Rotator cuff surgery in patients with rheumatoid arthritis: clinical outcome comparable to age, sex and tear size matched non-rheumatoid patients

SJ Lim¹, J-H Sun², AL Kekatpure³, J-M Chun¹, I-H Jeon¹

¹Asan Medical Center, School of Medicine, University of Ulsan, Seoul, Korea

²Department of Orthopaedic Surgery, Hi Hospital, Incheon, Korea

³Department of Orthopaedic Surgery, Sterling Wockhardt Hospital Vashi, Navi Mumbai, India

ABSTRACT

AIMS This study aimed to compare the clinical outcomes of rotator cuff repair in patients with rheumatoid arthritis with those of patients who have no known history of the disease. We hypothesised that the functional outcomes are comparable between patients and without rheumatoid arthritis and may be affected by the level of disease activity, as assessed from C-reactive protein (CRP) level and history of systemic steroid intake.

PATIENTS AND METHODS We conducted a retrospective review of the institutional surgical database from May 1995 to April 2012. Twenty-nine patients with rheumatoid arthritis who had rotator cuff repair were enrolled as the study group. Age, sex, and tear size matched patients with no disease who were selected as the control group. The mean duration of follow-up was 46 months (range 24–92 months). Clinical outcomes were assessed with the American Shoulder and Elbow Surgeons (ASES) questionnaire, Constant score and visual analogue scale (VAS). All data were recorded preoperatively and at regular postoperative follow-up visits. CRP was measured preoperatively as the disease activity marker for rheumatoid arthritis. Medication history was thoroughly reviewed in the study group.

RESULTS In patients with rheumatoid arthritis, all shoulder functional scores improved after surgery (ASES 56.1–78.1, Constant 50.8–70.5 and VAS 5.2–2.5; $P < 0.001$). The functional outcome of surgery in patients with rheumatoid arthritis was comparable to that of the control group (difference with control: ASES 78.1 vs. 85.5, $P = 0.093$; Constant 70.5 vs. 75.9, $P = 0.366$; VAS 2.5 vs. 1.8, $P = 0.108$). Patients with rheumatoid arthritis who had an elevated CRP level (> 1 mg/dl) showed inferior clinical outcomes than those with normal CRP levels. Patients with a history of systemic steroid intake showed inferior functional outcomes than those who had not taken steroids.

CONCLUSIONS Surgical intervention for rotator cuff tear in patients with rheumatoid arthritis improved the shoulder functional outcome comparable to that in matched patients without rheumatoid arthritis. Elevated preoperative CRP level and history of systemic steroid intake portend inferior functional outcome in patients with rheumatoid arthritis.

KEYWORDS

Rheumatoid arthritis – Rotator cuff repair – Steroid – C-reactive protein – CRP – Clinical outcome

Accepted: 23 April 2017

CORRESPONDENCE TO

In-Ho Jeon, E: jeonchoi@gmail.com

Introduction

Rheumatoid arthritis is a chronic inflammatory disease that can damage the affected joint if inadequately controlled.¹ The main disease process that results in arthropathy is proliferative synovitis, which involves the surrounding soft tissue structures resulting in enthesopathy and disuse muscle atrophy, which further leads to fatty infiltration. These soft-tissue lesions, combined with joint destruction, result in pain and restriction of joint movement.^{2–4}

The mainstay of surgical management of rheumatoid shoulder has been synovectomy for early-stage and

arthroplasty for late-stage disease.^{5–8} Although rotator cuffs are known to be pathological in patients with rheumatoid arthritis, there are only few focused clinical studies describing the rotator cuff surgery in these patients.^{4,7,9} The surgical repair of rotator cuff tears in patients with rheumatoid arthritis can be challenging, as the quality of muscle and tendon is poor and the tissues are fragile. These patients frequently also have accompanying degenerative changes of the shoulder joint, making the surgical option of rotator cuff repair alone unreasonable.^{8,10–12} The outcome of rotator cuff repairs in patients with rheumatoid arthritis is reported to be poor, especially for full-thickness cuff tears.⁹ To our

knowledge, there are no studies comparing the outcome of rotator cuff repair between patients with rheumatoid arthritis and matched patients without the disease.

