Arthroscopic versus mini-open repair of rotator cuff tears

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Background
Rotator cuff tears are very common in the general population. Different modalities of repair are well established. We describe two surgical techniques for repair, arthroscopic versus mini-open techniques.
Patients and methods
This prospective study included 20 patients with complete rotator cuff tear (small to large size) with grade A or B retraction with no or little fatty infiltration of cuff muscles. Patients were divided into two groups, each group included 10 patients: one group was treated by arthroscopic repair by anchors and the other group was treated by mini-open repair by anchors.
Results
For group A treated by arthroscopic repair over the period of follow-up, the mean Constant and Murley score was 82.1 ± 4.8 (76–90), and all the patients were satisfied. For group B treated by mini-open repair over the period of follow-up, the mean Constant and Murley score was 79.8 ± 7.2 (66–90), and eight patients out of 10 were satisfied. There was no statistically significant difference between both groups (*p* value 0.4). MRI showed satisfactory tendon healing 6 months postoperatively. Postoperative stiffness occurred in one patient undergoing mini-open repair mainly owing to poor compliance with the rehabilitation program.
Conclusion
Arthroscopic technique and mini-open technique are viable options for repair of rotator cuff tears in our study, with no significant variations noticed between them, although better results in arthroscopic group.

Keywords:
arthroscopic repair, mini-open repair, rotator cuff

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Introduction

Rotator cuff tears are a common source of shoulder pain and disability [1]. It can occur after an extreme overload, but typically it is the result of a degenerative process that compromises tendon integrity, starting with supraspinatus and progressing to the other cuff muscles [2].

Patients with shoulder pain and function impairment not responding to appropriate nonsurgical management are candidates for surgery [3].

The most frequently used methods for rotator cuff repair include the open [4], mini-open [5,6], and arthroscopic repair techniques [7,8]. Traditional open repair technique had its complications [9] (postoperative stiffness, failure of repair, and deltoid avulsion) [10].

Although both the mini-open and all arthroscopic techniques interventions are less invasive than open procedures [11] (maintain the integrity of the deltoid origin with minimal incision), there are variable advantages and concerns with these two procedures. Repair by an all arthroscopic procedure is less invasive but requires more extensive training [11].

We evaluated the effectiveness of rotator cuff repair in two groups of patients: one receiving an arthroscopic rotator cuff repair and the other receiving a mini-open rotator cuff repair.

Patients and methods

This prospective study was approved by ethical committee of Al-Azhar University and included 20 patients with small to large sized rotator cuff tears. They were treated at the Department of Orthopedic and Traumatology, Al-Azhar University Hospitals, during the period from June 2015 to January 2018. All patients signed an informative consent form. There were two groups according to surgical repair method used: the arthroscopic rotator cuff repair (group A) and the mini-open rotator cuff repair (group B).

The group A (arthroscopic rotator cuff repair) included 10 patients, five women and five men, with a mean age

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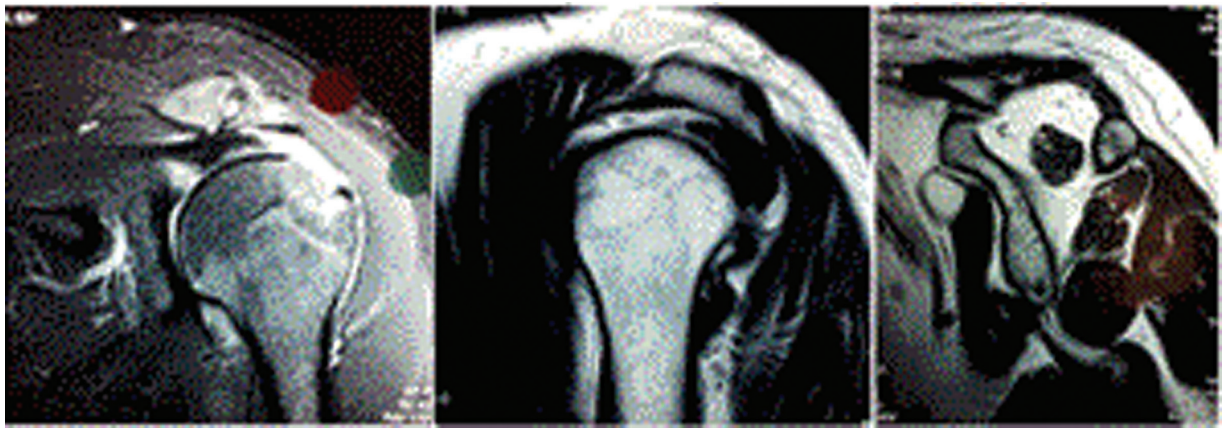
Figure 1



