Original Article

A Comparison of the Clinical Outcomes between Arthroscopic and Open Rotator Cuff Repair in Patients with Rotator Cuff Tear: A Nonrandomized Clinical Trial

Abolghasem Zarezadeh, Mohamad Dehghani, Ghasem Mohammadsharifi, Ali Omidian

From the Department of Orthopedics, Isfahan University of Medical Sciences, Isfahan, Iran

Abstract

Background: Several researchers have investigated the clinical outcomes in patients with rotator cuff tear who compared open and arthroscopic surgeries; however, there are limited studies that have compared the outcomes of arthroscopic and open rotator cuff repair. This study was aimed to compare the clinical outcomes of the patients who underwent rotator cuff repair using either arthroscopic or open repair techniques. **Materials and Methods:** This is a prospective cohort study in which 51 patients who underwent either open or arthroscopic rotator cuff repair were studied. Twenty-six patients underwent open repair, and 25 patients had an arthroscopic repair. Patients were followed for 6–36 months. The outcome of the two groups was evaluated using the Universal California Los Angles (UCLA) score. **Results:** The mean tear size was 4.93 ± 2.3 cm^2 in the open surgery group and 4.99 ± 2.3 cm^2 in the arthroscopic group ($P = 0.93$). All patients showed significant improvement in their scores for pain, active forward flexion, active abduction, and function at the time of follow-up. Improvement in scores within each group was significant, but the comparison of the two techniques was not statistically significant in pain, active abduction, active forward flexion, and UCLA, but in function, the open surgery group was superior ($P < 0.05$). **Conclusion:** This study revealed that short-term outcomes for arthroscopic and open cuff repair are similar, except in function, which was significantly better in the open surgery.

Keywords: *Arthroscopic rotator cuff repair, open rotator cuff repair, outcome, rotator cuff injury, shoulder*

Introduction

Rotator cuff tear is a common shoulder complaint worldwide.[1] Codman performed the first rotator cuff repair in 1909, and afterward, gradually, less invasive surgical methods were developed. Different types of rotator cuff repair include open surgery, arthroscopic, mini-open, and arthroscopic-assisted open methods.[2]

Arthroscopic surgery can be challenging even for skilled surgeons, as it demands full knowledge of the three-dimensional anatomy of the shoulder as well as the use of specific tools and instruments.[3,4]

In contrast, open surgery is less expensive and can provide more dominance over the anatomy of the shoulder that increases the feasibility of arthroscopy.[5]

Several researchers have investigated the clinical outcomes in patients with rotator cuff tear who compared open and arthroscopic surgeries; however, there are limited studies that compare the outcomes of arthroscopic and open rotator cuff repair.[6,7] According to this fact, the present study aimed to compare the clinical outcomes of patients who underwent rotator cuff repair by arthroscopic and open repair techniques, in order to determine the best and the most effective surgical approach in patients with rotator cuff tear.

Materials and Methods

Trial design

This study was a census prospective cohort study comparing the outcomes of arthroscopic and open surgical techniques in patients with acute rotator cuff tear who needed rotator cuff repair. The Regional

How to cite this article: Zarezadeh A, Dehghani M, Mohammadsharifi G, Omidian A. A comparison of the clinical outcomes between arthroscopic and open rotator cuff repair in patients with rotator cuff tear: A nonrandomized clinical trial. Adv Biomed Res 2020;9:13.

Received: 18 October 2019;
Revised: 23 November 2019;
Accepted: 17 February 2020;
Published: 22 April 2020

Address for correspondence:
Dr. Ghasem Mohammadsharifi, Department of Orthopedics, Isfahan University of Medical Sciences, Isfahan, Iran.
E-mail: iman.m.sharifi@gmail.com

Access this article online

Website: www.advbiores.net

DOI: 10.4103/abr.abr_226_19

Quick Response Code:

Bioethics Committee of Isfahan University of Medical Sciences (IUMS) approved the study protocol.

Participants

Patients with acute full-thickness rotator cuff tear underwent rotator cuff repair surgery using either arthroscopic or open techniques by the same surgeon from 2011 to 2015.