We aimed to compare the outcome of rotator cuff repair between patients with and without rheumatoid arthritis. We hypothesised that: (i) the postoperative functional score would improve compared with the preoperative scores in patients with rheumatoid arthritis; (ii) the clinical outcome of rotator cuff repair in patients with rheumatoid arthritis would be comparable to that of a control group of patients without the disease matched for age, sex and tear size; and (iii) the level of disease activity, as assessed from preoperative C-reactive protein (CRP) levels and systemic use of steroids may affect the functional outcomes of patients with rheumatoid arthritis.

Materials and Methods

Patient demographics

The institutional surgical database of rotator cuff repair was retrospectively queried for consecutive patients who underwent rotator cuff repair from 1995 to 2012. We included all patients who were preoperatively diagnosed with rheumatoid arthritis by rheumatologists at the Asan Medical Center. A total of 42 shoulders in 36 patients with rheumatoid arthritis had undergone rotator cuff repair. Any patients who had shoulder surgery before the index surgery, accompanying degenerative joint disease with definite erosion (Larsen grade ≥ 3)¹⁴ or a follow-up of less than 2 years were excluded. After patient exclusion, a total of 29 patients were enrolled in the study. There were three small tears, nine medium tears, ten large tears and seven massive tears. The mean duration of follow-up was 46 months (range 24–92 months). The study was approved by the institutional review board of our institution.

The study group (RA group) included 24 women and 5 men, with a mean age of 63.5 years (range 45–76 years) at the time of the index surgery. All patients had a diagnosis of adult-onset rheumatoid arthritis made by a rheumatologist at our institution before the surgical intervention and all patients met the criteria for rheumatoid arthritis established by the American Rheumatism Association.¹⁵ Twenty-seven patients were taking medication preoperatively to control the manifestations of the rheumatoid process. Eleven patients had used disease-modifying medications, including methotrexate, sulfasalazine and hydroxychloroquine. Thirteen patients had used oral corticosteroids. Six patients had used a combination of disease-modifying medications and oral corticosteroids.

From the surgical database, we identified patients matched for age, sex and tear size who have no known history of rheumatoid arthritis (non-RA group) with a minimum follow-up of 24 months.

Indications and operative technique

The indication for operative intervention was magnetic resonance imaging (MRI) proven full-thickness rotator cuff tears causing pain and disability with activities of daily living. On the basis of the intraoperative findings, full-

thickness tears were measured and subdivided based on the location of the tear and on the tear size, as follows: small (less than 1cm), medium (1–3cm), large (3–5cm) or massive (greater than 5cm).¹⁶ Open acromioplasty and rotator cuff repair were done in all shoulders through an anterosuperior approach. Rotator cuff tears were repaired with trans-ossous sutures using no. 2 Ethibond thread. After surgery, a shoulder abduction brace was applied for 8 weeks. The patients started passive forward elevation on the first postoperative day. On the third postoperative day, stretching exercises, including pendulum exercises and passive external rotation, were started. After 4 weeks, pulley exercises were started to gain full forward elevation. Strengthening of the rotator cuff and periscapular muscle by elastic band exercises and wall push-ups were commenced after removal of the shoulder brace at postoperative week 8. Posterior capsular stretching exercises and internal rotation stretching were initiated after approximately 3 months of strengthening exercises.

Rating of results

The patient self-report section of the American Shoulder and Elbow Surgeons (ASES) questionnaire and the Constant score were used to assess patient function. We used the visual analogue scale (VAS) as the parameter of pain evaluation. The shoulder range of motion (forward elevation and external rotation in adduction) was measured with a goniometer. The rotator cuff strength (supraspinatus and external rotation) was tested by using the Nottingham Mecmesin myometer and were recorded as percentages with the uninvolved shoulder as control. All data were recorded preoperatively and at the annual postoperative follow-up visit. In all patients, we documented CRP (reference range set as 0–1mg/dl) preoperatively as the disease activity marker for rheumatoid arthritis.