MRI shoulder showing full-thickness rotator cuff tear.

of 53.9 years (range, 37–73 years). Of the 10 patients three had history of trauma and seven were degenerative causes. The group B (mini-open rotator cuff repair) included 10 patients, four men and six women, with a mean age of 56 years (range, 39–72 years). Four patients out of 10 had history of trauma and six were degenerative causes.

The rotator cuff tear was diagnosed on clinical basis and radiological evaluation in the form of plain radiography (anteroposterior, axillary, and scapular Y views) together with shoulder MRI (Fig. 1), which were done for all patients.

The inclusion criteria were patients with complete rotator cuff tear diagnosed on clinical basis and MRI (small to large size) with grade A or B retraction with no or little fatty infiltration of cuff muscles.

Exclusion criteria were patients with massive or irreparable tears, patients with moderate or marked fatty infiltration (stage 3 or 4), patients with partial thickness tear, patients with inflammatory joint disease, patients with glenohumeral osteoarthritis, and patients with prior surgery on the affected shoulder.

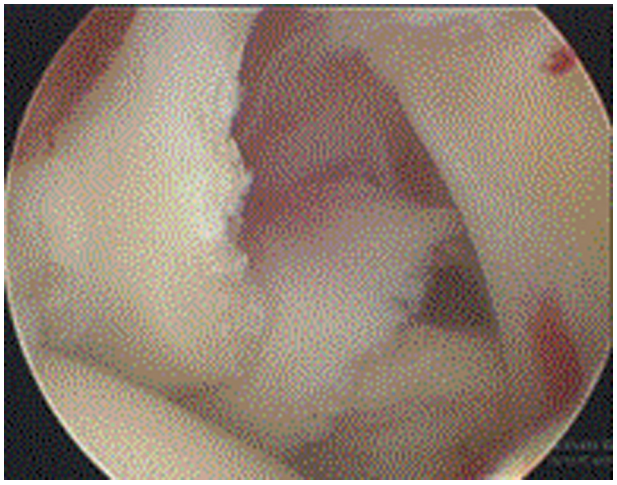
Operative technique

All the procedures were performed under hypotensive general anesthesia, with the patient in beach chair position.

Arthroscopic assessment of glenohumeral joint

For all patients in the study, standard anterior and posterior glenohumeral portals were established with the arthroscope being inserted in the posterior portal. The procedure begins with the intra-articular visualization of the entire glenohumeral joint and management of any additional pathology that may be present. Significant degeneration in the long head of biceps tendon was found in six cases and was treated by biceps tenotomy (Fig. 2) in two cases in group A and another two cases in group B, whereas biceps tenodesis was done in two cases in (group B).

