International Orthopaedics (SICOT) (2010) 34:389–394
DOI 10.1007/s00264-009-0796-z

ORIGINAL PAPER

Arthroscopic vs mini-open rotator cuff repair. A quality of life impairment study

Leonardo Osti · Rocco Papalia · Massimo Paganelli · Enzo Denaro · Nicola Maffulli

Received: 16 February 2009 / Revised: 22 April 2009 / Accepted: 22 April 2009 / Published online: 8 May 2009

Abstract We compared the clinical and quality of life related outcome of rotator cuff repair performed using either a mini-open or an arthroscopic technique for rotator cuff tears of less than 3 cm. The records of 64 patients who underwent rotator cuff repair between September 2003 and September 2005 were evaluated. Thirty-two patients underwent a mini-open rotator cuff repair, and 32 patients underwent an arthroscopic rotator cuff repair. The mean follow-up period was 31 months in the mini-open group and 30.6 months in the arthroscopic group ($P>0.05$). The UCLA rating system, range of motion examination and the self-administered SF-36 used for postoperative evaluation showed a statistically significant improvement from the preoperative to the final score for both groups ($P<0.05$). No statistically significant difference in the total UCLA scores was found when comparing the two repair techniques ($P> 0.05$). This study suggests that there is no difference in terms of subjective and objective outcomes between the two surgical procedures studied if patients have rotator cuff tears of less than 3 cm.

L. Osti
Unit of Arthroscopy and Sports Trauma Surgery,
Hesperia Hospital,
Via Arquà 80/b,
Modena, Italy

R. Papalia · E. Denaro
Department of Orthopaedic and Trauma Surgery,
Campus Biomedico University of Rome,
Via Alvaro del Portillo 200,
Rome, Italy

M. Paganelli
Unit of Orthopaedic and Trauma Surgery, Lugo Hospital,
Viale Dante 10,
48022 Lugo, Ravenna, Italy

N. Maffulli (✉)
Centre for Sports and Exercise Medicine, Barts and The London School of Medicine and Dentistry, Mile End Hospital,
275 Bancroft Road,
London E1 4DG, England
e-mail: n.maffulli@qmul.ac.uk

Introduction

Rotator cuff pathology is a an important determinant of overall health status, with a marked impact on an individual's quality of life [1]. Patients with shoulder pain and function impairment not responding to appropriate nonsurgical management are candidates for surgery [2, 3], ranging from open to arthroscopic repairs [4, 5].

We evaluated the effectiveness in term of patient's status and quality of life of rotator cuff repair in two groups of patients: one receiving a mini-open rotator cuff repair (MOR) and the other receiving an arthroscopic rotator cuff repair (FAR). We tested the null hypothesis that, in an homogenous group of patients with an arthroscopically confirmed lesion of the rotator cuff <3 cm, there is no difference between repair through a mini-open approach and an arthroscopic repair.

Materials and methods

Eligibility criteria

Patients were included in the study if they had a rotator cuff tear diagnosed on clinical grounds and magnetic resonance

imaging, or a rotator cuff tear ≤3 cm found at the time of surgery, with no radiographic signs of fracture of the glenoid or the greater or lesser tuberosity, and no episodes of shoulder instability. Patients were excluded from the study if they had inflammatory joint disease, a Bankart's lesion glenohumeral osteoarthritis, prior surgery on the affected shoulder, an arthroscopic diagnosis of subscapularis tears, other general comoribidities (cardiovascular and neurological diseases, diabetes) or psychiatric illness. Patients with workers' compensation claims or patients older than 60 years were also excluded from the study.

Study design

A total of 64 patients operated upon for unilateral cuff tears ≤3 cm repaired between September 2003 and September 2005 by one single fully trained orthopaedic surgeon with a special interest in arthroscopic surgery met our inclusion criteria. There were two groups according to surgical repair method used, namely, the mini-open rotator cuff repair group (MOR group) and the arthroscopic rotator cuff repair group (AR group). The MOR group included 32 patients, 18 men and 14 women, with an average age of 56.0 years (range 48–60, SD 3.4, 95%CI 54.8–57.3). The AR group included 32 patients, 15 men and 17 women, with an average age of 56.1 years (range 46–60, SD 3.7, 95%CI 54.7–57.4).

