

Arthroscopic Rotator Cuff Repair: Serial comparison of outcomes between full-thickness rotator cuff tear and partial-thickness rotator cuff tear

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— Abstract —

Purpose: To compare the results of arthroscopic rotator cuff repair and subacromial decompression in partial thickness rotator cuff tear (PTRCT) with those in full thickness rotator cuff tear (FTRCT).

Subjects and method: Of the 46 patients who were treated of the rotator cuff tear based on the operational findings, 42 patients who were able to receive a serial follow-up for 2 years were selected as the study subjects. The average age of the patients at the time of the operation was 55 years, and the mean duration of the follow-up was 34 months. The subjects included 22 cases of PTRCT and 20 cases of FTRCT. In terms of rotator cuff repair, the average number of tendon to tendon repair (TTR) was 1 in both PTRCT and FTRCT, and that of tendon to bone repair (TBR) was 1 and 3 in PTRCT and FTRCT, respectively. The average number of use of suture anchor was 1 and 2 in PTRCT and FTRCT, respectively. The level of shoulder pain and function of the subjects were measured using shoulder functional evaluation score of American shoulder and elbow society (ASES score) at before and 2 years following the operation.

Results: At the final follow-up following the operation, PTRCT group showed changes in scores from 7.2 to 0.9 on average pain score and 34 to 91 on ASES score, whereas FTRCT group showed changes in scores from 7.6 to 1.2 on pain score and 29 to 88 on ASES score. There were no significant differences between the two groups ($P > 0.05$). The average range of motion of shoulder significantly increased in both groups at the final follow-up in comparison with the pre-operative time point. The evaluation at the final follow-up showed that 93% of the total subjects showed good or excellent results, and 95% showed satisfactory results from the procedure with regard to pain reduction and functional outcomes. Two cases of the 3 fair results were caused by acromioclavicular arthritis.

Conclusion: It may be anticipated that arthroscopic rotator cuff repair and subacromial decompression may bring satisfactory post-operative outcomes in both PTRCT and FTRCT on pain relief and functional recovery. However, careful preoperative examination of the acromioclavicular joint is critical to avoid failures of these procedures.

Key Words: Rotator cuff, Partial thickness tear, Full thickness tear, Arthroscopic rotator cuff repair, Arthroscopy, Shoulder

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Introduction

Rotator cuff disease has been known as one of the most common causes of chronic shoulder pain reported among adults^{2,10}, and its treatment has been considered as important due to the increase of geriatric population and the advance in medical diagnosis and treatment procedures since the repair of rotator cuff tear was first reported by Codman⁹ in 1911.

Neer²⁶ suggested in 1972 that anterior acromioplasty is essential in the open repair of the rotator cuff tear, and Ellman¹³ devised arthroscopic acromioplasty in 1980s. The repair of the rotator cuff tear has been carried out in the forms of open repair^{8,24} and miniopen repair^{3,28,29,32} and, recently, arthroscopic repair^{6,7,16,20,33} has been utilized due to the advance of arthroscopic technique. The arthroscopic method offers several advantages, including smaller incisions, access to the glenohumeral joint for the inspection and treatment of intra-articular lesions, no need for detachment of the deltoid, and less soft-tissue dissection²⁰.

In the arthroscopic technique for partial thickness rotator cuff tear (PTRCT), the patients with tear with thickness of 50% or more may need a repair procedure as they may not have good treatment outcome by using only debridement and subacromial decompression¹¹. However, previous studies have reported the treatment results of the arthroscopic repair of full thickness rotator cuff tear (FTRCT)^{7,15,17,19,25,34,36} or debridement for PTRCT^{11,21,30,35}, and studies that compared the results of the arthroscopic repair in PTRCT with those in FTRCT have been rarely found in the literature. Therefore, the investigators carried out the arthroscopic rotator cuff repair and subacromial decompression for patients with significant PTRCT and FTRCT classified based on arthroscopic findings, and compared the two groups in their over-time improvement on pain and shoulder functional results at pre-operative and post-operative time points.