Figure 2



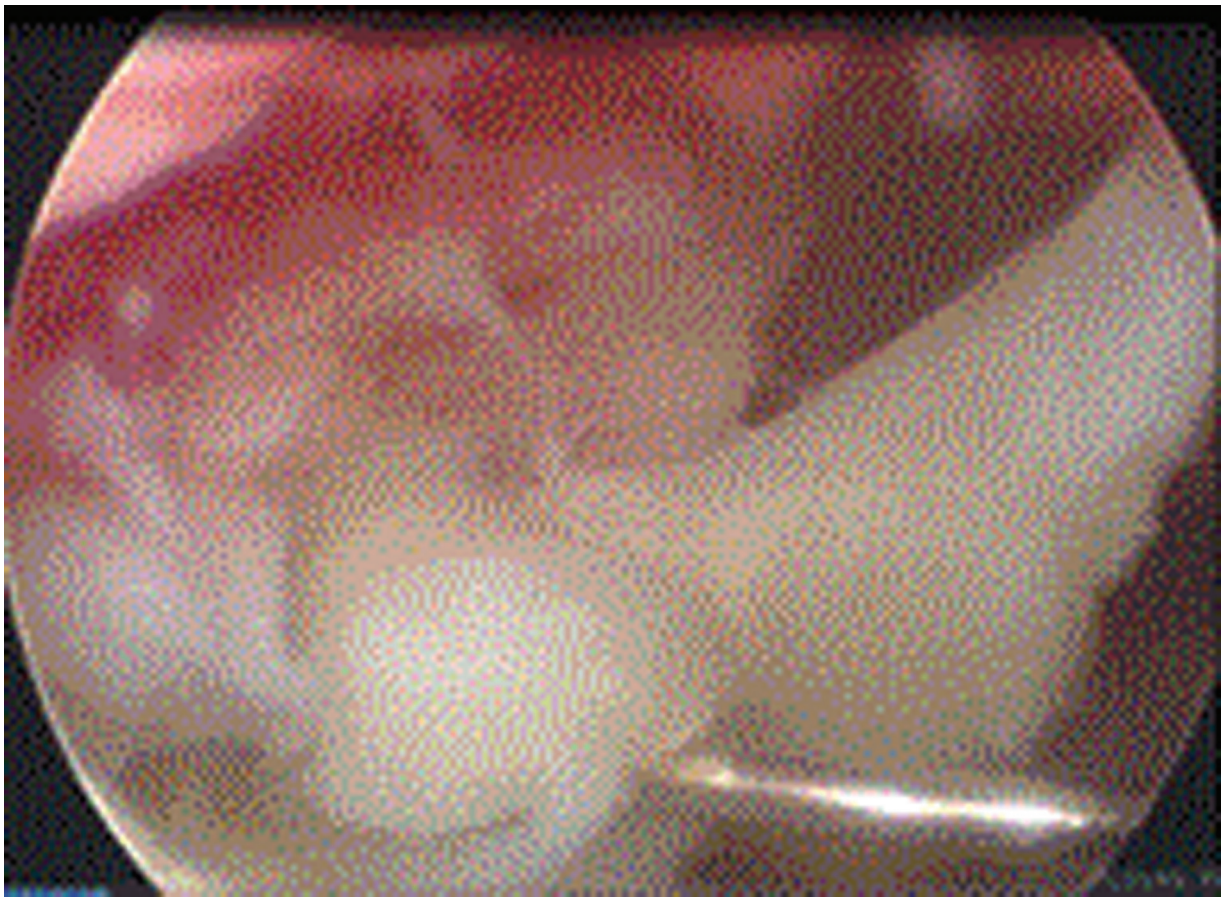
Arthroscopic biceps tenotomy.

Meticulous arthroscopic evaluation of the rotator cuff tear was done as well as tendon quality and a percutaneous long spinal needle was inserted from outside through the tear into the joint (Fig. 3).

Arthroscopic assessment of subacromial space

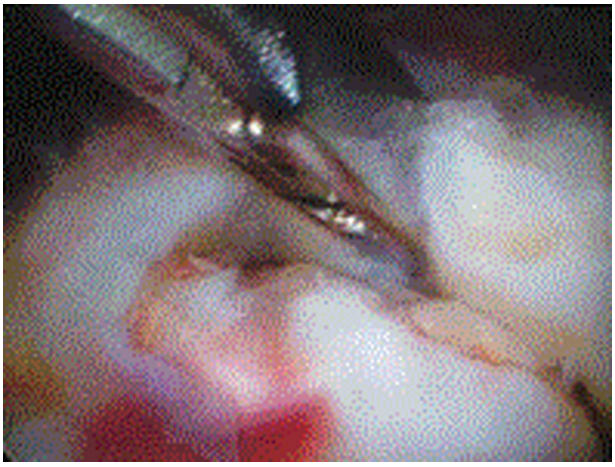
Careful arthroscopic evaluation of the size and pattern of the tear as well as mobility of the rotator cuff tear was done (Fig. 4). Bursectomy and limited acromioplasty were performed through the lateral portal. The tear size was measured using a standard-sized shaver graduated instrument and

Figure 3



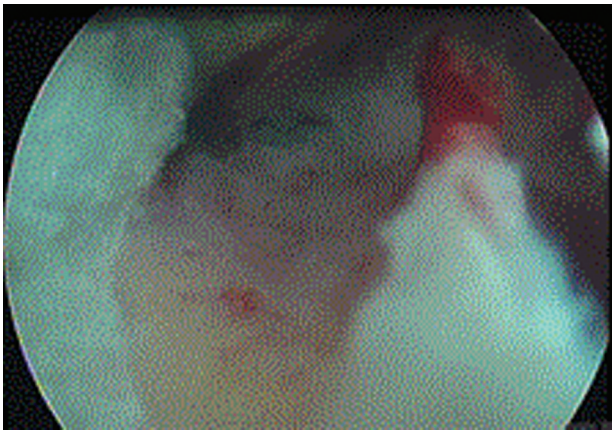
Localization of the tear.

