

No difference in outcome for open versus arthroscopic rotator cuff repair: a prospective comparative trial

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Abstract

Purpose Arthroscopic techniques tend to become the gold standard in rotator cuff repair. However, little data are reported in the literature regarding the improvement of post-operative outcomes and re-tear rate relative to conventional open surgery. The aim of this study was to compare clinical outcomes and cuff integrity after arthroscopic versus open cuff repair.

Methods We prospectively assessed clinical outcomes and cuff integrity after an arthroscopic or open rotator cuff repair with a minimum follow-up of 12 months. Clinical evaluation was based on Constant score, Simple Shoulder Value (SSV) and American Shoulder and Elbow Score (ASES). Rotator cuff healing was explored with ultrasound.

Results 44 patients in arthroscopic group A (mean age 56-year-old) and 43 in open group O (mean age 61-year-old) fulfilled the inclusion criteria. Tendons were repaired with a single row technique associated with biceps tenodesis and subacromial decompression. All objective clinical scores significantly improved postoperatively in both groups. No statistical difference was identified between group A and O regarding, respectively, Constant score (72 vs 75 points;

$p = 0.3$), ASES score (88 vs 91 points; $p = 0.3$), and SSV (81 vs 85%). The overall rate of re-tear (Sugaya type IV or V) reached 7 and 9%, respectively, in group A and O ($p = 0.8$).

Conclusion This study did not prove any difference of arthroscopic over open surgery in case of rotator cuff repair regarding clinical outcome and cuff integrity at 1-year follow-up.

Level II Prospective comparative study.

Keywords Open surgery · Arthroscopy · Rotator cuff repair · Shoulder · Re-tear · Clinical outcomes

Introduction

Currently all arthroscopic technique trends to establish itself as the gold standard for rotator cuff repair. In 2005, it was reported that AAOS surgeons performed cuff repairs with arthroscopic, mini-open, and open technique in 14.5, 46.2, and 36.6%, respectively [1]. In 2012, only 15.7% of surgeons' respondent to ASES survey still used an open technique [2].

Only few studies compared open and arthroscopic rotator cuff repair and it remains unclear that arthroscopic is superior to open technique in term of clinical outcomes and tendon healing [3–8].

Therefore, the purpose of the study was to compare the postoperative clinical results and structural integrity of rotator cuff repairs performed either open or arthroscopically. We hypothesized that both techniques would achieve equivalent clinical outcomes and tendon repair integrity.

IRB approval: Approved study on number 17-0313.

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Methods

Study design and patients

The study was a prospective comparative cohort analysis of rotator cuff repairs between 2012 and 2013. Inclusion criteria were: patients operated on for a primary rotator cuff repair of supraspinatus and/or infraspinatus tendons tears, and reviewed with clinical examination and ultrasound evaluation with a minimum follow-up of 12 months.

Exclusion criteria were: prior surgical procedure on the shoulder, cuff tear extended to subscapularis tendon (full thickness tear), irreparable tears, and degenerative or inflammatory arthritis of the glenohumeral joint.

The institutional review board approved the research protocol (number 17-0313).

Eighty-seven patients were consecutively included and enrolled in an arthroscopic surgery (group A) or open surgery group (group O) according to the surgeon who performed the procedure (NB for arthroscopic and PM for open surgery).

Surgical technique

Patients received a preoperative interscalene block (single injection of Ropivacaine 7.5 mg/mL) and were placed in a beach-chair position under general anaesthesia in both group.

Arthroscopic technique: after intra-articular examination, a biceps tenotomy or tenodesis was done in every case because of tenosynovitis or instability. A subacromial decompression was performed systematically with a burr and the footprint on the greater tuberosity was abraded before tendon fixation. The cuff repair was performed with a single row of double-loaded threaded suture anchors placed lateral to the greater tuberosity with a tension band technique as described by Boileau et al. [5].

Open technique

Through a superior approach the anterior body of the deltoid was detached from the acromion to perform a subacromial decompression with an osteotome. The long head of the biceps was fixed to the transverse ligament in the groove, after the intra-articular portion has been resected. Then, the cuff was repaired onto the abraded greater tuberosity with trans osseous number 2 non absorbable sutures and Masson-Allen stitches. At the end of the procedure the deltoid was reattached to the acromion with trans osseous sutures.