Materials and Methods

Of the 46 patients who were treated of the rotator cuff tear based on the operational findings, 42 patients who could underwent a serial follow-up for two years were included as the study subjects. One group consisted of 22 PTRCT cases and the other group consisted of 20 FTRCT cases. The average duration of the follow-up

was 34 months (24 months ~ 62 months). The mean age of the subjects was 55 years, and their age range included 13 (31%) subjects in 50s and 60s, respectively, comprising the largest portion of the subjects, followed by 12 (29%) subjects in 40s, 3 subjects (7%) in 30s, and 1 subject (2%) in 70s. The sample included 25 men and (60%) and 17 women (40%), and the 33 subjects (79%) had the rotator cuff tears on their the dominant arm.

Of the 42 subjects, 22 (52%) reported they were occupied with physical labor or had been sometime in the past. The history of trauma was reported in 17 subjects (40%), among whom seven subjects (32%) belonged to the group 1 and ten subjects (50%) belonged to the group 2. The average morbid period from the onset of symptoms such as pain or declined function to the time of the operation was 30 months (1-240 months).

In terms of the features of acromion reflected in radiological findings according to the classification by Bigliani¹¹, flat acromion was found in five cases of the group 1 and one case of the group 2, and curved acromion was found in nine cases of the group 1 and 13 cases of the group 2, and hooked acromion was found in eight cases of the group 1 and six cases of the group 2. The anterior length of acromion that was more protruded than inferior border of clavicle was measured using 30 degrees caudal tilt view before the procedure, and the level of protrusion from an axillary view in comparison with anterior border of acromion was also measured, after which the radiological pictures of these two were compared and then the resection amount of anterior acromion was determined. All procedures of arthroscopic subacromial decompression were conducted by one surgeon under general anesthesia in a beach-chair position. The presence of the rotator cuff tear was assured using the arthroscopic hook, and the depth of the tear was measured with the considering of the fact that the thickness of supraspinatus tendon is 12 mm on average¹⁴. The size of the tear was measured on the site with the largest length using the arthroscopic hook. The arthroscopic repair was done only in a case with a tear with its thickness greater than 6 mm. The patients with the tears with thickness lesser than 6 mm received the procedure of debridement and were excluded from this study. The failure of the arthroscopic repair occurred in two subjects, for whom the open rotator cuff repair was carried out. Both of the two subjects had massive rotator cuff tear, of which one subjects received complete repair and the other subject received incomplete repair. These two cases were also excluded from this study.

When classified according to Ellman's classification¹⁴, the group 1 included 16 cases (73%) of bursal side PTRCT, two cases (9%) of articular side PTRCT, one case of combined PTRCT of articular and bursal side tear, one case of intratendinous tear, and one case of articular side tear and bursal side tear, respectively, for which repair was conducted after making them as FTRCT because they had 90% of PTRCT. Intratendinous tear type was suspected as a tear on MRI, and, although it did not have a tear at bursal side, its thin remaining bursal side rotator cuff was removed to find the presence of tear using the arthroscopic hook.

The size of the rotator cuff tear in the group 2 was classified according to the rating system proposed by DeOrio and Cofield¹², showing that the tear with size less than 1cm in length was classified as small-sized tear, the tear with size of 1~3 cm as medium-sized tear, the tear with size of 3~5 cm as large-sized tear, and the tear with size greater than 5 cm as massive tear. The group included three cases (15%) of small-sized tear, eight cases (40%) of medium-sized tear, four cases (20%) of large-sized tear, and five cases (25%) of massive tear.

In terms of accompanied pathologic lesion, three subjects with PTRCT, in whom over 50% of tear was found in their long head of biceps, were found in the group 1 and thereby tenotomy to long head of biceps was carried out for them. Degenerative arthritis of acromioclavicular joint was found in two subjects in the group 1 and one subject in the group 2, for whom distal clavicle resection was also conducted except one subject in the group 1.

After the procedures, the patients began passive exercise within 24 hours, maintained their humerus in the internal rotation with 30° to 40° and abduction with 20° using ultrasling for 6 weeks to protect the repair site.

Function of the shoulder was evaluated using shoulder functional evaluation of American Shoulder and Elbow

Society (ASES score)³¹) that consisted of a summed score in a 100 point system (50 points for daily function and 50 points for pain) at 6 time points: before the operation, 6 weeks, 3 months, 6 months, 1 year, and final follow-up following the procedure. The ratings of ASES score included 91~100 points as excellent, 81~90 points as good, 71~80 points as fair, and 70 points or less as poor. Of these, excellent and good group were defined as a satisfactory group. Telephone interview was carried out on the cases, on which the final follow-up after two years of the operation could not be achieved. Statistical analysis included student t-test on age and range of motion of the patients, and Mann-Whitney U-test on pain degree and daily functional score. All tests involved the comparison of post-procedure scores with pre-procedure scores, and the probability level lesser than 0.05 was regarded as statistically significant.