Figure 4



Mobilization of rotator cuff.

Figure 5

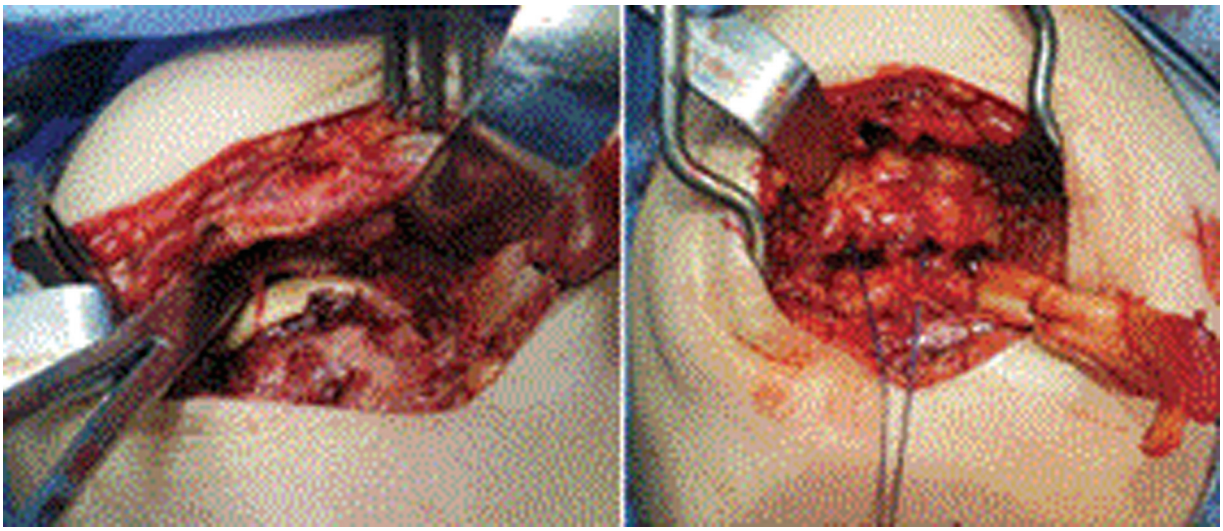


Arthroscopic preparation of RC footprint. RC, rotator cuff.

classified according to their size as small (<1 cm), medium (1–3 cm), large (3–5 cm), and massive if the tear was greater than 5 cm in length. (DeOrio and Cofield classification system) [12]. The greater tuberosity was debrided and gently decorticated without exposure of the subcortical bone (Fig. 5).

In group A (arthroscopic rotator cuff repair), the rotator cuff tears were classified as small (<1 cm) in four patients, medium (1–3 cm) in five patients, and large (3–5 cm) in one patient. In group B, the rotator cuff tears were classified as small (<1 cm) in two patients, medium (1–3 cm) in seven patients, and large (3–5 cm) in one patient.

Figure 6



Mini-open repair technique.

Arthroscopic technique

The footprint of the rotator cuff in the greater tuberosity was identified and prepared using a motorized shaver and burr to obtain a bleeding surface (Fig. 5). We performed a single row repair using metal anchors 5 mm (Corkscrew; Arthrex, Naples, Florida, USA). The anchors were placed through an additional percutaneous access to obtain optimal anchor orientation at 45°. The tendons were repaired using two pairs of nonabsorbable no. 2 sutures from the anchors and secured through the tendon by a suture-passing device or by shuttle relay technique. The sutures were tied using a sliding knot with simple half-hitches on alternating posts.

Mini-open repair technique

A longitudinal skin incision 4–5 cm was made in the direction determined by following the spinal needle starting from the anterolateral corner of the acromion and extending distally. The deltoid muscle was split in line with its fibers at the raphe between anterior and middle fibers with no detachment from the acromial edge, and the rotator cuff was exposed.