Statistical analysis

To analyse the changes in functional outcome after surgery for each group, we used the Wilcoxon signed-rank test. The Kruskal–Wallis test was used to compare the functional outcome (i) between the RA group and the non-RA group, (ii) between patients with rheumatoid arthritis with and without a history of oral steroid intake, (iii) between patients with rheumatoid arthritis with a high CRP level ($> 1\text{mg/dl}$) and those with a normal CRP level ($\leq 1\text{mg/dl}$). All analyses were performed with SPSS version 19.0. *P*-values of less than 0.05 were considered statistically significant.

Results

In both groups, the postoperative functional outcomes (ASES score, Constant score, VAS, range of motion and muscle strength) improved significantly compared with preoperative scores. The functional improvement in the RA group was comparable to that of the non-RA group (difference with control: ASES 78.1 vs. 85.5, $P = 0.093$; Constant 70.5 vs. 75.9, $P = 0.366$; VAS 2.5 vs. 1.8, $P = 0.108$; forward elevation 142 degrees vs. 146 degrees, $P = 0.641$; external rotation 42 degrees vs. 45 degrees, $P = 0.594$; supraspinatus power 80%

vs. 84%, $P = 0.473$ and external rotator power 77% vs. 81%, $P = 0.529$). The full preoperative and postoperative indices are shown in Table 1.

In the RA group, patients with CRP levels greater than 1.0mg/dl (reference range, 0–1mg/dl) presented inferior functional outcomes compared with patients with normal CRP levels (Table 2). All groups showed improvement in terms of the ASES score compared with the preoperative scores regardless of the CRP level. The results indicated that patients with CRP levels >1 mg/dL tend to have lower preoperative and postoperative functional scores than the other RA patients.

RA patients with a history of oral steroid intake presented inferior functional outcomes compared with RA patients without a history of steroid intake (Table 3). Both groups of patients showed improvement postoperatively. However, the group of patients without steroid intake had better functional outcomes. Of the 29 shoulders in the RA group, 15 shoulders had postoperative MRI at 12 months after the index surgery. Of the 15 shoulders, 3 had re-tear. One patient with re-tear had a history of slip and fall before the repeat onset of pain. In the non-RA group, MRI was performed on 12 shoulders postoperatively after 12 months. One MRI showed re-tear. The patients with re-tear were followed for a further 12 months, without substantial pain and functional disability.

Discussion

To our knowledge, this is the first study comparing the clinical outcome of full-thickness rotator cuff repair between patients with rheumatoid arthritis and matched controls. Our study showed that the functional outcome scores improved in patients with rheumatoid arthritis after rotator cuff repair. Although there was a trend toward better functional outcomes in patients without rheumatoid arthritis, no

Table 2 Postoperative functional outcomes in patients with rheumatoid arthritis: C-reactive protein

	CRP 0.1–1 (<i>n</i> = 25)		CRP > 1.0 (<i>n</i> = 4)		<i>P</i> -value ^a
	(mean)	(SD)	(mean)	(SD)	
ASES	82	± 13.1	53.5	± 16	0.006
Constant	74.2	± 16.9	47.3	± 16.1	0.01
VAS	2.2	± 1.5	4	± 1.4	0.0043

^a Kruskal–Wallis test, significance level $P < 0.05$

Table 3 Postoperative functional outcomes in patients with rheumatoid arthritis: steroids

	With steroids (<i>n</i> = 13)		Without steroids (<i>n</i> = 16)		<i>P</i> -value ^a
	(mean)	(SD)	(mean)	(SD)	
ASES	57.6	± 20	86.3	± 5.9	< 0.001
Constant	68.1	± 20	80.9	± 9.8	0.008
VAS	3.2	± 1.6	1.9	± 1.3	0.024

^a Kruskal–Wallis test, significance level $P < 0.05$

clinically significant difference was noted. The disease activity level, which was determined according to the preoperative CRP levels and history of systemic steroid use, played an important role in predicting the functional outcome.