Postoperative protocol

In both group a sling was placed for 6 weeks and passive range of motion as well as pendulum exercises were authorized from the day after the surgery. A physiotherapist controlled the rehabilitation program from the 2nd week to the 3rd month. Active motion started at 6 weeks. No heavy labour or activities were allowed before the 6 months.

Clinical assessment

All the patients were evaluated by an independent observer (XB or TTP) preoperatively, at 3 months, 6 months and 1 year after the surgery. At last follow-up, Constant score, American Shoulder and Elbow Surgeons (ASES) score and Simple Shoulder Value (SSV) were used [9, 10]. For active range of motion, elevation was measured with a goniometer (patient in a seated position) in the sagittal plane, external rotation was measured in the coronal plane with the arm by the patient's side, and internal rotation was measured by level when the patient was asked to reach behind to the highest vertebral level.

Radiological assessment

Preoperatively, tendon retraction was staged on MRI or arthro-CT scan according to Patte's classification and fatty degeneration according to Gouttalier [11, 12]. At follow-up, ultrasonographic evaluation was performed by two radiologists specialized in musculoskeletal disorders in a blinded double-check. Cuff repair integrity was classified into five types following Sugaya classification adapted for ultrasound [13]: type I, sufficient and homogeneous thickness; type II, sufficient, but heterogeneous thickness; type III, less than half the thickness without discontinuity; type IV, minor discontinuity; and type V, major discontinuity. In case of disagreement between the radiologists, the worst grade of healing was taken.

Statistical analysis

Descriptive statistical analysis consisted of means, maximum, minimum and standard deviations for continuous variables and percentages for discrete variables. Statistical comparisons between groups were performed with paired *t* tests or Wilcoxon test for continuous variables and the χ^2 or Fisher test for categorical variables. The significant difference was set at $p < 0.05$. All analyses were performed with the use of SAS software (SAS Institute, Cary, NC).

Results

Patients demographics

One hundred and eighteen patients were operated on for rotator cuff repair during the period of the study. Eighteen were excluded and 13 were lost before the minimum follow-up of 12 months, leaving 44 patients in group A and 43 in group O available for analysis.

As documented in Table 1, there was no statistical difference between group A and O regarding gender, trauma incidence, work compensation context, tobacco use, diabetes,

dominance side involved, active range of motion, preoperative Constant score, ASES score, and SSV. However, patients of group O were older and with smaller tears in group A (Table 2).

Clinical assessment

At mean follow-up of 13 months (12–17), Constant score, ASES score and SSV significantly improved post-operatively in both groups. No significant difference was detected between the two groups regarding total Constant score, ASES score, SSV (Table 3). However, active internal

Table 1 Preoperative analysis of group O and group A

	Group O (n = 43)	Group A (n = 44)	p
Age (years)	61.6 (43–78; ± 8)	55.6 (37–72; ± 7)	0.0026*
Gender (female/male)	17/26	20/24	0.57
Worker compensation	7 (16%)	10 (23%)	0.45
Traumatic etiology	13 (30%)	13 (30%)	0.94
Tobacco use	6 (14%)	10 (23%)	0.29
Diabetes	3 (7%)	4 (7%)	0.77
Dominant side involved	30 (70%)	36 (82%)	0.19
Mobility			
Elevation	121 (60–180; ± 34)	147 (60–180; ± 36)	0.65
External rotation at side (°)	39 (10–90; ± 15)	42 (10–80; ± 15)	0.38
Internal rotation (points)	6 (2–10; ± 3)	6 (2–10; ± 3)	0.9
Functional scores			
Total constant (points)	42	46	0.27
Adjusted constant (%)	52.1	55.5	0.42
ASES (points)	61.2	61.4	0.95
SSV (%)	42.4	45.9	0.45