The footprint underwent minimal shaving using a rasp. The rotator cuff tear was repaired using a single row configuration with metal anchor 5 mm (Corkscrew; Arthrex) oriented at 45°. The tendons were repaired using two pairs of nonabsorbable no. 2 sutures from the anchors, and secured through the tendon. The sutures were tied using a sliding knot with simple half-hitches on alternating posts. In 8 cases with moderate and large size tear, the repair was augmented by transosseous sutures using Ethibond No. 5 (Ethicon, Somerville, New Jersey, USA) (Fig. 6).

Finally, we adequately closed the deltoid muscle and fascia, subcutaneous tissue, and skin.

Postoperative management

For both groups, the arm was supported in abduction pillow for 6 weeks. Hand exercises and active elbow flexion and extension were allowed starting from the first postoperative day. Pendulum exercises and assisted passive ROM were started within the first 2 weeks and were maintained within a comfortable range until 6 weeks postoperatively. At 6 weeks, overhead stretching with a rope and pulley was allowed without restriction. Deltoid strengthening with low resistance was started after at least 3 months after the procedure. Heavy manual work and overhead activities were allowed after a good restoration of shoulder strength, which occurred 6–10 months after surgery.

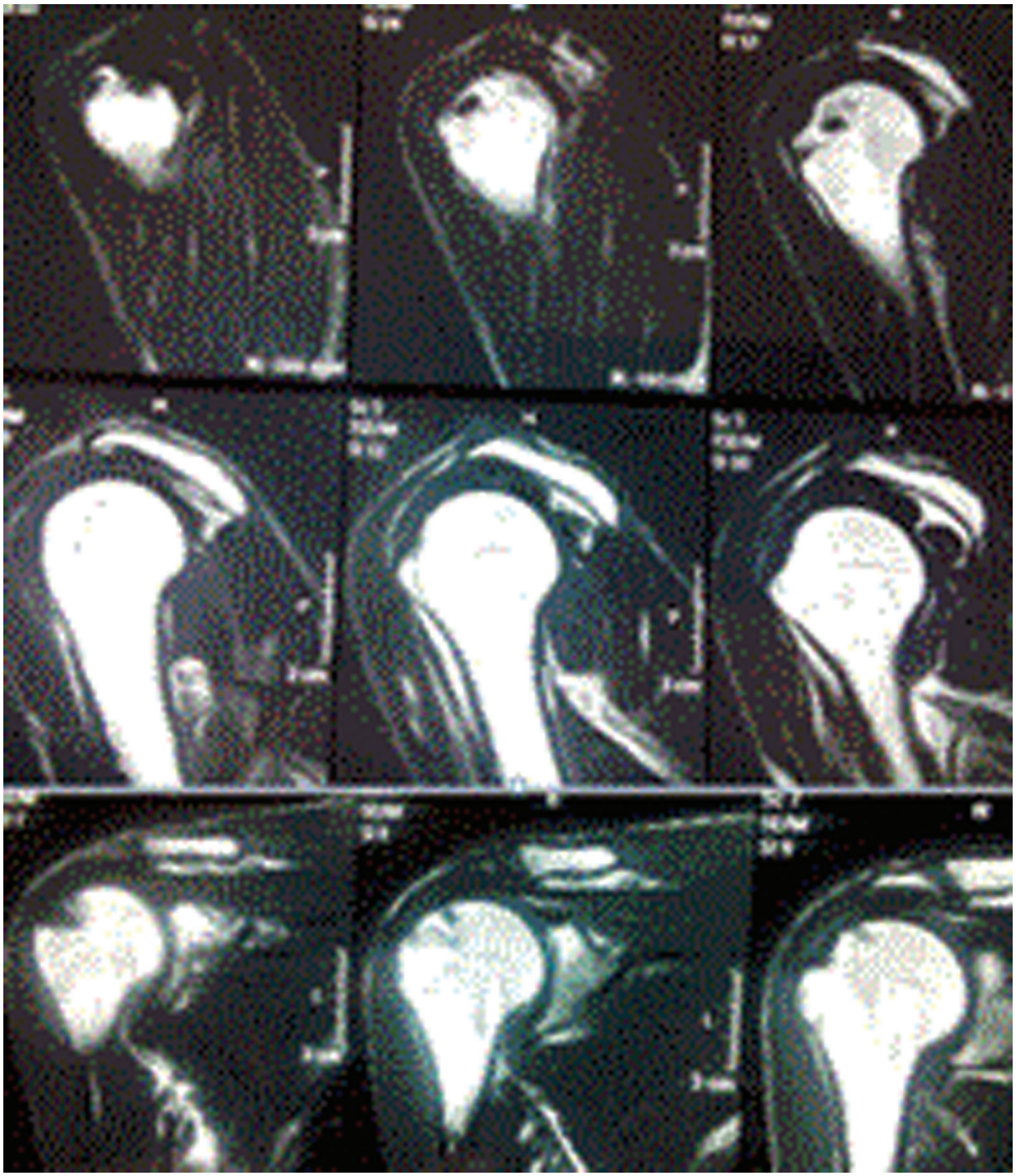
Methods of evaluation of the results

Preoperative evaluations were done before surgery and reported together with the results of postoperative evaluation at 6 months and at final follow-up at an average of 12 months.

Results were assessed according to Constant–Murley score [13]. This scoring system consists of four parts: pain with maximum score of 15 points, activity of daily living with maximum score of 20 points, range of motion with maximum score of 40 points, and power with maximum score of 25 points.

Patient satisfaction was recorded. MRI was done at 6 months postoperatively to assess the rotator cuff healing (Figs 7).

Figure 7



Follow-up MRI shows adequate RC tendon healing 6 months after arthroscopic repair by anchors. RC, rotator cuff.

Statistical analysis of the present study was conducted, using the mean, SD, and χ^2 test by statistical program for the social sciences (SPSS; SPSS Inc., Chicago, Illinois, USA) version 15.0.

