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[Original Article]

POSTOPERATIVE OUTCOMES OF ARTHROSCOPIC SUBACROMIAL DECOMPRESSION FOR ROTATOR CUFF TEAR WITH SHOULDER STIFFNESS

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Abstract : Some patients with rotator cuff tear have shoulder stiffness preoperatively. Concomitant preoperative shoulder stiffness may affect postoperative outcomes of arthroscopic subacromial decompression (ASD) for rotator cuff tear. The purpose of this study was to compare postoperative outcomes for ASD between rotator cuff tear patients with and without preoperative shoulder stiffness and to analyze the serial change in functional scores, range of motion (ROM), and pain intensity of the 2 groups after operation.

60 shoulders of 58 patients who underwent ASD for rotator cuff tear were studied. Arthroscopic release was performed for the stiffness group. The results were assessed before surgery and 1, 3, 6, 12 and 24 months after surgery, and the results in the stiffness group and non-stiffness group were compared.

No differences in serial changes for postoperative outcomes of ASD were seen in terms of the Japanese Orthopaedic Association shoulder scoring system (JOA scores) and the visual analog scale (VAS scores) for pain at night and pain during motion between the stiffness group and non-stiffness group. However, compared to the non-stiffness group, forward flexion and abduction angles were significantly smaller for the stiffness group at 1 and 3 months after surgery. External rotation and internal rotation angles were significantly smaller at 1 month after surgery for the stiffness group than for the non-stiffness group.

Preoperative shoulder stiffness does not affect improvement of postoperative JOA scores and VAS scores of ASD. When measured 6 months after surgery, ROM in the stiffness group and the non-stiffness group was similar.

Key words : rotator cuff tear, shoulder stiffness, arthroscopic subacromial decompression

INTRODUCTION

Arthroscopic subacromial decompression (ASD) has been shown to be an effective procedure in the treatment of subacromial impingement including rotator cuff tear, which has been refractory to conservative treatment[1-4]. We have performed ASD for patients with rotator cuff tear whose principal complaint is pain and who don't need good function and strength. We reported satisfactory results in patients with rotator cuff tear who underwent ASD without a cuff repair[5]. However, rotator cuff tear is sometimes complicated by shoulder stiffness. Concomitant preoperative shoulder stiffness may affect postoperative outcomes of ASD.

We hypothesized that there would be no difference in the final clinical results between rotator cuff tear with and without concomitant preoperative

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shoulder stiffness if stiffness were managed by same-stage arthroscopic capsular release, but rotator cuff tear with shoulder stiffness is expected to take longer time in pain reduction and recovery of range of motion. The purpose of the present study was to compare postoperative outcomes for ASD between rotator cuff tear patients with and without preoperative shoulder stiffness and to analyze the serial change in functional scores, range of motion (ROM), and pain intensity of the 2 groups after operation.

METHODS

This study was a prospective evaluation of 60 shoulders in 58 patients (38 men, 20 women) who underwent ASD for rotator cuff tear. All patients were followed up for two years. Mean age of patients at the time of surgery was 62 years (range, 29-80 years). We set the criteria of shoulder stiffness for preoperative passive forward elevation at less than 120°, external rotation at less than 30° according to Hirooka *et al.*'s[6] and Oh *et al.*'s[7] definition for stiffness. Forward elevation represents the location of the inferior capsular contracture, and external rotation represents the location of the anterior capsular contracture. We defined patients in the stiffness group as those who exhibit above criteria. Stiffness group consisted of 25 shoulders, and non-stiffness group consisted of 35 shoulders without shoulder stiffness.

Indications for surgery were persistent pain, limitation of range of motion and functional disability without improvement after conservative treatment for a minimum of 3 months. Conservative treatment included physical therapy, oral non-steroidal anti-inflammatory drugs, and subacromial injection of steroid. However, surgery was also performed for patients who had responded temporarily to conservative therapy but wished to achieve early improvements, irrespective of the duration of conservative therapy.