Surgical technique

All the patients received a preoperative interscalene block. All the procedures were performed by one single surgeon, with the patient in beach chair position with 8–10 lb of traction applied to the arm to be operated upon. Gravity joint irrigation was provided using four litre saline bags hung at a height of 8 feet. An arthroscopic pump was not used. After a careful arthroscopic evaluation of the full thickness rotator cuff tear through standard posterior and anterior portals, a bursectomy and limited acromioplasty were performed through the lateral portal. The tear size was measured using a standard-sized shaver graduated instrument (Arthex, Naples, Florida, USA) and classified according to their size as small (<1 cm), medium (1–3 cm), and large (3–5 cm).

AR approach

The footprint was identified in the greater tuberosity and prepared using a motorised shaver (Arthex, Naples, Florida, USA) to obtain a bleeding surface. We performed a single row repair using metal anchors (Corkscrew; Arthrex). The anchors were placed through an additional percutaneous access to obtain optimal anchor orientation at 45°. The tendons were repaired using two pairs of non-absorbable no. 2 sutures (Arthrex, Naples, Florida, USA) from the anchors and secured through the tendon by a suture passer (Viper; Arthrex). The sutures were tied using a sliding knot with simple half-hitches on alternating posts.

MOR approach

The rotator cuff tear was located arthroscopically by inserting a spinal needle percutaneously. A 3–4-cm longitudinal skin incision was made in the direction determined by following the spinal needle. The deltoid muscle was split in line with its fibres, and the rotator cuff was exposed.

The footprint underwent minimal shaving using a rasp. The rotator cuff tear was repaired in the same way as in the AR group using a single row configuration with metal anchor (Corkscrew; Arthrex) oriented at 45°. The tendons were repaired using two pairs of non-absorbable no. 2 sutures (Arthrex) from the anchors, and secured through the tendon by a free needle. The sutures were tied in the same way as in the AR group.

Postoperative management

Postoperative management was the same for both groups. The arm was supported using a sling with 30° of abduction for three weeks. Pendulum exercises and active elbow flexion and extension were allowed starting from the first postoperative day. Assisted passive ROM started within the first two weeks and was maintained within a comfortable range until six weeks postoperatively to avoid damaging the repair.

Water rehabilitation was encouraged starting after the third postoperative week. At six weeks, overhead stretching with a rope and pulley were allowed without restriction. Rehabilitation of the rotator cuff and exercises aimed at stabilising the scapula were initiated at 10–12 weeks after the operation. Deltoid strengthening with low resistance was started after at least three months after the procedure in patients who had regained 90% of the full range of motion of the operated shoulder. Heavy manual work and overhead activities were allowed after a good restoration of shoulder strength, which occurred six to ten months after surgery.

Evaluation

An author not involved in the surgical procedure performed all the outcome assessments. We performed preoperative evaluations the day before surgery and report the results of postoperative evaluation at six months and at final follow-up at an average of 31 months (range 24–42, SD 5.4, 95% CI 29.0–32.9) in the MOR group and 30.6 months (range 24–40, SD 4.5, 95% CI 29.0–32.2) in

the AR group ($P > 0.05$) after the operation. Each patient was evaluated for pre- and postoperative range of motion (ROM), pre- and postoperative modified shoulder score (UCLA), as well as pre- and postoperative SF-36 self administered questionnaire.

Imaging

All patients received a standard preoperative assessment using standard radiographs (anteroposterior projections, neutral, external and internal rotation) and MRI scans. Oblique coronal, oblique sagittal and axial T2-weighted spin-echo MRIs (repetition time [RT] 3,200 ms; echo time [ET] 85 ms) were obtained in all patients.

Functional assessment

A modified University of California, Los Angeles (UCLA) [6] rating scale for pain, function, ROM, and patient satisfaction was used to evaluate each patient preoperatively and at follow-up. The maximum score obtainable was 35, and the results were classified as excellent (34–35), good (28–33), fair (21–27), or poor (0–20).

Range of motion

The shoulder range of motion (forward elevation, external rotation and internal rotation) was recorded preoperatively and at six months and two years after the surgery. Measurements were made, following standard guidelines [7], in the supine position with the scapula stabilised by anterior pressure on the shoulder against the examining table. The examiner obtained three measurements for each shoulder, and the mathematical mean was used for statistical purposes.

Quality of life (SF 36)

All patients completed a self-administered SF-36. The SF36 is a 36-item questionnaire widely used to measure health status. Scores for each item range from 0 (poor) to 100 (good) [8, 9].