* Significant difference at $p < 0.05$

Table 2 Preoperative analysis of tear patterns in group O and group A

	Group O (n = 43)	Group A (n = 44)	p
Tendon (s) involved			
Isolated supraspinatus	26 (61%)	28 (63%)	
Supraspinatus + infraspinatus	17 (39%)	16 (37%)	0.3
Stage of retraction of supraspinatus [11]			
Stage 1	11 (26%)	32 (72%)	< 0.0001*
Stage 2	26 (60%)	10 (23%)	0.0003*
Stage 3	6 (14%)	2 (5%)	0.13
Fatty degeneration of supraspinatus [12]			
Stage 0	32 (74%)	39 (89%)	0.08
Stage 1	8 (19%)	4 (9%)	0.19
Stage 2	3 (7%)	1 (2%)	0.29
Fatty degeneration of infraspinatus [12]			
Stage 0	32 (74%)	42 (95%)	0.006*
Stage 1	9 (20%)	2 (5%)	0.02*
Stage 2	2 (6%)	0	0.24

* Significant difference at $p < 0.05$

Table 3 Postoperative outcomes

Variable	Group O	Group A	<i>p</i> value
Constant score			
Pain (/15 points)	13 (5–15; ± 3)	12.6 (2.5–15; ± 4)	0.25
Activity (/20 points)	16.7 (5–20; ± 4)	16.2 (3–20; ± 5)	0.31
Mobility (/40 points)	36.2 (22–40; ± 4)	33.6 (8–40; ± 7)	0.02*
Strength (/25 points)	9 (1–20; ± 4)	10.1 (0–20; ± 5)	0.15
Total (/100 points)	75.4 (39–92; ± 12)	72.6 (15–95; ± 18)	0.20
Adjusted (%)	95 (41–136; ± 17)	87.9 (20–124; ± 24)	0.056
ASES score			
Pain (/5 points)	4 (0–5; ± 1)	3.9 (0–5; ± 2)	0.26
Activity (/60 points)	53 (30–60; ± 8)	51.8 (7–60; ± 11)	0.19
Strength (/20 points)	17.7 (12–20; ± 2)	17.4 (11–20; ± 3)	0.31
Stability (/15 points)	15	15	–
Total (/100 points)	75.4 (39–92; ± 12)	72.6 (15–95; ± 18)	0.16
SSV (/100%)	91.2 (68–100; ± 9)	88.5 (33–100; ± 15)	0.21
Active ROM			
Anterior elevation (°)	163 (110–180; ± 20)	160 (100–180; ± 27)	0.3
External rotation at side (°)	51 (25–80; ± 14)	48 (10–80; ± 16)	0.13
Internal rotation (points)	9 (4–10; ± 1)	7.6 (2–10; ± 3)	0.001*

* Significant difference at $p < 0.05$

rotation was significantly better in group O, as well as the mobility according the Constant score.

Tendon integrity

The rate of re-tear (stage IV and V) was 7 and 9%, respectively, for group A and O ($p = 0.8$) (Table 4).

Complications

One patient in each group developed capsulitis. Neither patient required further surgical intervention. No complication related to the deltoid detachment was observed in group O. No patient needed revision surgery (even in case of tendon re-tear) at the last follow-up.

Discussion

This study compared open and arthroscopic cuff repair in a prospective case series. Because arthroscopic technique became the gold standard over the past decade, the debate is to know if open surgery is still warranted or not. Therefore, we demonstrated that there was not any significant difference

between both techniques, regarding functional outcomes and cuff integrity at the minimum follow-up of 12 months.

This study has some limitations. Firstly, patients were not randomly included in arthroscopic or open group. Thereby, two different surgeons performed two different technique of cuff repair. However, each of them had a wide experience in his own technique and could attest of its reproducibility. This allowed to compare properly the outcomes of both technique. Secondly, the number of patients lost of follow-up was high (13 patients). The main reason was the lack of clinical and ultrasound examination at 12 months for many of them. Because the number of patient lost was equivalent in each group (group O $n = 7$; group A $n = 6$), this bias should not impact our comparative analysis and as far as the 6th postoperative month, none of them needed a revision surgery or complained of unsatisfactory results. In addition, both group were not perfectly similar in terms of age and tear size, which could have specifically an impact on tendon healing and clinical outcomes. Finally, the follow-up for clinical and ultrasound evaluation was only 1 year. However, it was previously reported that re-tears mainly occur during the first postoperative year [14, 15].