Inclusion criteria were as follow: (1) more than 18 years of age, (2) suffering from acute traumatic rotator cuff tear defined as the tear incidence since ≤6 months, (3) absence of any underlying disease that contraindicated for the surgery, (4) patient's willingness to participate in this study with fulfilling written informed consent, and (5) patients with severe pain or functional impairments who had been under conservative treatments for the least of 1 month and had not shown an appropriate response to the medical conservative treatments. If patients did not continue their presence in the follow-up period, and if they were unwilling to continue the study, they were excluded. Patients who suffered from chronic rotator cuff tear (>6 months) and cases with rheumatoid arthritis or diabetes, were excluded from the study, as well as the patients whose magnetic resonance imaging (MRI) had revealed degenerative fatty tissue changes in supraspinatus muscle.

A total of 55 patients were selected to participate in this study through a census design. The study was explained for all of the patients, and consent letters were fulfilled. Due to the unwillingness to continue the study, four patients excluded from the study. Finally, from 51 patients, 26 cases had undergone open repair surgery, and 25 patients had undergone arthroscopic repair [Figure 1].

Outcomes

At first, for all the patients' physical examination was performed, and demographic data, including age and gender, were recorded in the checklist. The patients were examined by the skilled orthopedist and were scored according to the function-forward flexion-pain-abduction using the University of California, Los Angeles (UCLA) scale. The diagnosis of full-thickness rotator cuff tear was made by clinical examination and MRI. All the patients attended the least number of 10 sessions of physiotherapy before surgery.

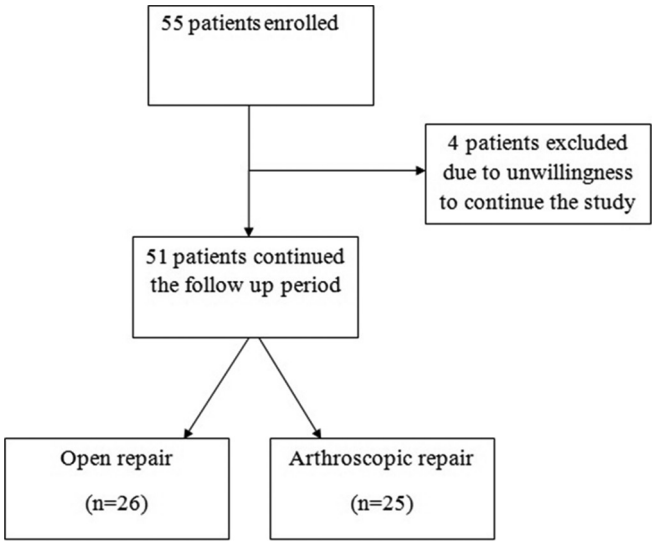

Figure 1: Study algorithm for patients enrollment

During the surgery, the tearing size was compared after bursectomy and full exposure. The mediolateral size was measured from greater tuberosity to medial tear expansion, and the anteroposterior size was measured from the anterior tear border to its posterior border, which was usually within or in parallel with the infraspinatus muscle and calculated in terms of cm^2. Physical examination performed after surgery and follow-up were performed in 6–36 months after surgery. Patients with small- and medium-sized tears used shoulder brace, and patients with large tears used abduction pillows for 4–6 weeks. At the end of 4 weeks, the patients underwent physiotherapy treatment with pendulum and passive motion exercises under the supervision of a single-skilled physiotherapist. The passive range of motion physiotherapy continued for four weeks, and then, the active range of motions and muscle strengthening motions began progressively and continued until the end of the follow-up.

Interventions

The patient was lateral decubitus positioned, and physical examinations to assess passive ranges of motion were performed. After that, in cases with limited passive range of motion, gentle manipulation was done. Then, the arm was positioned in 10°–40° of abduction and longitudinal traction using a 3–4 kg weight.

Within 2 cm inferior and 2 cm medial to the posterolateral acromial angle, a posterior portal was created. The inside-out technique was used to place the anterior portal in the rotator interval. Therefore, glenohumeral arthroscopy was done to clear the debridement of intra-articular lesions. After that, the arthroscope was inserted into subacrominal space following an anterior skin incision. In the next step, a lateral subacrominal portal on a sagittal line from the posterior corner of the acromioclavicular joint to the lateral border of the acromion was created.