There is no definite guideline concerning patient selection for operative intervention on rotator cuff tears in

Table 1 Pre- and postoperative functional outcomes in patients with (RA group; *N* = 29) and without rheumatoid arthritis (non-RA group; *N* = 29)

	RA group ^a					Non-RA group ^b				
	Preoperative		Postoperative		<i>P</i> -value	Preoperative		Postoperative		<i>P</i> -value
	(mean)	(SD)	(mean)	(SD)		(mean)	(SD)	(mean)	(SD)	
ASES	56.1	± 17.1	78.1	± 16.6	< 0.001	57	± 16.1	85.5	± 9.1	< 0.001
Constant	50.8	± 19.7	70.5	± 19.0	< 0.001	55.3	± 16.0	75.9	± 10.8	< 0.001
VAS	5.2	± 1.7	2.5	± 1.6	< 0.001	5.2	± 2.0	1.8	± 1.0	< 0.001
ROM, FE (degrees)	128	± 20	142	± 14	< 0.001	132	± 18	146	± 15	< 0.001
ROM, ER (degrees)	21	± 11	42	± 7	< 0.001	25	± 16	45	± 10	< 0.001
SST power (%)	59	± 18	80	± 14	< 0.001	63	± 20	84	± 13	< 0.001
External rotator power (%)	54	± 13	77	± 12	< 0.001	58	± 11	81	± 14	< 0.001

ASES, American Shoulder and Elbow Surgeons; ER, external rotation; FE, forward elevation; ROM, range of motion; SD, standard deviation; SST, supraspinatus; VAS, visual analogue scale.

^a Wilcoxon signed rank test, significance level $P < 0.05$

^b Kruskal–Wallis test

patients with rheumatoid arthritis. Smith *et al.* reported that repair of partial and full thickness tear of rotator cuff in patients with rheumatoid arthritis can be undertaken when non-operative measures for pain relief have failed.⁹ However, their study did not include a comparative control group and had only 14 cases with full-thickness tears. In our study, we enrolled 29 patients with full-thickness rotator cuff tears, which makes this the biggest retrospective case-control study of patients with rheumatoid arthritis. On the basis of the available data, we believe that surgical intervention can improve the functional outcome in patients with rheumatoid arthritis who have full-thickness rotator cuff tears.

In our study, disease activity in terms of CRP level had a definite influence on the functional outcome. Patients with normal CRP levels up to 1mg/dl had better functional outcomes than those with levels greater than 1mg/dl. CRP is considered as important disease activity marker for rheumatoid arthritis. Persistently elevated CRP levels are especially associated with a higher risk of progressive joint involvement.^{17,18} This finding suggests that the preoperative CRP levels can provide the surgeon with an estimation of the disease activity of the patient and allow the prediction of the outcome of rotator cuff repair.

Another notable finding of this study is that the patient history of systemic steroid intake for the control of rheumatoid arthritis was an important predictor of the functional outcome. Patients who had a history of steroid intake had inferior functional outcomes in terms of the ASES, Constant and VAS scores compared with patients with no history of steroid intake. This may be due to the high level of disease activity itself and the effects of systemic steroids, which result in poor tendon quality. This finding supports our initial hypothesis about the prognosis of functional outcome in patients with steroid intake. Surgeons need to be aware of the medication of patients who plan to undergo rotator cuff repair and expect a suboptimal outcome in those with a history of steroid intake.

This study also has some limitations. Although we tried to control the variables by matching age, sex and tear size, there may be other confounding factors which may have affected the outcome between study group and control group. In this study, CRP levels and history of steroid intake was used as a parameter for high disease activities. Although CRP is often used an important biomarker for rheumatoid arthritis, CRP may not encompass the entire spectrum of disease activity. However, CRP is relatively inexpensive to evaluate when compared with other specific rheumatoid arthritis markers and can be readily examined. Detailed data concerning the dose and duration of steroid intake were not available in the retrospectively evaluated medical records, which could have disclosed more important information. Finally, postoperative MRI examination was available in only a small number of patients in both groups, making MRI comparison impossible.

This study is, however, the largest series of surgical intervention for full-thickness rotator cuff tears in patients with rheumatoid arthritis with a matched control group. Our results can help in the provision of guidelines for the patient selection and estimation of prognosis in surgical

intervention of rotator cuff tears in patients with rheumatoid arthritis.

Conclusion

Our study showed that surgical intervention for rotator cuff tears in patients with rheumatoid arthritis improved the functional outcomes, with comparable outcomes to those of a control group matched for age, sex and tear size. Patients with rheumatoid arthritis with elevated CRP levels greater than 1mg/dl showed poor outcomes compared with patients with rheumatoid arthritis who had normal CRP levels (up to 1mg/dl). Patients with a history of oral steroid intake showed inferior functional outcomes compared with those without steroid intake; however, the postoperative functional scores improved regardless of the medication history. On the basis of these findings, we recommend that patients with rheumatoid arthritis with symptomatic rotator cuff tears be considered as candidates for surgery. CRP levels and history of steroid intake may be used to predict the surgical outcome.