Results

The average time of arthroscopic repair was 85 min (65–120 min), and average time of mini-open repair was 70 min (55–110 min).

The mean follow-up was 18 month (12–30 month), and functional outcomes were recorded at the 12-month postoperative visit for all 20 patients.

For group A treated by arthroscopic repair over the period of follow-up, the mean Constant and Murley score was 82.1 ± 4.8 (76–90), and all the patients were satisfied. For group B treated by mini-open repair over the period of follow-up, the mean Constant and Murley score was 79.8 ± 7.2 (66–90), and eight

patients out of 10 were satisfied. There was no statistically significant difference between both groups (p value 0.4). Postoperative stiffness occurred in one patient undergoing mini-open repair mainly owing to poor compliance with the rehabilitation program. No incidence of re-tear in our study during the period of follow up.

In the group A treated by arthroscopic repair, the active forward flexion improved from averaged 75° (45–90°) preoperatively to 155° (140–170°) at last follow-up ($P<0.001$). Active external rotation improved from a mean of 40° preoperatively to a mean of 70° at the latest follow-up ($P<0.001$). The mean active internal rotation improved from 25° to 35° at the latest follow-up ($P<0.001$). Using the Constant scoring system, the group A demonstrated a statistically significant improvement in range of motion (ROM) from a mean preoperative rating of 23 to a mean 32.4 at the latest follow-up ($P<0.001$) (Table 1 and Fig. 8).

In the group B treated by mini-open repair, the active forward flexion improved from averaged 65° (50–85°) preoperatively to 150° (140–160°) at last follow-up ($P<0.001$). Active external rotation improved from a mean of 35° preoperatively to a mean of 65° (50–85°) at the latest follow-up ($P<0.001$). The mean active internal rotation improved from 20° to 30° at the latest follow-up ($P<0.001$). Using the Constant scoring system, group B demonstrated a statistically significant improvement in range of motion (ROM) from a mean preoperative rating of 23 to a mean 32 at the latest follow-up ($P<0.001$) (Tables 1 and 2). Using the Constant-Murley Scoring System, there was no statistically significant difference between both groups (p value 0.281) as regard range of motion (Table 1).