Anterior acrominoplasty was performed for all patients; therefore, coplaning of the acromioclavicular joint was done in cases with the distal clavicle inferior spurs. Then, a bursectomy was done. In the next step, a grasper was utilized to assess the mobility of the torn tendon. Therefore, the edge of the tear was debrided. The soft-tissue covering the greater tuberosity was removed, and the tuberosity was lightly decorticated using a burr. The size of the tear was measured, and in cases with large U-shaped tears, the tears were converted to crescent-shape side-to-side nonabsorbable sutures from posterior to anterior. Eventually, a spinal

needle was inserted percutaneously to determine the proper point of anchor insertion on the greater tuberosity. Thus, a small incision with a size of 5 mm was made on the lateral aspect of the shoulder where the spinal needle was localized, and the suture anchor, which has nonabsorbable sutures per anchor, was inserted. Then, the sutures were passed through the torn tendon, and retrieved through the posterior or anterior portal, to eventually make a mattress stitch. An arthroscopic knot on a Duncan Loop sliding knot was created, followed by three alternating post half-hitches. The crescent edge of the rotator cuff was repaired to the greater tuberosity. One, two, two–three, and three suture anchors were used for small, medium size, large size, and massive tears, respectively.

The open repair was performed by proximal extension of the lateral portal to the lateral border of the acromion. The deltoid muscle was split without detachment from the acromion. Simple sutures were used to repair the rotator cuff by rotating the humeral head to visualized the tear's margin. The suture anchor technique was done to fix the repaired tears. Therefore, a suture anchor was inserted at the site of the humeral head adjacent to the articular surface of the greater tuberosity on the medial side. The torn tendon was fixed in the greater tuberosity, using mild tension on the sutures. The deltoid muscle fascia was repaired at the end.

Statistical analysis

Data from all participants were entered into SPSS 20 (SPSS crop, Chicago, IL, USA) for statistical analysis. In order to report qualitative variables, we used mean ± standard deviation and number or percentages, respectively. For comparing variables, Chi-square test, independent *t*-test, paired *t*-test, and ANOVA were applied. A two-sided α level of 0.05 was used to assess statistical significance.

Results

Baseline data

In this study, 51 patients were evaluated. Twenty-six of them (16 males and 10 females) underwent open repair, and 25 patients (14 males and 11 females) underwent arthroscopic repair. The mean age of the patients was of 47.7 ± 10.7 years ranging from 27 to 60 years in the arthroscopy group, and 47.8 ± 10.2 years ranged from 21 to 66 years in the open surgery group. The two groups were similar in terms of age (P = 0.97) and gender distribution (P = 0.461).

Outcomes and estimation

The mean tear size was 4.99 ± 2.3 cm² in the arthroscopy group and 4.93 ± 2.3 cm² in the open group (P = 0.93).

Both of the treatment approaches accompanied by a significant improvement in the Universal California Los Angles (UCLA), active forward flexion, and active abduction increased (P < 0.001) [Table 1].

As the two groups, ULCA, active abduction and active forward flexion measurements were significantly different at the baseline, the analysis of covariance was utilized, in which by the adjustment of initial values, differences were detected between the groups in terms of neither UCLA (P = 0.27) nor active forward flexion (P = 0.97) and nor active abduction (P = 0.42). Besides, mean scores of pain (P = 0.09) and function (P = 0.57) were insignificantly different between the assessed groups using independent *t*-test [Table 2].

Covariance analysis showed that after the surgery (by adjusting the values before the intervention) the mean score of pain was not significantly different between two groups (P = 0.87); however, the mean score of patients' function was significantly higher in the open surgery treated patients as compared to the arthroscopic-treated ones (P = 0.026) [Table 2].

Discussion

Due to the fewer invasions, the arthroscopic technique has become the gold standard approach for the treatment of rotator cuff tear, while a question has not been responded, whether open surgery is still warranted.[8] The current study has been designed to compare the outcomes of the two routine techniques used for the surgical treatment of rotator cuff tear, open surgery versus arthroscopic technique. Our research has notable limitations, including failure to divide the tears into stages based on the size of tears, stage of supraspinatus retraction,[9] and fatty degeneration of supraspinatus and infraspinatus muscles.[10] However, our research found that the two techniques posed remarkable

Table 1: Comparison of preoperative and postoperative movement indices among study population

Variable		Preoperative		Postoperative		*P*
		Mean	SD	Mean	SD	
Open surgery	UCLA*	10.5	3.1	22.1	8.1	< 0.001**
	Active Forward Flexion	55.2	2.22	108	36.6	< 0.001**
	Active Abduction	48	14.6	111	44.3	< 0.001**
Arthroscopy	UCLA*	12.8	4.4	25.2	9.4	< 0.001**
	Active Forward Flexion	68.1	28	111.7	39.1	< 0.001**
	Active Abduction	63.8	6.6	119.8	36.2	< 0.001**

