 month (2.90.6 vs. 2.60.6, $P=0.03$). At other periods during the follow-up, there was no difference in the scores between the two groups. Only on postoperative day 1 and 1 month following surgery, significant differences emerged. In addition, Karakoc and Atalay [24] examined arthroscopic and mini-open surgical procedures and found that when pain was assessed on the seventh day following surgery, individuals who had mini-open surgery had much more discomfort. Despite the findings of Bayle *et al.* [25], flexion ROM and functional assessment score improved significantly. The differences could be explained by the surgeons' differing experiences with each approach. Moreover, the disparity in results could be explained in part by the use of distinct functional evaluation questionnaires and our long-term follow-up.

In terms of intraoperative and postoperative complications, there were no significant differences between the groups evaluated in this study. In a similar vein, Huberty *et al.* [26] found stiffness rates ranging from 4.9 to 32.7%. Complications were reported in 59 micro-open and 115 arthroscopic groups, according to Montaser *et al.* [27]. (stiffness and retear founded mainly in mini-open group). In a study by Chung *et al.* [28], examining postoperative stiffness in 288 patients with full-thickness rotator cuff tears, patients who underwent mini-open repair had higher stiffness at the final follow-up ($P=0.02$) than patients who underwent all-arthroscopic repair. The mini-open group, on the contrary, appeared to have a higher percentage of complications, such as revision, arthrofibrosis, and postoperative impingement, according to Nho *et al.* [29]. However, mini-open studies tended to have longer follow-up, which may allow for a greater number of complications. In retrospective cohort studies, the mini-open group had around two times the number of revisions and cases of arthrofibrosis. In the mini-open group, there were four revisions and six cases of arthrofibrosis, whereas the arthroscopic group had two revisions and three cases of arthrofibrosis. Different results may be explained with the conclusion of Kim *et al.* [30], who suggested that surgical outcomes depend upon the size of the tear, rather than the method of repair.

Except for the ability to wash the back of the opposite shoulder with the affected extremity, which was considerably increased in group B compared with group A in the current study, there was no significant difference between the analyzed groups on other outcomes. Several investigations, like those by Williams *et al.* [31], compared the outcomes of mini-open and all-arthroscopic operations, and found similar results. In addition, Ji *et al.* [32] did a meta-analysis on randomized controlled trials comparing the outcomes of arthroscopic and mini-open rotator cuff repair, and the authors found no differences regarding

the functional outcome score between these two techniques. The SF-36 outcome measures were used by Pearsall *et al.* [21], who found no significant difference between preoperative and postoperative scores. This is in line with the findings of Gartsman *et al.* [5], who employed the SF-36 to assess patients following rotator cuff surgery. Another study by de Boer *et al.* [4] found that when arthroscopic cuff repair was compared with open repair, SST gave equivalent or better results, with the main benefit being increased mobility, likely owing to decreased scar development.

SST was found to be substantially linked with sex, preoperative and postoperative VAS scores, and postoperative problems in our investigation. Procedure time and intraoperative problems, on the contrary, had no significant relationship with SST. A correlation analysis was done between all demographic characteristics and outcome indicators for the full group in the study by Pearsall *et al.* [21]. Smoking was found to have an unfavorable relationship with progress on the Short Shoulder Form (P=0.05). Age, sex, diabetes, biceps pathology, simultaneous distal clavicle excision, and improvement in any of the outcome variables or glenohumeral range of motion were not shown to be related.

Limitations of the study

The data are limited to a single surgeon and may not be applicable to all rotator cuff repair surgeons of varied skill levels. The current study's sample size is quite tiny. There was a difference in the percentage of dominant arm injuries between the two groups. Furthermore, we were unable to establish a thorough difference between arthroscopic and open repair, as well as the influence of suture type, owing to a lack of recording of data (e.g. surgical techniques and outcomes) for the population of interest. Another limitation was the quality of the studies included, as there was a significant amount of risk in the randomized controlled trials owing to a lack of randomization and participant blinding.

Conclusions

The most common cause of shoulder pain is rotator cuff disease. For rotator cuff repairs, there has recently been a shift in the management from an open approach to an arthroscopic operation (RCR). Arthroscopic surgery has been found to have a lower rate of morbidity, recovery time, and complications than traditional surgery. The clinical outcomes of arthroscopy and open repair are nearly identical. There were no statistically significant changes in postoperative SST score, pain score VAS, or complications. Before more clear recommendations can be provided, more research is needed, including randomized, controlled trials, studies examining short-term pain results, and trials comparing long-term integrity. In addition, future studies should concentrate on tear patterns, size, degree of delamination, mobility, and surgical repair outcomes.

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Conflicts of interest

There are no conflicts of interest.

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