

Functional outcome of arthroscopic debridement for massive, irreparable rotator cuff tears

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Abstract. *Background and aim of the work.* Rotator cuff tears are a common cause of shoulder pain in the middle-aged population. The treatment of these lesions remains controversial and must be individualized on the basis of the type of patient, the clinical and anatomical picture. Arthroscopic debridement is indicated in painful massive tears, in the absence of severe functional impairment of the shoulder. The aim of this study is the evaluation of the short and medium term clinical results of this surgical procedure. *Methods.* We retrospectively assessed patients who underwent arthroscopic debridement surgery for massive rotator cuff injury in the period between January 2011 and December 2016 at our institution. A group of patients underwent a follow-up evaluation during which the Constant Score, Oxford Shoulder Score and NRS pain score were compiled. Those who were unable to attend the evaluation were assessed through a telephone questionnaire aimed at investigating pain and degree of satisfaction with the outcome of the treatment. *Results.* 93% of patients were satisfied with the results obtained, especially the decrease in pain, with an average NRS of 1.31 for patients undergoing the medical examination and 0.68 for patients contacted by telephone. The mean Constant score of the clinically evaluated patients was $75.6 \pm \text{sd}$, with a mean strength of $3.92 \pm \text{sd}$, while the mean value of the Oxford Shoulder Score was $16.8 \pm \text{sd}$. *Conclusions.* The study suggests that arthroscopic debridement is a viable therapeutic option for the surgical treatment of massive rotator cuff tears. The clinical results and patient satisfaction are conditioned by the preoperative functional status: an optimal outcome can be expected for painful shoulders with sufficiently preserved active mobility. A great advantage of arthroscopic debridement is the short and simple postoperative rehabilitation. (www.actabiomedica.it)

Key words: shoulder; massive rotator cuff tear; arthroscopic debridement.

Introduction

Rotator Cuff Tears (RCT) are a common source of pain and disability, especially in the elderly population (1). The management of patients affected by RCT includes several treatment options ranging from conservative methods to shoulder replacement. The treatment choice is influenced by different factors, that are related either to the lesion (size, location, pathogenesis, time of onset) or to the patient (age, clinical status,

functional demands) (2-6).

In case of symptomatic small and medium RCT, surgical repair usually yields to good outcomes and patients' satisfaction (7).

Conversely, massive RCT, are still a difficult and challenging problem (8). The definition of massive RCT varies in literature: in fact according to Cofield et al. (9, 10), a tear with antero-posterior or medio-lateral diameter ≥ 5 cm is considered massive, while Gerber et al.(11) defined massive a complete tear of

two or more tendons.

Rockwood and others defined irreparable tears as those that, because of their size and retraction, cannot be repaired primarily to their insertion onto the tuberosities despite conventional techniques of mobilization and soft-tissue releases (12).

According to Bedi et al (13) a massive RCT is considered irreparable if associated with cranial migration of the humeral head, and severe muscle atrophy and fatty infiltration.

The reported incidence of RCT varies from 5 to 40% and the prevalence increases with the age, reaching 50% in patients over 80 years old (14).

The real incidence of massive RCT is difficult to estimate (15), because they are often due to slow, degenerative process, associated with none or few symptoms; in fact several cadaveric and in vivo studies have shown that rates of asymptomatic rotator cuff tears increase proportionally with age, with 20% of patients in their 60s and up to 80% of patients over 80 years-old having tears (16).

However, given the insidious nature of rotator cuff disease, many patients do not seek treatment until considerable degeneration has occurred, presenting a formidable challenge to the surgeon (17).

In literature, several treatment modalities have been described for the management of massive RCT. Conservative therapies include non-steroidal anti-inflammatory drugs, local corticosteroids injections and rehabilitation programs to strengthen the deltoid and the residual cuff (18, 19). Surgical options include complete repair (interval slide or side to side technique), partial repair (20-23), superior capsular reconstruction (24-26), subacromial spacer (27-29), tendon transfer (30, 31), cuff debridement with or without tenotomy or tenodesis of the long head of the biceps (32-34), tuberopecty, graft with or without biceps augmentation, shoulder hemiarthroplasty and total shoulder reverse arthroplasty (35-37).