Results

In terms of rotator cuff repair, the average number of tendon to tendon repair (TTR) was 1 in both PTRCT and FTRCT, and that of tendon to bone repair (TBR) was one and three in PTRCT and FTRCT, respectively. The average number of use of suture anchors with two #2 braided polyester suture was one and two in PTRCT and FTRCT, respectively.

The average pre-operative pain score was 7.2 in the group 1 and 7.6 in the group 2, which, however, decreased by 0.9 and 1.3 at the final follow-up, respectively, showing no statistical significance between the two groups (Table 1).

Except that the group 2 reported more discomfort on putting on a coat and combing hair at pre-operative time point, there was no statistically significant difference between the two groups. The level of daily functioning in items such as, 'put on a coat', 'sleep on your painful

Table 1. Results of visual analog scale of pain in operated shoulder

	Preop*	PO [†] 6W	PO 3M	PO 6M	PO 1Y	Last
PTRCT [‡]	7.19	4.14	2.59	1.73	1.05	0.91
FTRCT [§]	7.55	3.90	3.35	1.85	1.40	1.30

*Preop: preoperative

†PO: postoperative

‡PTRCT: PTRCT

§FTRCT: FTRCT

or affected shoulder', 'wash back', 'manage toileting', 'comb hair', 'reach a high shelf', 'lift 5 kg above shoulder', 'throw a ball overhead', 'do usual work', and 'do usual sport' significantly improved at post-operative time points compared to those at pre-

operational time point (Table 2).

The active range of motion significantly improved after the procedure on forward elevation, external rotation, and external rotation at 90° abduction as well as on internal rotation. There was no statistical differences

Table 2. Results of patient self-evaluation for shoulder function

	Preop*	PO† 6W	PO 3M	PO 6M	PO 1Y	Last
Put on a coat						
PTRCT†	1.67 [‡]	1.91	2.23	2.64	2.77	2.82
FTRCT§	1.00	1.70	2.16	2.60	2.75	2.75
Sleep on your painful or affected shoulder						
PTRCT	1.29	1.73	2.05	2.45	2.68	2.73
FTRCT	1.55	1.95	2.65	2.75	2.80	2.80
Wash back/do up bra in back						
PTRCT	1.05	0.89	1.55	2.05	2.55	2.64
FTRCT	1.00	0.95	1.55	2.20	2.45	2.55
Manage toileting						
PTRCT	1.90	1.91	2.64	1.91	2.95	3.00
FTRCT	1.58	1.85	2.20	2.85	2.85	2.85
Comb hair						
PTRCT	1.76 [‡]	1.86	2.59	3.00	3.00	3.00
FTRCT	1.11	1.45	2.20	2.90	3.00	3.00
Reach a high shelf						
PTRCT	1.24	1.50	2.14	2.64	2.77	2.95
FTRCT	0.79	1.05	1.70	2.75	2.85	2.85
Lift 10 lbs. above shoulder						
PTRCT	0.90	0.82	1.14	1.86	2.09	2.18
FTRCT	0.84	0.89	1.10	2.00	2.20	2.25
Thorw a ball overhead						
PTRCT	1.00	1.09	1.64	2.32	2.59	2.68
FTRCT	0.53	0.85	1.50	2.40	2.45	2.50
Do usual work						
PTRCT	1.29	1.45	2.14	2.45	2.64	2.77
FTRCT	1.00	1.20	1.75	2.45	2.70	2.70
Do usual sport						
PTRCT	1.10	1.32	2.00	2.32	2.32	2.45
FTRCT	0.79	1.00	1.60	2.25	2.45	2.40

*Preop: preoperative

†PO: postoperative

‡PTRCT: PTRCT

§FTRCT: FTRCT

[‡]: p<0.05 between partial and FTRCT

between pre- and post-operative time points, except that the group 2 showed a more severe limitation on forward elevation and internal rotation before the procedure and the group 1 showed more degree of forward elevation at 6 months and 1 year following the procedure (Table 3).