Table 1 Constant and Murley score

	Arthroscopic technique	Mini-open technique
Pain		
Pre–post	7.0 12.0 ± 3.50	6.0 11.00 ± 3.38
Activity of daily living		
Pre–post	10.0 14.6 ± 1.35	9.6 14.40 ± 1.84
Range of motion		
Pre–post	23.0 32.4 ± 1.65	23.0 32 ± 2.99
Power		
Pre–post	14 23.10 ± 1.29	15 22.4 ± 1.43

Discussion

Rotator cuff tears are very common in the general population. Pain, weakness, and limited range of motion of the shoulder are the usual symptoms. Surgical repair has evolved over years from open to mini-open to all arthroscopic repair techniques [11]. The goal of any surgical cuff repair technique is to decrease pain and improve shoulder function and quality of life. This study points to compare the results of arthroscopic technique and mini-open technique in repair of rotator cuff tears. Reproductions of rotator cuff anatomy are thought to be better by arthroscopic repairs because the three-dimensional evaluation allows for the recognition of tear configuration [14]. However, in a mini-open procedure, the visualization is limited by the size of the wound, which may not allow adequate access

Figure 8

Active forward flexion and external rotation after arthroscopic RC repair. RC, rotator cuff.

Table 2 Results of current study

Patients		Age	Sex	Side affected	Previous disease	Previous Local corticosteroid injection	Size of Tear	Biceps Tendon	C-M Score
Arthroscopic Group	1	37	M	L	Trauma	No	Small	Intact	90
	2	54	M	R	Degeneration	No	Medium	Intact	81
	3	40	F	L	Degeneration	Yes	Small	Intact	79
	4	58	F	L	Degeneration	No	Medium	Tenotomy	77
	5	42	M	L	Trauma	No	Medium	intact	81
	6	61	M	L	Degeneration	Yes	Medium	Intact	90
	7	57	F	R	Trauma	No	Small	Intact	81
	8	60	F	R	Degeneration	No	Medium	Intact	85
	9	73	M	L	Degeneration	Yes	Large	Tenotomy	76
	10	57	F	L	Degeneration	No	Small	Intact	81
Mean		53.9							82.1 ± 4.8 (76-90)
Mini-Open Repair	11	48	M	R	Trauma	No	Medium	Intact	85
	12	66	F	R	Degeneration	Yes	Large	Tenodesis	74
	13	55	F	R	Degeneration	No	Medium	Intact	86
	14	57	F	L	Degeneration	Yes	Medium	Intact	79
	15	39	M	R	Trauma	No	Small	Intact	90
	16	65	F	R	Degeneration	Yes	Medium	Tenotomy	77
	17	47	M	R	Trauma	No	Small	Intact	86
	18	72	M	R	Degeneration	No	Medium	Tenotomy	66
	19	50	F	R	Trauma	Yes	Medium	Intact	80
	20	61	F	R	Degeneration	No	Medium	Tenodesis	75
Mean		56							79.8 ± 7.2 (66-90)

C-M score, Constant and Murley score; F, female; L, left; M, male; R, right.

to the rotator cuff and can compromise the ability to perform necessary surgical releases [15–17].

Pearsall *et al*. [16] performed a comparison of clinical outcomes and patient satisfaction following arthroscopic and mini-open rotator cuff repair. He found no statistical difference between the results of the two techniques after 50 months of follow-up, indicating that either procedure is efficient in the treatment of small-sized and medium-sized rotator cuff tears. In our study, no incidence of re-tear was found in both groups, as we include only patients with small to large size rotator cuff tear and exclude patients with massive tear as well as short term follow up. Verma *et al*. [17] performed the same comparison between arthroscopic and mini-open techniques and found no difference in clinical outcomes after a minimum of 2 years of follow-up. Verma et al, found overall rates of repair failure of 24% in the mini-open group and 25% in the arthroscopic group.

Sauerbrey *et al*. [18] compared clinical outcomes of arthroscopic and mini-open repair after 33 months of follow up. They found no significant difference between the two techniques.

Osti *et al*. [19] compared subjective and objective outcomes of arthroscopic and mini-open repair of cuff tears less than 3 cm. They found no statistical difference in the total score at a mean follow-up of 6 months and other long-term follow-up of 31 months.

Clinical outcome in our study was based on Constant–Murley score, and all parameters were gradually improved till the end of follow-up in both groups. The intense physical therapy program proved to be very helpful for recovery. By the analysis of final results, no significant variation (p value 0.4) between arthroscopic and mini-open technique were noticed.

The arthroscopic approach offers several advantages, including a smaller incision, easy access to the glenohumeral joint for treatment of intra-articular pathology, easy mobilization of the tendon, better panorama viewing of the tears less soft tissue dissection, and less potential harm to the deltoid. However, a purely arthroscopic rotator cuff repair requires advanced arthroscopic skills and specific equipment.