Statistics

Data were presented using the mean, standard deviation, 95% CI and range and data ranges as appropriate. Statistical analysis was done with the SPSS software package, version 11.0 (SPSS, Chicago, IL, USA). The analyses between the differences in means were performed by analysis of variance (ANOVA) and paired-samples *t* test. Significance was set at $P<0.05$.

Results

In the MOR group, the rotator cuff tears were classified as small (<1 cm) in seven patients, and medium (1–3 cm) in 25 patients. In the AR group, the rotator cuff tears were classified as small (<1 cm) in nine patients, and medium (1–3 cm) in 23 patients, with no statistically significant difference in the distribution of the size of rotator cuff tears between the groups ($P>0.05$) (ANOVA).

The number of suture anchors used to repair the rotator cuff tear varied with the size of the tear; we used 1.75 (range 1–2) anchors in the MOR group, and 1.63 anchors (range 1–2) in the AR group ($P>0.05$) (ANOVA).

Because of associated biceps tendon pathology, nine patients required a tenotomy and three patients a tenodesis in the MOR group, and ten patients required a tenotomy and three patients a tenodesis in the AR group ($P>.0.05$).

There were no intra- or perioperative complications.

Clinical findings

MOR group

The range of motion of the affected shoulder improved from the baseline to last follow-up. Forward flexion averaged 84° (SD 32°, 95% CI 73–96°) preoperatively and 157° (SD 8°, 95% CI 154–160°) at the last follow-up ($P<.0.001$). External rotation improved from a mean of 81° (SD 7.8°, 95% CI 79–84°) preoperatively to a mean of 126° (SD 14, 95% CI 121–131°) at the latest follow-up ($P<.0.001$). The mean internal rotation improved from 28° (SD 2°, 95% CI 27–29°) at baseline to 38° (SD 4, 95% CI 36–39°) at the latest follow-up ($P<.0.001$). Using the modified UCLA rating system, the MOR group demonstrated a statistically significant improvement from a mean preoperative rating of 11 (SD 2, 95% CI 10–11) to a mean 32 (SD 2, 95% CI 31–33) at the latest follow-up ($P<.0.001$) (Table 1).

AR group

The range of motion of the affected shoulder improved from the baseline to last follow-up. Forward flexion averaged 85° (SD 31°, 95% CI 74–96°) preoperatively and 157° (SD 9°, 95% CI 154–160°) at the latest follow-up ($P< 0.001$). External rotation improved from a mean of 81° (SD 8°, 95% CI 78–85°) preoperatively to a mean of 125° (SD 13°; 95% CI 120–130°) at the latest follow-up ($P<0.001$). The mean internal rotation improved from 28° (SD 3°, 95% CI 27–29°) at baseline to 38° (SD 3, 95% CI 36–39°) at the latest follow-up ($P< 0.001$). Using the modified UCLA rating system, the AR group demonstrated a statistically significant improvement from a mean preoperative rating of

Table 1 Clinical findings[a]

Evaluation	MOR group			AR group		
	Baseline	Six months[b]	Latest follow-up[b]	Baseline	Six months[b]	Latest follow-up[b]
Forward flexion[c] (deg)	84 (32; 73–96)	120 (21; 112–127)	157 (8; 155–160)	85.2 (31; 74–96)	107 (30; 96–118)	157 (9; 154–160)
External rotation[c] (deg)	81 (8; 79–84)	99 (15; 94–105)	126 (14; 121–131)	81 (8; 78–85)	101 (14; 96–107)	125 (13; 120–130)
Internal rotation[c] (deg)	28 (2; 28–29)	33 (3; 31–34)	38 (3; 37–39)	28 (23; 27–29)	32 (3; 31–34)	38 (3; 36–39)
UCLA[c]	11 (2; 10–11)	23 (5; 21–25)	32 (2; 31–33)	11 (2; 10–11)	21 (4; 20–23)	31 (3; 30–32)

[a] Analysed using repeated-measures analysis of variance. The values given as mean score (SD; 95% CI)

[b] $P<0.001$ between baseline and latest follow-up

[c] No group to group differences preoperatively and at latest follow-up ($P>0.05$)

11 (SD 2, 95% CI 10–11) to a mean of 31 (SD 3, 95% CI 30–32) at the latest follow-up ($P<0.001$) (Table 1). At the latest follow-up, there were no statistically significant differences between the MOR and the AR groups.