In anterior acromioplasty, anterior cutting of acromion was conducted with the average length of 9.5 mm and no statistical difference was found in the results of the operation by the shape of the acromion and the degree of protruding. The results from the operation were satisfactory regardless of the pre-operative pain level and the morbid period of functional declining, showing no statistical significance.

The ASES evaluation scores reflected statistically significant pain reduction and shoulder functional improvement, which is indicated by that the scores were 34 points in the group 1 and 29 points in the group 2 before the operation but improved as 91 points in the group 1 and 83 points in the group 2. However, there was no statistically significant difference between the two groups (Table 4).

The results of the final follow-up showed that ASES scores were rated as satisfactory in 93% of the total patients. The group 1 included 13 cases rated as excellent, eight cases as good, one case as fair, and no case as poor, whereas the group 2 included ten cases rated as

excellent, eight cases as good, two cases as fair, and no case as poor. In patients' satisfaction, 95% of the subjects reported positive responses with regard to their level of satisfaction for the operation. Of the three cases reporting the fair results, one case was the patient in the group 1 who had bursal side PTRCT accompanied by degenerative arthritis of acromioclavicular joint and expressed dissatisfaction for the results of the operation because of no implementation of any treatment to his acromioclavicular joint. Another case included a patient with massive FTRCT accompanied by degenerative arthritis to knee joint. The patient underwent arthroscopic rotator cuff repair in 1 month after total knee replacement arthroplasty by not having a sufficient time to participate in a rehabilitation program, and thereby reported dissatisfaction for operation by complaining limitation of motion and night pain at the final follow-up. The other case included a patient in the group 2 who had small-sized FTRCT accompanied by degenerative arthritis to acromioclavicular joint and underwent distal clavicle resection, reporting satisfaction for the operation.

The complications after the operation included 1 case of facial nerve palsy caused by a poor beach chair position at the time of operation and 1 case of recurrent laryngeal nerve palsy that induced a swallowing difficulty, which, however, were recovered within a few months.

Table 3. Results of range of motion for shoulder function

	Preop*	PO† 6W	PO 3M	PO 6M	PO 1Y	Last
Forward elevation (degrees)						
PTRCT†	136‡	143	149	153‡	158‡	158
FTRCT§	107‡	147	147	148‡	151	159
External rotation (degrees)						
PTRCT	60	43	57	67	76	81
FTRCT	53	43	57	66	80	82
External rotation at 90° abduction (degrees)						
PTRCT	69	67	77	81	85	85
FTRCT	61	72	78	81	82	84
Internal rotation (levels of spinous process)						
PTRCT	T ₁₁ ‡	L ₂	T ₁₂	T ₁₀	T ₉	T ₇
FTRCT	L ₁ ‡	L ₂	L ₁	T ₁₀	T ₉	T ₇

*Preop: preoperative

†PO: postoperative

‡PTRCT: PTRCT

§FTRCT: FTRCT

‡: p<0.05 between partial and FTRCT

There was no post-operative complication such as infection, stiffness, and failure of suture anchor reported by the subjects. However, pull-out failure occurred during our arthroscopic repair of the bursal side partial thickness rotator cuff tear on a 62 year old male patient who had suffered continual shoulder pain for 7 years.

Discussion

The treatment for rotator cuff disease include conservative treatment and operative treatment, but a certain confusion has been existed in terms of the diverse operative indications²²⁾. In general, operative treatment has been conducted for patients with the rotator cuff disease^{10,18,26)} who have pain and do not respond to the conservative treatment^{24,27,29)}.

Paulos et al.²⁹⁾ and Blevins et al.³⁾ obtained satisfactory and fair results from the arthroscopic subacromial decompression and miniopen repair in 89% of the FTRCT patients, and suggested making portal extension approach as the treatment for a small and less retracted tear in anterior half of infraspinatus and supraspinatus rotator cuff. Use of this treatment method has shown satisfactory results up to 96%²⁸⁾.

Treatment using arthroscopic technique has several advantages including involvement of a small skin incision, inspection of glenohumeral joint, treatment of intraarticular pathology, no need for detachment of deltoid, less post-operational pain due to less soft tissue dissection, and fast rehabilitation, but also has a limitation in that it requires sufficient operational skills of the operator²⁰⁾. Recently, arthroscopic repair that has multiple advantages has been fairly utilized due to the advances in arthroscopic instruments, suture anchors and knot-tying.