The main goal of arthroscopic debridement is pain relief and improvement of shoulder motion secondary to discomfort reduction, while strength recovery is not to be expected (38). Therefore, this procedure is mainly indicated in older patients with massive/irreparable RCT, complaining of pain recalcitrant to conservative therapies, but not exhibiting severe restriction of ac-

tive shoulder motion (8). Arthroscopic debridement could be indicated even in some younger patients with massive, irreparable cuff tear that could prefer, at least initially, a less invasive treatment with quicker rehabilitation program just to achieve pain reduction.

The primary aim of this study is to assess the mid-term clinical outcome of arthroscopic debridement and tenotomy of the long head of the biceps for massive, irreparable RCT. The secondary aim is to evaluate if tear location (supero-posterior vs supero-anterior) influences the result.

Materials and methods

We retrospectively identified all consecutive patients who underwent arthroscopic debridement for massive, irreparable RCT between January 2011 and December 2016 at our institution consulting the surgical records. All the procedures were performed by the same surgeon. The study design protocol was approved by the Institutional Review Boards of Novara (Number of protocol 186/19) and it was conducted under the principles of the Declaration of Helsinki.

The diagnosis of massive, irreparable RCT was made through clinical examination and confirmed by MRI (Fig.1). Shoulder imaging was necessary to assess tear pattern and muscle condition. Tendon retraction and muscle fatty infiltration were evaluated using Patte and Goutallier (39) classifications, respectively. RCT were classified as massive when there was complete tear of two or more tendons and irreparable if fatty infiltration of tendons involved was at least III stage according to Goutallier (19).

Patients with a preoperative least active forward elevation of 90°, a reported pain $\geq 6/10$ were included.

Patients who had previous surgery on the affected shoulder and those with radiographic signs of glenohumeral arthropathy were excluded.

All operations were performed in beach-chair position and under regional (interscalene block) and general anesthesia. Tenotomy of the Long Head of the Biceps (LHB) was performed in case of its instability, degeneration or chronic synovitis. In the subacromial space, reparability of RCT was tested by grasping the edges of the tendons with a clamp and trying to mobilize them to the footprint; the quality of tendon tis-

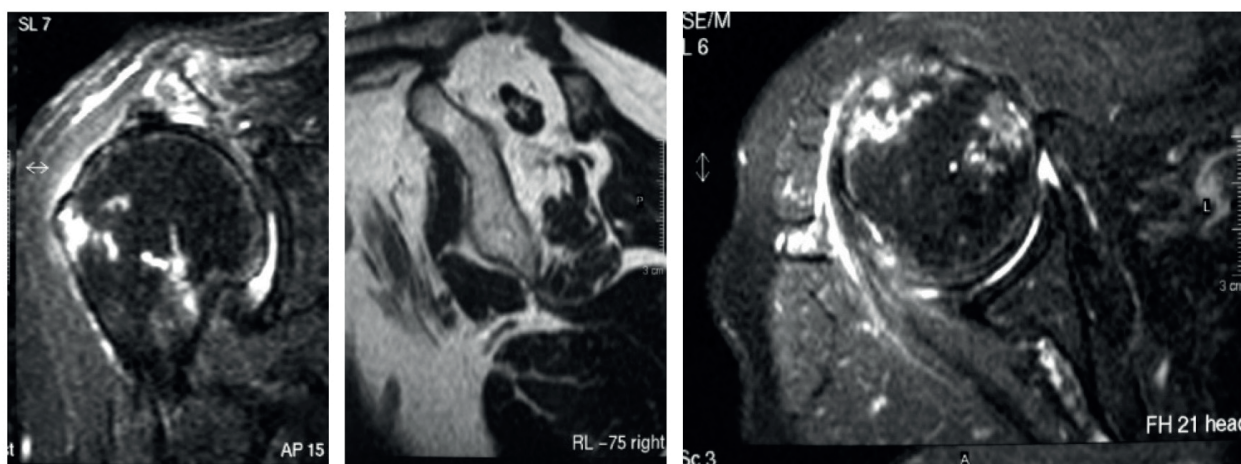


Figure 1. MR view of massive posterosuperior RCT with muscle atrophy and fatty infiltration (Goutallier III-IV)

sue was evaluated as well. If the tear was considered irreparable after this assessment, the debridement was carried out by removing debris and loose fragments of tendons, shaving their frayed edges and ablating the inflamed synovial tissue. Subacromial decompression was performed in patients that presented an acromion type II or III according to Bigliani (40) with an evident subacromial impingement of the supraspinatus tendon and consisted in the excision of subacromial spurs, with maintenance of the coracoacromial arch, in order to prevent antero-superior migration of the humeral head.