Quality of life (SF-36)

The SF-36 demonstrated a significant improvement in comparison to their preoperative scores ($P<0.001$). The AR group showed improvement similar to the MOR group at all postoperative intervals in all the categories. There were no statistically significant differences between the two groups ($P>0.05$) (Table 2).

Discussion

The goal of rotator cuff repair is to decrease pain and improve shoulder function and quality of life [10]. We compared clinical and health related quality of life outcomes of two similar cohorts of patients younger than 60 years of age and treated with either mini-open repair or arthroscopic rotator cuff repair for an arthroscopically confirmed lesion of the rotator cuff <3 cm (small and medium tears). The marked improvement from pre- to postoperative scores using either repair supports the null hypothesis that there is no difference in terms of subjective and objective outcomes between the two surgical proce-

Table 2 SF-36 outcomes[a]

Measure [b]	MOR group			AR group		
	Baseline	Six months	Latest follow-up[c]	Baseline	Six months	Latest follow-up[c]
Physical functioning	45.0 (5.39; 43.1–46.9)	53.3 (7.9; 50.4–56.1)	65.1 (5.1; 63.3–66.9)	45.0 (5.6; 43.0–47.0)	51.5 (5.4; 49.6–53.4)	66.7 (4.3; 65.1–68.2)
Role physical	24.3 (4.7; 22.6–26.0)	37.2 (7.9; 34.3–40.0)	48.7 (7.1; 46.1–51.2)	23.8 (2.9; 22.7–24.8)	39.1 (7.7; 36.3–41.9)	50.0 (5.5; 48.0–52.0)
Bodily pain	32.0 (4.1; 30.5–33.5)	44.6 (9.6 ; 7.7–12.8)	58.5 (6.1; 56.3–60.7)	30.3 (4.0; 28.9–31.8)	47.7 (7.1; 45.1–50.2)	59.3 (4.5; 57.7–61.0)
General health	23.1 (3.4; 21.9–24.4)	37.0 (8.7; 33.9–40.2)	49.5 (5.3; 47.6–51.4)	22.5 (2.9; 21.5–23.6)	34.7 (6.9; 32.2–37.2)	48.5 (5.0; 46.7–50.3)
Vitality	43.1 (4.2; 41.6–44.7)	47.0 (4.1; 45.5–48.4)	53.3 (3.8; 51.9–54.7)	42.4 (4.4; 40.8–44.0)	46.0 (5.5; 44.0–47.9)	50.5 (7.3; 47.9–53.2)
Social functioning	51.3 (3.9; 49.9–52.7)	57.6 (5.0; 55.8–59.4)	69.2 (4.6; 67.5–70.8)	50.1 (4.8, 48.3–51.8)	58.4 (6.7; 56.0–60.8)	67.9 (4.2; 66.4–69.4)
Role emotional	41.5 (5.4; 39.6–43.5)	51.5 (6.7; 49.1–53.99	67.7 (5.6; 65.7–69.7)	42.1 (5.8; 40.0–44.2)	49.7 (6.0; 47.5–51.9)	66.8 (5.1; 64.9–68.6)
Mental health	48.7 (4.2; 47.2–50.2)	54.7 (4.9; 53.0–56.5)	61.3 (5.2; 59.4–63.1)	48.5 (6.1; 46.3–50.7)	52.8 (5.1; 50.9–54.6)	58.2 (8.5; 55.1–61.3)

[a] Analysed using repeated-measures analysis of variance. The values given as mean score (SD; 95% CI)

[b] No group to group differences preoperatively and at latest follow-up ($P>0.05$)

[c] $P<0.001$ between baseline and latest follow-up

dures studied at an average follow-up of more that two years if the patients have rotator cuff tears less than 3 cm. The major strengths of this study are that a single fully-trained surgeon performed all the operations using a well-established technique and that the follow-up evaluations were performed by independent assessors. A limitation is the retrospective nature of the study, which leads to bias in selecting the patients. Moreover, the use of two different procedures for biceps tendon pathology inevitably introduced a bias. In our sample, however, we did not note discernable differences in results in terms of patients' satisfaction or general status, using either a tenotomy or tenodesis [11].

There are only a few published articles reporting on quality of life in patients operated upon with either mini-open or arthroscopic rotator cuff repair.

Kang et al. [12] reported, in a retrospective study of 63 patients treated with mini-open rotator cuff repair and 65 treated with arthroscopic rotator cuff repair, no statistically significant improvements at six months in SF-36 general health, role-emotional, and mental health.