Previously several studies compared arthroscopic and mini-open surgery, and did not find any statistical differences

Table 4 Ultrasound evaluation in both group and results according Sugaya's classification

	Type I	Type II	Type III	Type IV	Type V
Group O ($n = 43$)	26% ($n = 11$)	63% ($n = 27$)	2% ($n = 1$)	9% ($n = 4$)	0
Group A ($n = 44$)	43% ($n = 19$)	50% ($n = 22$)	0	7% ($n = 3$)	0

in outcomes measurement [16–22]. Only few studies compared clearly open surgery to all arthroscopic procedure. Buess et al. [6] compared clinical results after open and arthroscopic rotator cuff repair. They concluded that arthroscopic cuff repair yielded equal or better results than open. However, the open group mixed conventional technique and mini-open (12 and 18 patients, respectively). In the same way, Bishop et al. [4] constructed in their prospective study a heterogeneous cohort of 24 open and 8 mini-open surgery compared to an arthroscopic cohort. They suggested that open technique should be chosen for large tears because of a lower rate of re-tears. Walton and Murrell [8] published a large series of 200 true open and 200 arthroscopic cuff repair. They excluded lesion that exceeded 16 cm² and did not report how they managed long head of the biceps' pathologies. A decompression was performed systematically in open group compared to 76% in arthroscopic group, and two different configurations of single row arthroscopic repair were used. However, they concluded that arthroscopic repair was superior to open regarding operative time, cuff integrity, and speed of postoperative recovery.

In our study, the clinical evaluation at follow-up did not highlight any difference between the two groups, except a greater active internal rotation after open surgery. However, this parameter did not influence overall clinical scores. This finding was contrary to many studies which were in favour of better range of motion after arthroscopic technique [6, 8]. However, it was observed that passive range of motion converging at 2 years of follow-up between both technique [8].

One relevant information of this study is that open surgery did not increase the rate of postoperative complications. We did not identify clinical deltoid impairment despite the detachment of its proximal origin [23]. This finding confirmed the study of Cho et al. [24] who explored with MRI postoperative thickness of the deltoid after open and arthroscopic surgery and did not find out any difference between both techniques.

However, in a large series of more than 1800 cuff repairs, Vopat et al. [25] reported that open technique was more at risk of infection than arthroscopic surgery, as well as to be a male and to have a high body mass index. Owens et al. [26] confirmed a higher incidence of complication and hospital readmission after open cuff repair in a veteran population.

Conclusion

This study did not demonstrate any difference of arthroscopic over open surgery in case of rotator cuff repair regarding clinical outcome and cuff integrity at 1-year follow-up. Moreover, the rate of postoperative complication remained low in both group and this cannot be an argument to support one technique.

Compliance with ethical standards

Financial biases None.

Conflict of interest The authors declare that they have no conflict of interest.