After surgery, the arm was kept in a sling to control postoperative pain. Passive and active mobilization was started immediately and continued until full motion was recovered.

At the time of this study, the patients were contacted for a follow up visit, in order to assess shoulder ROM and strength (Kg) in forward elevation and abduction by means of a dynamometer; the Constant-Murley score (CMS), Oxford Shoulder Score (OSS) and Numeric Rating scale (NRS) for pain were also recorded. Patients unable to attend the visit were asked to take part in a telephone interview, to inquire their postoperative history and collect the NRS for pain and the OSS. All included patients were assessed for satisfaction and classified in the following 4 degrees: very satisfied, satisfied, disappointed, dissatisfied.

Statistical analysis was performed with STATA software. Descriptive statistics were used to present pa-

tients' characteristics. Normal distributed continuous variables were expressed as mean \pm standard deviation (SD), non-normal distributed continuous variables as median and range and categorical data with frequencies and percentages. The Chi-square or Fisher exact test was used for discrete variable association, while for continuous variables independent t tests and Mann-Whitney tests were used. The level of statistical significance was set at p value $< 0,05$ with a confidence interval of 95%.

Results

107 patients were eligible for our study. 34 could not collaborate with data collection, 2 died during the follow-up and 1 patient underwent reoperation: these patients were excluded from analysis. All the enrolled patients agreed to attend this study and signed an informed consent for the anonymous collection of their data.

At a mean follow up of 64 months (range 29-98 months) 70 patients were evaluated: 42 clinically, while 28 were investigated by telephone interview.

44 (63%) patients were men and 26 (37%) women. Their mean age at the time of surgery was 61,77 \pm 8,18 years; 48 (69%) patients were operated at the dominant arm, 22 (31%) at the non dominant arm. At the time of surgery, 11 (16%) patients were active smokers and 9 (13%) diabetic. Baseline patient's characteristics are reported in Table 1.

The MRI evaluation revealed that supraspinatus tendon was torn in all patients, presenting grade 2 re-