Acknowledgements

This work was supported by the Industrial Strategic Technology Development Program (10041605) funded by the Ministry of Trade, Industry and Energy, Korea. Institutional Review Board Ethical Committee Approval: AMC IRB 2014-0487.

References

1. Wolfe F, Hawley DJ. The longterm outcomes of rheumatoid arthritis:work disability: a prospective 18 year study of 823 patients. *J Rheumatol* 1998; **25**: 2,108-2,117.
2. Parsons IM, Campbell B, Titelman RM *et al.* Characterizing the effect of diagnosis on presenting deficits and outcomes after total shoulder arthroplasty. *J Shoulder Elbow Surg* 2005; **14**: 575-584.
3. Hettrich CM, Weldon E 3rd, Boorman RS *et al.* Preoperative factors associated with improvements in shoulder function after humeral hemiarthroplasty. *J Bone Joint Surg Am* 2004; **86-A**: 1,446-1,451.
4. Smith AM, Sperling JW, Coefield RH. Arthroscopic rotator cuff debridement in patients with rheumatoid arthritis. *J Shoulder Elbow Surg* 2007; **16**: 31-36.
5. Clayton ML, Ferlic DC. Surgery of the shoulder in rheumatoid arthritis: a report of nineteen patients. *Clin Orthop Relat Res* 1975; **(106)**: 166-174.
6. Smith AM, Sperling JW, O'Driscoll SW *et al.* Arthroscopic shoulder synovectomy in patients with rheumatoid arthritis. *Arthroscopy* 2006; **22(1)**: 50-56.
7. Rozing PM, Brand R. Rotator cuff repair during shoulder arthroplasty in rheumatoid arthritis. *J Arthroplasty* 1998; **13**: 311-319.
8. Bennett WF, Gerber C. Operative treatment of the rheumatoid shoulder. *Curr Opin Rheumatol* 1994; **6**: 177-182.
9. Curran JF, Ellman MH, Brown NL. Rheumatologic aspects of painful conditions affecting the shoulder. *Clin Orthop Relat Res* 1983; **(173)**: 27-37.
10. Cruess RL. Rheumatoid arthritis of the shoulder. *Orthop Clin North Am* 1980; **11**: 333-342.
11. Hirooka A, Wakitani S, Yoneda M *et al.* Shoulder destruction in rheumatoid arthritis: classification and prognostic signs in 83 patients followed 5-23 years. *Acta Orthop Scand* 1996; **67**: 258-263.
12. Lehtinen JT, Belt EA, Lyback CO *et al.* Subacromial space in the rheumatoid shoulder: a radiographic 15-year follow-up study of 148 shoulders. *J Shoulder Elbow Surg* 2000; **9**: 183-187.
13. Smith AM, Sperling JW, Coefield RH. Rotator cuff repair in patients with rheumatoid arthritis. *J Bone Joint Surg Am* 2005; **87-A**: 1,782-1,787.
14. Larsen A, Dale K, Eek M. Radiographic evaluation of rheumatoid arthritis and related conditions by standard reference films. *Acta Radiol Diagn (Stockh)* 1977; **18**: 481-491.

15. Arnett FC, Edworthy SM, Bloch DA *et al.* The American Rheumatism Association 1987 revised criteria for the classification of rheumatoid arthritis. *Arthritis Rheum* 1988; **31**: 315–324.
16. Cofield RH. Current concepts review: rotator cuff disease of the shoulder. *J Bone Joint Surg Am* 1985; **67**: 974–979.
17. Otterness IG. The value of C-reactive protein measurement in rheumatoid arthritis. *Semin Arthritis Rheum* 1994; **24(2)**: 91–104.
18. Emery P, Gabay C, Kraan M *et al.* Evidence-based review of biologic markers as indicators of disease progression and remission in rheumatoid arthritis. *Rheumatol Int* 2007; **27(9)**: 793–806.