References

- Dunn WR, Schackman BR, Walsh C et al (2005) Variation in orthopaedic surgeons' perceptions about the indications for rotator cuff surgery. *J Bone Jt Surg Am* 87:1978–1984
- Acevedo DC, Paxton ES, Williams GR, Abboud JA (2014) A survey of expert opinion regarding rotator cuff repair. *J Bone Jt Surg Am* 16(96):e123
- Adla DN, Rowsell M, Pandey R (2010) Cost-effectiveness of open versus arthroscopic rotator cuff repair. *J Shoulder Elbow Surg* 19:258–261
- Bishop J, Klepps S, Lo IK, Bird J, Gladstone JN, Flatow EL (2006) Cuff integrity after arthroscopic versus open rotator cuff repair: a prospective study. *J Shoulder Elbow Surg* 15:290–299
- Boileau P, Brassart N, Watkinson DJ, Carles M, Hatzidakis AM, Krishnan SG (2005) Arthroscopic repair of full-thickness tears of the supraspinatus: does the tendon really heal? *J Bone Jt Surg Am* 87:1229–1240
- Buess E, Steuber KU, Waibl B (2005) Open versus arthroscopic rotator cuff repair: a comparative view of 96 cases. *Arthroscopy* 21:597–604
- Ide J, Maeda S, Takagi K (2005) A comparison of arthroscopic and open rotator cuff repair. *Arthroscopy* 21:1090–1098
- Walton JR, Murrell GA (2012) A two-year clinical outcomes study of 400 patients, comparing open surgery and arthroscopy for rotator cuff repair. *Bone Jt Res* 1:210–217
- Constant CR, Murley AH (1987) A clinical method of functional assessment of the shoulder. *Clin Orthop Relat Res* 214:160–164
- Richards RR, An KN, Bigliani LU, Friedman RJ et al (1994) A standardized method for the assessment of shoulder function. *J Shoulder Elbow Surg* 3:347–352
- Patte D (1990) Classification of rotator cuff lesions. *Clin Orthop Relat Res* 254:81–86
- Goutallier D, Postel JM, Bernageau J, Lavau L, Voisin MC (1994) Fatty muscle degeneration in cuff ruptures. Pre- and postoperative evaluation by CT scan. *Clin Orthop Relat Res* 304:78–83
- Sugaya H, Maeda K, Matsuki K, Moriishi J (2007) Repair integrity and functional outcome after arthroscopic double-row rotator cuff repair. A prospective outcome study. *J Bone Jt Surg Am* 89:953–960
- Kim JH, Hong IT, Ryu KJ, Bong ST, Lee YS, Kim JH (2014) Retear rate in the late postoperative period after arthroscopic rotator cuff repair. *Am J Sports Med* 42:2606–2613
- Iannotti JP, Deutsch A, Green A et al (2013) Time to failure after rotator cuff repair: a prospective imaging study. *J Bone Jt Surg Am* 95(11):965–971
- Ji X, Bi C, Wang F, Wang Q (2015) Arthroscopic versus mini-open rotator cuff repair: an up-to-date meta-analysis of randomized controlled trials. *Arthroscopy* 31:118–124
- Kim SH, Ha KI, Park JH, Kang JS, Oh SK, Oh I (2003) Arthroscopic versus mini-open salvage repair of the rotator cuff tear: outcome analysis at 2 to 6 years' follow-up. *Arthroscopy* 19:746–754
- Lindley K, Jones GL (2010) Outcomes of arthroscopic versus open rotator cuff repair: a systematic review of the literature. *Am J Orthop (Belle Mead NJ)* 39:592–600

19. van der Zwaal P, Thomassen BJ, Nieuwenhuijse MJ, Lindenburg R, Swen JW, van Arkel ER (2012) 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* 29:266–273
20. Youm T, Murray DH, Kubiak EN, Rokito AS, Zuckerman JD (2005) Arthroscopic versus mini-open rotator cuff repair: a comparison of clinical outcomes and patient satisfaction. *J Shoulder Elbow Surg* 14:455–459
21. Osti L, Papalia R, Paganelli M, Denaro E, Maffulli N (2010) Arthroscopic vs mini-open rotator cuff repair. A quality of life impairment study. *Int Orthop* 34:389–394
22. Kasten P, Keil C, Grieser T, Raiss P, Streich N, Loew M (2011) Prospective randomised comparison of arthroscopic versus mini-open rotator cuff repair of the supraspinatus tendon. *Int Orthop* 35:1663–1670
23. Gumina S, Di Giorgio G, Perugia D, Postacchini F (2008) Deltoid detachment consequent to open surgical repair of massive rotator cuff tears. *Int Orthop* 32:81–84
24. Cho NS, Cha SW, Rhee YG (2015) Alterations of the deltoid muscle after open versus arthroscopic rotator cuff repair. *Am J Sports Med* 43:2927–2934
25. Vopat BG, Lee BJ, DeStefano S et al (2016) Risk factors for infection after rotator cuff repair. *Arthroscopy* 32:428–434
26. Owens BD, Williams AE, Wolf JM (2015) Risk factors for surgical complications in rotator cuff repair in a veteran population. *J Shoulder Elbow Surg* 24:1707–1712