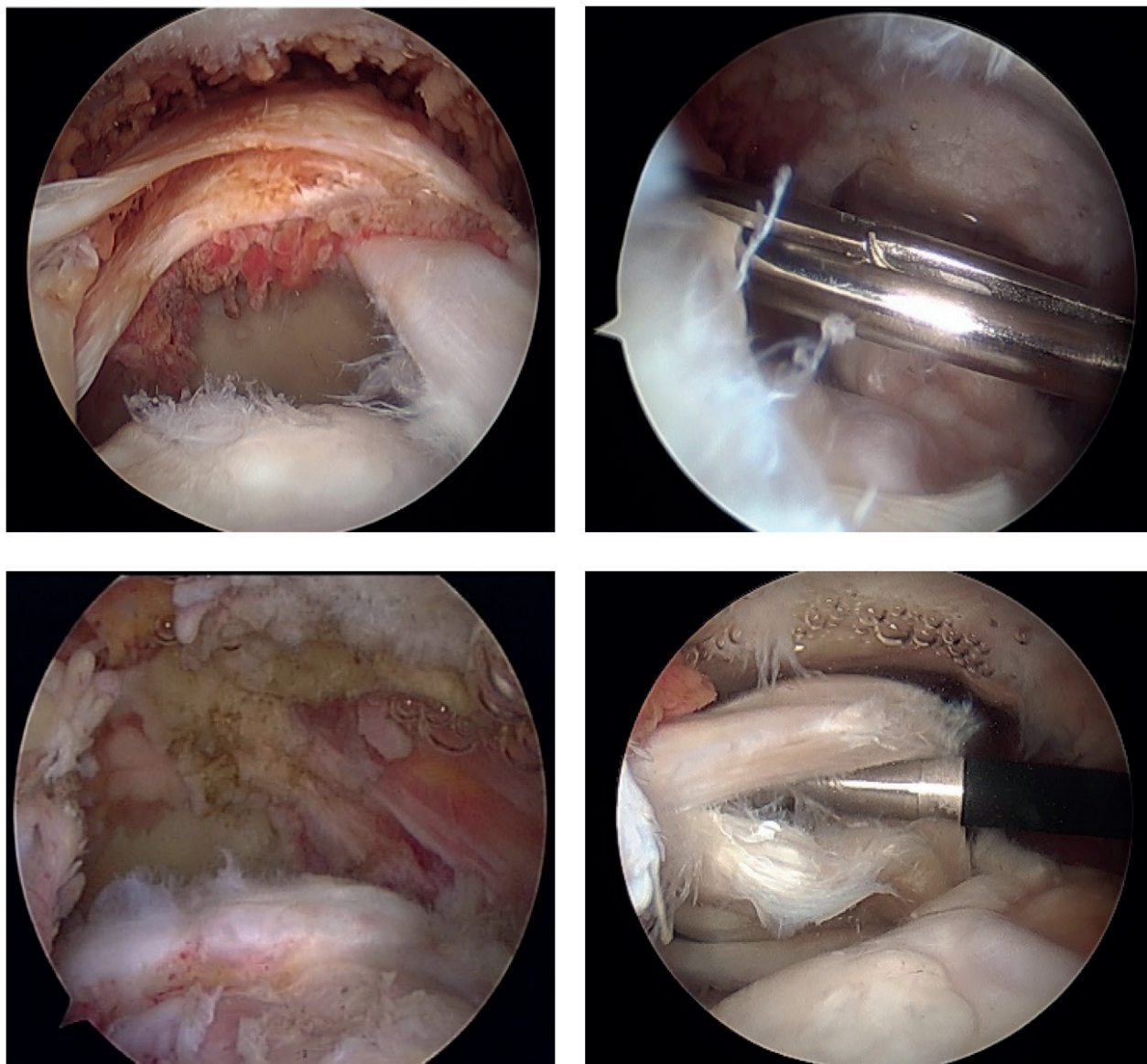


Figure 2. Arthroscopic view of a massive, retracted RCT and lesion of long head of the biceps

traction according to Patte in 28 cases and grade 3 in 42; the infraspinatus tendon was involved in 45 cases, the subscapularis in 11 while in 4 cases the three tendons were torn. Severe fatty infiltration was found in all cases. In 10 shoulders the LHB was absent and in the remaining 60 LHB tenotomy was performed.

At the follow-up evaluation mean OSS was 16,8 \pm 6,4 (range 12-43); mean NRS value was 1,06 \pm 1,9 (range 0-8), in particular for patients that underwent clinical evaluation mean NRS was 1,31 and for patients investigated only by telephone the value was 0,68.

Mean CMS value was 75,6 \pm 10,5 (range 52,9-97), with a mean strength of 3,92 \pm 2,82 Kg.

With regard to the degree of satisfaction, 54 patients were very satisfied, 11 satisfied, 5 disappointed and none of the patients evaluated was dissatisfied.

No differences were encountered in clinical and functional mean \pm SD scores between postero- and antero-superior RCT: postero-superior CMS 76,25 \pm 10,43, OSS 16,33 \pm 6,92, NRS 0,95 \pm 1,90, antero-superior CMS 76,57 \pm 14,68, OSS 17,27 \pm 5,25, NRS 1,18 \pm 1,99. Statistical significance was



Figure 3. Postoperative view of a patient's right shoulder

insufficient in all the aforementioned results with a *p*-value > 0,05 (Table 2)

Significant better results in terms of CMS were obtained in patients operated on the non dominant arm (81,6 +/- 3,88), compared to those operated on the dominant one (73,44 +/- 11,35)(*p*=0.0071), and in men compared to women, considering OSS (*p*=0,02) and CMS (*p*=0.002): men OSS 15,54 +/- 5,02, CMS 78,64 +/- 9,51, women OSS 19,04 +/- 7,95, CMS 67,92 +/- 9,28.