Pearsall et al. [13] used a case-control study design to report on 52 patients treated with either technique. Although there was a significant improvement in clinical outcome from preoperative (UCLA, SST, Constant and Murley score) to the latest follow-up, the SF-36 was not significantly different postoperatively.

Gartsman et al. [14] reported highly significant improvements in both general health and function of the shoulder in 55 consecutive patients treated with arthroscopic repair for full-thickness tears of the rotator cuff. They used the SF-36, UCLA, and ASES scores to assess the outcomes, and concluded that SF-36 score could demonstrate the impact of orthopaedic pathology as well as the outcomes of the treatment.

Baysal et al. [10] assessed the quality of life results by administration of the Western Ontario Rotator Cuff (WORC) index and the American Shoulder and Elbow Surgeons (ASES) questionnaire. They found no significant changes in shoulder pain and function between one and five years after the repair at a median of five years postoperatively in 69% of the patients.

Mothadi et al. [2] conducted a randomised clinical trial to compare open surgery to arthroscopic acromioplasty with mini-open repair using a disease-specific quality of life questionnaire (RC-QOL). They found similar results in terms of quality of life between two groups at final follow-up. On the other hand, at three months the mini-open group showed a better RC-QOL score than the open group (55.6) (P=0.005). This finding is related to the low invasive nature of mini-open repair.

We used the SF-36 self-administered questionnaire. Although the SF-36 is not joint specific [15, 16], it can show the impact of rotator cuff repair in patients without other major illnesses [17]. We found a statistically significant improvement from baseline to six months and to last follow-up using both repair techniques (AR and MOR). These results could arise from accurate patient selection excluding confounding factors such as other general comoribidities, psychiatric pathology or patients with workers' compensation claims [18, 19], which would alter the components of the SF-36 questionnaire. Furthermore, we compared only rotator cuff tears with similar size and with similar fixation (suture anchor).

Previous studies demonstrated the fixation strength for suture anchor repairs [20, 21]. The UCLA scores and ROM findings improved significantly from baseline to the last follow-up [14, 22–24].

Several papers reported satisfactory results with acromioplasty for the management of partial and full-thickness rotator cuff tears [25, 26]. Moreover, Norlin et al. [27] found good long-term results (10–13 years) for full thickness small defects using only subacromial decompression. Indeed, several studies reported subjective improvement of the Short Form 36 outcomes in comparison to preoperative status, performing cuff repair without decompression for full-thickness rotator cuff tears [28–30].

In our sample, a bursectomy and limited acromioplasty were associated with the arthroscopic repair, but the effect of the procedure on general outcome was not quantifiable, since it was performed in all patients.

In the future, there is a need for a randomised clinical trial to evaluate outcome after rotator cuff repair with either mini-open repair or the arthroscopic technique using at least two health-related quality of life questionnaires—one regarding the general health status and the other joint specific to evaluate the real impact of rotator cuff repair on the quality of life.

Conclusion

There are no differences in objective and subjective outcomes with AR and MOR techniques in rotator cuff tears less than 3 cm. When facing patients with these tears, surgeons should chose the technique they are more familiar with, as the objective and subjective results using either technique are equally good and predictable.

References

1. MacDermid JC, Holtby R, Razmjou H, Bryant D (2006) All-arthroscopic versus mini-open repair of small or moderate-sized rotator cuff tears: a protocol for a randomized trial [NCT00128076]. BMC Musculoskelet Disord 7:25. doi:10.1186/1471-2474-7-25