Limitations of the study

The small number of patients was the first limitation of this study. This study was not a blind study with a short-term follow-up.

Conclusion

Repair of rotator cuff tears using arthroscopic technique or mini-open technique is a valuable

option, with no differences in objective and subjective outcomes, because of their advantages as less stiffness, less pain, early return to usual life, and less morbidity to deltoid muscle. Arthroscopic repair is gaining more and more popularity but still it is a technically demanding procedure that needs special equipment to be done smoothly. Surgeons should choose the technique they are more familiar with, as the results are equally good and predictable.

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Nil.

Conflicts of interest
There are no conflicts of interest.

References

1 Norberg FB, Field LD, Savoie FH. Repair of the rotator cuff. Mini-open and arthroscopic repairs. Clin Sports Med 2000; 19:77–99.

2 Jerosch J, Muller T, Castro WH. The incidence of rotator cuff rupture. An anatomic study. Acta Orthop Belg 1991; 57:124–129.

3 Mohtadi NG, Hollinshead RM, Sasyniuk TM, Fletcher JA, Chan DS, Li FX. A randomized clinical trial comparing open to arthroscopic acromioplasty with mini-open rotator cuff repair for full-thickness rotator cuff tears: disease-specific quality of life outcome at an average 2-year follow-up. Am J Sports Med 2008; 36:1043–1051.

4 Bigliani LU, Cordasco FA, McIlveen SJ, Musso ES. Operative repairs of massive rotator cuff tears: long-term results. J Shoulder Elbow Surg. 1992; 1:120–130.

5 Yamaguchi K. Mini-open rotator cuff repair. J Bone Joint Surg 2001; 83:53–61.

6 Levy HJ, Uribe JW, Delaney LG. Arthroscopic assisted rotator cuff repair: preliminary results. Arthroscopy 1990; 6:55–60.

7 Gartsman GM, Khan M, Hammerman SM. Arthroscopic repair of full-thickness tears of the rotator cuff. J Bone Joint Surg 1998; 80-A:832–840.

8 Frisella WA, Cuomo F. Basics of arthroscopic rotator cuff repair. Tech Shoulder Elbow Surg 2007; 8:166–174.

9 Gumina S, Di-Giorgio G, Perugia D. Complications consequent to open surgical repair of massive rotator cuff tears. Int Orthop 2008; 32:81–84.

10 Sakoma Y, Sano H. Anatomical and functional segments of the deltoid muscle. J Anatomy 2010; 218:185–190.

11 Nho SJ, Shindle MK, Sherman SL, Freedman KB, Lyman S, MacGillivray S. Systematic review of arthroscopic rotator cuff repair and mini-open rotator cuff repair. J Bone Joint Surg Am 2007; 89(Suppl 3):127–136.

12 DeOrio JK, Cofield RH. Results of a second attempt at surgical repair of a failed initial rotator-cuff repair. J Bone Joint Surg Am 1984; 66:563–567.

13 Constant CR, Murley AH. A clinical method of functional assessment of the shoulder. Clin Orthop Relat Res 1987; 214:160–164.

14 Lo IK, Burkhart SS. Current concepts in arthroscopic rotator cuff repair. Am J Sports Med 2003; 31:308–324.

15 Yamaguchi K, Ball CM, Galatz LM. Arthroscopic rotator cuff repair: transition from mini-open to all-arthroscopic. Clin Orthop Relat Res 2001; 390:83–94.

16 Pearsall AW, Ibrahim KA, Madanagopal SG. The results of arthroscopic versus mini-open repair for rotator cuff tears at mid-term follow-up. J Orthop Surg Res 2007; 2:24.

17 Verma NN, Dunn W, Adler RS. All-arthroscopic versus mini-open rotator cuff repair: a retrospective review with minimum 2-year follow-up. Arthroscopy 2006; 22:587–594.

18 Sauerbrey AM, Getz CL, Piancastelli M. Arthroscopic versus mini-open rotator cuff repair: a comparison of clinical outcome. Arthroscopy 2005; 21:1415–1420.

19 Osti L, Papalia R, Paganelli M. Arthroscopic vs mini-open rotator cuff repair. A quality of life impairment study. Int Orthop 2010; 34:389–394.