Burkhart et al.^{6,7)} classified FTRCT as two main types,

crescent-shaped tear and U-shaped tear. The authors reported in their studies that U-shaped tear comprises 40% of the total tears and 85% of the large and massive tears. Crescent-shaped tear can be shown in large and massive tear but is typically unable to be retracted far from the bones. Therefore, it makes direct tendon to bone suture possible only by small amount of tension. At that point, the authors used suture anchors (Mitek, Ethicon, inc, Westwood, MA, U.S.A.; Statak, Zimmer, Warsaw, Indiana, U.S.A.) as bone fixation by suture anchors which is more stronger than suture by transosseous bone tunnels⁵⁾. U-shaped tear is generally more retracted to distant interior junction than crescent-shaped tear, and the apex of the ligament with tear is extended to the upper portion of glenoid margin or inner glenoid. Therefore, the investigators implemented TTR from the internal direction, after which posterior leaf to anterior leaf of rotator cuff was fixated with TBR on bone bed using suture anchors. L-shaped tear is a similar tear as this, in which vertical limb of rotator cuff was fixated with TTR and horizontal limb was fixated with TBR. In this study, 20 cases of FTRCT included nine cases of crescent-shaped tear (45%), five cases of U-shaped tear (25%), and six cases of L-shaped tear (30%). Of the nine cases with massive and extensive tear, four cases were U-shaped tear (44%) and three cases were L-shaped tear (33%).

Burkhart et al.⁷⁾ found good or more level of satisfactory results in 95% of the patients by the arthroscopic rotator cuff repair, regardless of the significant differences among the them on size of the tear or numbers of tendon involvement. Gartsman et al.²⁰⁾ observed significant pain decrease and functional improvement through the arthroscopic repair for patients with FTRCT. In this study, it was also found that the arthroscopic rotator cuff repair resulted in significant improvement for PTRCT and FTRCT on pain and daily function ($P < 0.05$).

Table 4. Results of ASES shoulder score index

	Preop*	PO [†] 6W	PO 3M	PO 6M	PO 1Y	Last
ASES shoulder score index						
PTRCT [‡]	34	53	71	83	89	91
FTRCT [§]	29	51	63	83	85	88

*Preop: preoperative

†PO: postoperative

‡PTRCT: PTRCT

§FTRCT: FTRC

Several authors documented sound satisfaction reported by patients following the procedure of the arthroscopic subacromial decompression and rotator cuff repair^{6,7,20}. This study also showed that the satisfactory post-operative results were found in 40 cases (95%). Of the 2 cases showing dissatisfaction for the operation, 1 case was the patient with bursal side PTRCT accompanied by degenerative arthritis of acromioclavicular joint, whose reason for dissatisfaction was no implementation of treatment to acromioclavicular joint. Neer²¹ has addressed that spur removal of acromioclavicular joint plays an important role in anterior acromioplasty, and Buford et al.⁴ also suggested osteotomy for 20~25% of undersurface of distal clavicle that is conducted along with subacromial decompression is helpful for the treatment. Martin et al.²³ reported that distal clavicle resection can bring satisfactory results in the case of lesion in acromioclavicular joint. In this study, there were three patients who had degenerative arthritis in acromioclavicular joint, of whom two cases were satisfied after, and one case who did not underwent distal clavicle resection was not satisfied for the operation as the patient showed sound function scores but had pain in the night. Another case of dissatisfaction was a patient with massive rotator cuff tear who underwent arthroscopic rotator cuff repair in one month after total knee replacement arthroplasty and thereby could not have sufficient time to participate in a rehabilitation program. It should be noted that the shoulder operation for rotator cuff in patients who underwent another operation in another site should be conducted after the sufficient amount of rehabilitation therapy on the operated site.

Conclusion

Arthroscopic rotator cuff repair and subacromial decompression of the rotator cuff tear did not induce any statistically significant differences between PTRCT and FTRCT groups on the treatment outcomes. Good or more effective results from the operation were found in 93% of the patients, and satisfaction for the operation was reported in 95% of the patients. In addition, the results of the operation were satisfactory, regardless of the subjects' pre-operative morbid period for pain or ASES scores. However, careful preoperative examination of the acromioclavicular joint is critical to avoid failures of this procedure.

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