Universal California Los Angles: *. Statistically Significant: **

Table 2: Comparison of pain and function preoperatively and postoperatively among study population

Variable	Arthroscopy		Open surgery		P^1	P^2
	Mean	SD	Mean	SD		
Preoperative Pain	3.2	1.8	4.3	2.5	0.09	0.87
Postoperative Pain	6.8	2.07	7.8	2.8	0.21	
Preoperative Function	2.6	1.7	2.8	1.9	0.57	0.026
Postoperative Function	4.5	2.9	6.5	3.2	0.02	

P^1: Independent *T*-Test. P^2: ANCOVA Test

improvement in the ULCA score and range of motion in active abduction and forward flexion. Despite the similar pain scores, an open surgical approach for the treatment of rotator cuff tear accompanied with significant superior function to arthroscopic treatment. On the other hand, the strength of this report is the duration of follow-up, as most of the re-tears occur within the first postoperative year[11,12] while we have followed the patients for 36 months.

Numerous studies in the literature have compared mini-open surgery with arthroscopic techniques in which they have presented nonsignificant differences in outcome measurements.[13-16] There are a few studies that have compared open surgery with the arthroscopic approach. In the study conducted by Buess *et al*., the equality or mild superiority of arthroscopic technique was notified,[17] while the latter study by Bishop favored open surgery for large tears, due to the less probability of re-tear by open surgical approach.[18] Another study was performed by Walton and Murrel, in which they compared 200 open surgeries versus 200 arthroscopic ones. In this study, they excluded the tears over 16 cm^2 and reported decompression requirements in all of the open surgeries, but 76% of arthroscopic ones. In general, they concluded that arthroscopic technique was superior to open surgery considering aspects such as operative time, rotator cuff muscle integrity, and the postoperative time of recovery.[19] These aspects are not evaluated in our study.

In our study, the clinical assessments showed remarkable superiority of open surgery in the function aspect only, but other aspects, including the range of motion or pain. These findings are consistent with the study by Bayle *et al*.[8] while contrary to other studies that presented a better range of motion following arthroscopic surgery.[17,19]

Although we have not assessed the postoperative complications of each technique, deltoid impairment due to detachment of this muscle during open surgery is a leading cause of orthopedists' preference for arthroscopic surgery, in contrast to open technique.[20] However, Cho *et al*. performed follow-up imaging for their study population and presented the thickness of the deltoid muscle due to both of the techniques.[21] In general, the risk of complications is considerably higher in open surgery, a fact that has deviated the orthopedists' attention toward arthroscopic technique.[22,23]

The diversity in the follow-up period of the patients, failure to categorizing the tear size, and failure to assess the postoperative complications are the significant limitations of the current study that should be considered in further reports.

Conclusion

Open and arthroscopic methods of rotator cuff tear repair are both effective for the improvement of the function, range of motion, and pain in patients with cuff tear. However, there are no significant differences in terms of pain relief and range of motion between the two groups. Nevertheless, the function of the patients underwent open surgery, improved more than the arthroscopic group.

Acknowledgment

The authors of this study acknowledge nurses and employees of orthopedics operation rooms of Alzahara and Kashani Hospitals affiliated at Isfahan University of Medical Sciences.

Financial support and sponsorship

The study was sponsored by Isfahan University of Medical Sciences.

Conflicts of interest

There are no conflicts of interest.