2. Mohtadi NG, Hollinshead RM, Sasyniuk TM, Fletcher JA, Chan DS, Li FX (2008) 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 36:1043–1051
3. Codman EA (1984) The shoulder: rupture of the supraspinatus tendon and other lesions in or about the subacromial bursa, reprint ed. Robert E Krieger, Malabar, FL
4. Bigliani LU, Cordasco FA, McIlveen SJ, Musso ES (1992) Operative treatment of failed repairs of the rotator cuff. J Bone Joint Surg Am 74:1505–1515
5. Motycka T, Kriegleder B, Landsiedl F (2001) Results of open repair of the rotator cuff–a long-term review of 79 shoulders. Arch Orthop Trauma Surg 121:148–151
6. Ellman H, Hanker G, Bayer M (1986) Repair of the rotator cuff. End-result study of factors influencing reconstruction. J Bone Joint Surg Am 68:1136–1144
7. American Academy of Orthopaedic Surgeons (1965) Joint motion: method of measuring and recording. Elsevier, Chicago, IL
8. Ware JE Jr (1987) Standards for validating health measures: definition and content. J Chronic Dis 40:473–480
9. Ware JE Jr, Sherbourne CD (1992) The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care 30:473–483
10. Baysal D, Balyk R, Otto D, Luciak-Corea C, Beaupre L (2005) Functional outcome and health-related quality of life after surgical repair of full-thickness rotator cuff tear using a mini-open technique. Am J Sports Med 33:1346–1355
11. Frost A, Zafar MS, Maffulli N (2009) Tenotomy versus tenodesis in the management of pathologic lesions of the tendon of the long head of the biceps brachii. Am J Sports Med 37:828–833
12. Kang L, Henn RF, Tashjian RZ, Green A (2007) Early outcome of arthroscopic rotator cuff repair: a matched comparison with mini-open rotator cuff repair. Arthroscopy 23:573–582
13. Pearsall AW 4th, Ibrahim KA, Madanagopal SG (2007) The results of arthroscopic versus mini-open repair for rotator cuff tears at mid-term follow-up. J Orthop Surg 2:24. doi:10.1186/1749-799X-2-24
14. Gartsman GM, Brinker MR, Khan M (1998) Early effectiveness of arthroscopic repair for full-thickness tears of the rotator cuff: an outcome analysis. J Bone Joint Surg Am 80:33–40
15. Beaton D, Richards RR (1998) Assessing the reliability and responsiveness of 5 shoulder questionnaires. J Shoulder Elbow Surg 7:565–572
16. Gay RE, Amadio PC, Johnson JC (2003) Comparative responsiveness of the disabilities of the arm, shoulder, and hand, the carpal tunnel questionnaire, and the SF-36 to clinical change after carpal tunnel release. J Hand Surg [Am] 28:250–254
17. MacDermid JC, Ramos J, Drosdowech D, Faber K, Patterson S (2004) The impact of rotator cuff pathology on isometric and isokinetic strength, function, and quality of life. J Shoulder Elbow Surg 13:593–598
18. McKee MD, Yoo DJ (2000) The effect of surgery for rotator cuff disease on general health status. Results of a prospective trial. J Bone Joint Surg Am 82-A:970–979
19. Henn RF 3rd, Kang L, Tashjian RZ, Green A (2008) Patients with workers' compensation claims have worse outcomes after rotator cuff repair. J Bone Joint Surg Am 90:2105–2113
20. Goradia VK, Mullen DJ, Boucher HR, Parks BG, O'Donnell JB (2001) Cyclic loading of rotator cuff repairs: A comparison of bioabsorbable tacks with metal suture anchors and transosseous sutures. Arthroscopy 17:360–364
21. Craft DV, Moseley JB, Cawley PW, Noble PC (1996) Fixation strength of rotator cuff repairs with suture anchors and the transosseous suture technique. J Shoulder Elbow Surg 5:32–40
22. 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
23. Tauro JC (1998) Arthroscopic rotator cuff repair: analysis of technique and results at 2- and 3-year follow-up. Arthroscopy 14:45–51
24. Warner JJ, Tetreault P, Lehtinen J, Zurakowski D (2005) Arthroscopic versus mini-open rotator cuff repair: a cohort comparison study. Arthroscopy 21:328–332
25. Cordasco FA, Backer M, Craig EV, Klein D, Warren RF (2002) The partial-thickness rotator cuff tear: is acromioplasty without repair sufficient? Am J Sports Med 30:257–260
26. De Baere T, Dubuc JE, Joris D, Delloye C (2004) Results of arthroscopic acromioplasty for chronic rotator cuff lesion. Acta Orthop Belg 70:520–524
27. Norlin R, Adolfsson L (2008) Small full-thickness tears do well ten to thirteen years after arthroscopic subacromial decompression. J Shoulder Elbow Surg 17:12S–16S
28. Budoff JE, Nirschl RP, Guidi EJ (1998) Debridement of partial-thickness tears of the rotator cuff without acromioplasty. Long-term follow-up and review of the literature. J Bone Joint Surg Am 80:733–748
29. Goldberg BA, Lippitt SB, Matsen FA 3rd (2001) Improvement in comfort and function after cuff repair without acromioplasty. Clin Orthop Relat Res 390:142–150
30. McCallister WV, Parsons IM, Titelman RM, Matsen FA 3rd (2005) Open rotator cuff repair without acromioplasty. J Bone Joint Surg Am 87:1278–1283