No significant differences were found between diabetic (CMS 68,18 +/- 12,79, OSS 19,22 +/- 6,72, NRS 2,33 +/- 2,55) and non diabetic patients (CMS 76,58 +/- 9,99, OSS 16,49 +/- 6,38, NRS 0,87 +/-

1,76) and between active smokers (CMS 68,64 +/- 10,26, OSS 20,82 +/- 2,80, NRS 2,36 +/- 2,90) and non smokers (CMS 76,51 +/- 10,36, OSS 16,10 +/- 5,56, NRS 0,81 +/- 1,60) (Table 3).

Discussion

Different treatment options have been proposed for massive RCT, but the ideal management is still controversial (41).

This kind of injury usually occurs in elderly patients, that can be totally asymptomatic without significant functional limitation; however, when RCT get symptomatic, patients complain about functional

Table 1: patients characteristics

Gender	
Male	44 (67%)
Female	26 (37%)
Age	
Minimum	51
Maximum	85
Mean (+/- SD)	67,2 (\pm 7,91)
Operated Side	
Dominant	48 (69%)
Non dominant	22 (31%)
Smoking	
Yes	11 (16%)
No	59 (84%)
Diabetes	
Yes	9 (13%)
No	61 (87%)
Classification	
Posterosuperior	45 (75%)
Anterosuperior	11 (18%)
Antero and Posterosuperior	4 (7%)

Table 2: postero-superior RCT vs antero-superior RCT

	Postero-Superior Rct	Antero-Superior Rct
CMS	76,25 +/-10,43	76,57 +/-14,68
OSS	16,33 +/-6,92	17,27 +/-5,25
NRS	0,95 +/-1,90	1,18 +/-1,99

Table 3: results

	CMS	OSS	NRS
Operated Side			
Dominant arm	73,44 +/- 11,35	17,79 +/- 7,02	1,23 +/- 2,17
Non dominant arm	81,6 +/- 3,88	14,77 +/- 4,42	0,68 +/- 1,17
Gender			
Male	78,64 +/- 9,51	15,54 +/- 5,02	0,84 +/- 1,60
Female	67,92 +/- 9,28	19,04 +/- 7,95	1,42 +/- 2,37
Diabetic			
Yes	68,18 +/- 12,79	19,22 +/- 6,72	2,33 +/- 2,55
No	76,58 +/- 9,99	16,49 +/- 6,38	0,87 +/- 1,76
Smoker			
Yes	68,64 +/- 10,26	20,82 +/- 2,80	2,36 +/- 2,90
No	76,51 +/- 10,36	16,10 +/- 5,56	0,81 +/- 1,60

impairment and pain that interferes with sleep and daily living activities (8). Conservative management should always be considered at first, with pain control and strengthening exercises.

If conservative treatment fails, surgery is indicated (12). Several treatment options are available, such as subacromial balloon spacer placement or tendon transfer. Subacromial balloon spacer is a good option mainly indicated for lower demand patients as shown in a recent systematic review (42). Tendon transfer could also be promising for cases in which rotator cuff tendons are ruptured and have retracted beyond surgical repair or those in which other attempts at surgical repair have failed (43).

Complete rotator cuff repair, if possible, can guarantee a better outcome (44), but in this kind of injury results of repair are inhomogeneous, because usually RCT is chronic, with high degree of retraction, characterized by friable tissue, muscle atrophy and high degree of fatty muscular infiltration. All these factors can easily lead to non consolidation of the lesion after repair (8).

According to many authors re-rupture after rotator cuff repair occur in 20-65% over time and this percentage increases with different factors such as age, tendon retraction, atrophy of rotator cuff muscles and fatty infiltration (11, 45).

Randelli et al.(46) in a recent study reported that at 10 years follow up 53,47% of previously repaired RCT was still intact at ultrasound examination and they found that re-rupture is related especially to RCT size at the time of surgery.