References

1. Eren I, Ozben H, Gunerbuyuk C, Koyuncu Ö, Aygün MS, Hatipoglu E, *et al*. Rotator cuff tear characteristics: How comparable are the pre-operative MRI findings with intra-operative measurements following debridement during arthroscopic repair? Int Orthop 2019;43:1171-7.
2. Kataoka T, Kokubu T, Muto T, Mifune Y, Inui A, Sakata R, *et al*. Rotator cuff tear healing process with graft augmentation of fascia lata in a rabbit model. J Orthop Surg Res 2018;13:200.
3. Osti L, Buda M, Andreotti M, Gerace E, Osti R, Massari L, *et al*. Arthroscopic-assisted latissimus dorsi transfer for massive rotator cuff tear: A systematic review. Br Med Bull 2018;128:23-35.
4. Kanji F, Naoya N, Taishi U, Hiroaki T. Arthroscopic superior capsule reconstruction for irreparable rotator cuff tear and axillary nerve palsy associated with anterior dislocation of the shoulder. J Orthop Case Rep 2018;8:100-3.
5. Hata Y, Saitoh S, Murakami N, Seki H, Nakatsuchi Y, Takaoka K. A less invasive surgery for rotator cuff tear: Mini-open repair. J Shoulder Elbow Surg 2001;10:11-6.
6. Ryösä A, Laimi K, Äärimaa V, Lehtimäki K, Kukkonen J, Saltychev M. Surgery or conservative treatment for rotator cuff tear: A meta-analysis. Disabil Rehabil 2017;39:1357-63.
7. Yoo JC, Lim TK, Kim DH, Koh KH. Comparison between the patients with surgery and without surgery after recommendation of surgical repair for symptomatic rotator cuff tear. J Orthop Sci 2018;23:64-9.
8. Bayle X, Pham TT, Faruch M, Gobet A, Mansat P, Bonnevialle N. No difference in outcome for open versus arthroscopic rotator cuff repair: A prospective comparative trial. Arch Orthop Trauma Surg 2017;137:1707-12.

9. Patte D. Classification of rotator cuff lesions. Clin Orthop Relat Res 1990; 1 (254):81-86:81-6.
10. Goutallier D, Postel JM, Bernageau J, Lavau L, Voisin MC. Fatty muscle degeneration in cuff ruptures. Pre- and postoperative evaluation by CT scan. Clin Orthop Relat Res 1994;(304); 78-83:78-83.
11. Kim JH, Hong IT, Ryu KJ, Bong ST, Lee YS, Kim JH. Retear rate in the late postoperative period after arthroscopic rotator cuff repair. Am J Sports Med 2014;42:2606-13.
12. Iannotti JP, Deutsch A, Green A, Rudicel S, Christensen J, Marraffino S, *et al*. Time to failure after rotator cuff repair: A prospective imaging study. J Bone Joint Surg Am 2013;95:965-71.
13. Ji X, Bi C, Wang F, Wang Q. Arthroscopic versus mini-open rotator cuff repair: An up-to-date meta-analysis of randomized controlled trials. Arthroscopy 2015;31:118-24.
14. Lindley K, Jones GL. Outcomes of arthroscopic versus open rotator cuff repair: A systematic review of the literature. Am J Orthop (Belle Mead NJ) 2010;39:592-600.
15. Kasten P, Keil C, Grieser T, Raiss P, Streich N, Loew M. Prospective randomised comparison of arthroscopic versus mini-open rotator cuff repair of the supraspinatus tendon. Int Orthop 2011;35:1663-70.
16. van der Zwaal P, Thomassen BJ, Nieuwenhuijse MJ, Lindenburg R, Swen JW, van Arkel ER. Clinical outcome in all-arthroscopic versus mini-open rotator cuff repair in small to medium-sized tears: A randomized controlled trial in 100 patients with 1-year follow-up. Arthroscopy 2013;29:266-73.
17. Buess E, Steuber KU, Waibl B. Open versus arthroscopic rotator cuff repair: A comparative view of 96 cases. Arthroscopy 2005;21:597-604.
18. Bishop J, Klepps S, Lo IK, Bird J, Gladstone JN, Flatow EL. Cuff integrity after arthroscopic versus open rotator cuff repair: A prospective study. J Shoulder Elbow Surg 2006;15:290-9.
19. Walton JR, Murrell GA. A two-year clinical outcomes study of 400 patients, comparing open surgery and arthroscopy for rotator cuff repair. Bone Joint Res 2012;1:210-7.
20. Gumina S, Di Giorgio G, Perugia D, Postacchini F. Deltoid detachment consequent to open surgical repair of massive rotator cuff tears. Int Orthop 2008;32:81-4.
21. Cho NS, Cha SW, Rhee YG. Alterations of the deltoid muscle after open versus arthroscopic rotator cuff repair. Am J Sports Med 2015;43:2927-34.
22. Vopat BG, Lee BJ, DeStefano S, Waryasz GR, Kane PM, Gallacher SE, *et al*. Risk factors for infection after rotator cuff repair. Arthroscopy 2016;32:428-34.
23. Owens BD, Williams AE, Wolf JM. Risk factors for surgical complications in rotator cuff repair in a veteran population. J Shoulder Elbow Surg 2015;24:1707-12.