However, it's important to appreciate that the presence of a persistent rotator cuff defect doesn't necessarily imply a clinical failure and is compatible with a good postoperative result; in fact, even if in elder patient the rate of re-tear increases, the functional requirements decrease and subjective satisfaction is reported, even without anatomical integrity of rotator cuff. The conversion of a symptomatic rotator cuff tear into an asymptomatic re-tear is not entirely clear, but probably is due to subacromial decompression, debridement and biceps tenotomy (47).

In patients with irreparable RCT, Rockwood et al. (12) performed debridement, evaluated clinical outcome at 6,5 years follow-up and reported a 83% pain reduction rate and the average mobility improved from

105 degrees of active elevation preoperatively to 140 degrees postoperatively.

Also Garstaman (48) reported good postoperative results after arthroscopic debridement: in particular average CMS improved from 31 points preoperatively to 52 points postoperatively.

Results of this study suggest that debridement can offer good results in terms of pain reduction and improvement of the range of motion; several authors reported good clinical results after arthroscopic debridement, but also worsening of the radiological condition, with a significant reduction of the acromio-humeral distance and progression to osteoarthritis (32, 49, 50).

Berth et al (1) performed a prospective randomized study involving 42 patients with massive RCT, treated with debridement or partial repair of RCT and at 2 years follow-up they found good functional results in both groups, but better clinical outcome for those patients that underwent repair of the cuff tear, regardless of high rate of structural fail of the repair.

The primary goal of debridement is to eliminate possible sources of shoulder pain (38). The removal of rotator cuff unstable remnants and subacromial bursa, according to Burkhart et al. reduces mechanical irritation and inflammation (51).

The role of acromioplasty is controversial because it can weaken coracoacromial arch and cause, together with RCT, superior migration of humeral head (8, 49). Fenlin et al. (52) suggested that in these cases tuberculo-plasty can be performed in order to restore acromio-humeral articulation, as we did in our case series.

Considering that in this kind of injury the LHB is an important source of pain, (38, 53) we performed tenotomy in all cases; Boileau et al. (32) in a series of patients with massive RCT performed arthroscopic biceps tenotomy or tenodesis and at a minimum follow-up of 2 years reported excellent results in terms of pain and dysfunction reduction and no difference between tenotomy and tenodesis groups. Moreover Walch et al. evaluated at a mean follow-up of 57 months, 307 patients that underwent arthroscopic biceps tenotomy for an irreparable RCT; the mean CMS increased from 48.4 points preoperatively to 67.6 points postoperatively, 87% of patients were satisfied or very satisfied with the result. They also performed radiographic examination that showed that acromiohumeral interval

decreased by a mean of 1.3 mm during the follow-up period and that there wasn't significant progression of glenohumeral arthritis. Acromioplasty guaranteed better subjective and objective results only in patients with an acromio-humeral distance greater than 6 mm. Muscle fatty infiltration had a negative influence on both the functional and radiographic results.

Collin et al. (41) suggested that a rotator cuff tear that involves the supraspinatus and the entire subscapularis is a risk factor for pseudoparalysis; nevertheless in our study no significant difference in terms of clinical outcome between antero and postero superior RCT was reported. This could be probably due to the fact that the lesion of subscapularis, in most patients, involved mainly the superior part of the tendon, which is associated with a better range of motion.

One of the main risk of arthroscopic debridement is the progression to eccentric osteoarthritis that may occur few years after arthroscopic debridement. In this case there are two options: the patient is asymptomatic, not complaining pain or functional limitations, and in this case there are no further surgical indications, or the patient has a symptomatic arthritis; in this case there still is the chance for a reverse prosthesis implant.

Limitations of our study include the small sample size and the retrospective design with lack of preoperative data about shoulder pain and function, that didn't allow a comparison with postoperative results; moreover, patients at follow up didn't undergo radiological evaluation to assess the acromio-humeral distance and progression to osteoarthritis.

Conclusions

Our study suggests that arthroscopic debridement of massive RCT can be a good surgical option in selected patients; in fact, according to our experience is indicated in elderly patients, with severe and constant pain, good remaining mobility, low expectations in terms of functionality. The short operation time, a low rate of complications and the possibility of a quicker rehabilitation program are also to be considered. Further studies with a longer follow-up are needed to evaluate the actual risks and benefits of debridement for massive rotator cuff tears over time.

Conflict of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

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