Preoperative and Postoperative Evaluation

Clinical outcomes were evaluated by use of the Japanese Orthopaedic Association shoulder scoring system (JOA score) and passive shoulder range of motion (ROM). Subjective pain at night and during shoulder motions was measured with the visual analog scale (VAS). JOA score is based on a total of 100 points, with 30 points for pain, 20 points for function, 30 points for range of motion, 5 points for radiographic change, and 15 points for joint stability. ROM (forward flexion, abduction, external rotation with the arm at the side, and internal rotation behind the back) was measured by the same observer with a goniometer. Internal rotation was determined as the highest spine level to which the extended thumb could reach. VAS was used to measure pain of the patients, with 0 indicating no pain and 10 indicating extremely severe pain. Follow-up examinations were performed before rehabilitation. JOA score, ROM and VAS scores were assessed before surgery and 1, 3, 6, 12 and 24 months after surgery, and the results in the stiffness group and non-stiffness group were compared. We did not adjust for sex ratio and age between the 2 groups, because it is considered that gender and age do not affect stiffness after rotator cuff tear[6,8].

Surgical technique

All surgical procedures were performed by the senior author. All patients had general anesthesia. After positioning patients in the lateral decubitus position, an arthroscope was introduced into the glenohumeral joint. In the stiffness group, we performed arthroscopic capsular release. We released the superior, posterior, and anterior capsule including the rotator interval, the middle glenohumeral ligament, and the anterior band of the inferior glenohumeral ligament using radiofrequency device. We did not release the inferior portion of the capsule to avoid axillary nerve injury[9]. After completion of the glenohumeral arthroscopy, ASD including bursectomy, resection of the antero-inferior aspect of the acromion, and detaching the coracoacromial ligament was performed. No additional debridement of torn rotator cuff fibers or labral tears, biceps tenotomy, or lateral clavicle resections was done in the present series.

The postoperative rehabilitation protocols were the same for both groups. Patients were admitted to the hospital for 2 weeks postoperatively. Passive range-of-motion exercises and active-assisted motion exercises, including pendulum exercise, passive elevation, external rotation, and internal rotation were started by a physiotherapist on the first postoperative day. Then, active range-of-motion and muscle strengthening exercises were followed. Physical therapy performed twice a day, for 20 minutes. Before discharge, the patient was reminded by a therapist how to perform exercises. Each patient was instructed to perform stretches in elevation, external rotation, and internal rotation. We recommended this exercise be completed three times a day for 10 minutes. They mainly performed home rehabilitation self-exercises after discharged from the hospital. Strenuous repetitive overhead activities were avoided for at least 4 weeks.

Statistical Analysis

All statistical analyses were performed using the JMP for Macintosh (SAS Institute Inc., Cary). Chi-square test, Wilcoxon signed rank test, and Mann-Whitney U test were used, and $P<0.05$ was considered to be statistically significant.

RESULTS

Preoperative Patient Demographics

Demographic data are listed in Table 1, and the differences were not statistically significant between the 2 groups. The distribution of the tear size is shown in Table 2. The extent of the tear was determined intraoperatively under direct arthroscopic visualization. There was no statistically significant difference in the size of rotator cuff tear between the 2 groups ($p=.644$).

JOA score

At the last follow-up (24 months after surgery), the mean JOA score was 93.1 in stiffness group and 93.0 in non-stiffness group. Both groups showed significant improvement from preoperative levels (Table 3,4).

Serial changes of JOA score in the stiffness and nonstiffness groups. JOA score were significantly lower for stiffness group than for non-stiffness

Table 1. Patient demographics of stiffness and nonstiffness group

Variable	Stiffness group ($n=25$)	Nonstiffness group ($n=35$)	P
Mean age (years)*	62.0±10.0	62.0±12.4	.719
Gender (male : female)	14 : 11	25 : 10	.217
Duration of symptom (months)*	15.7±18.8	14.7±18.8	.413
Dominant involvement (No.)	15	27	.153

*Data represent the mean±SD

Table 2. Distribution of the tear size in each group

	Size of tear			
	Partial	Small (<1 cm)	Medium (1-3 cm)	Large (3-5 cm)
Stiffness group (No.)	13	4	5	3
Nonstiffness group (No.)	14	4	11	6

Table 3. Clinical Outcome of the Stiffness Group

Stiffness group*	Preoperative	Postoperative	P
JOA score	54.0±7.2	93.1±9.0	<.001
ROM			
FF (°)	99.0±13.8	159.1±14.2	<.001
Abd(°)	88.2±14.0	156.1±17.7	<.001
ER (°)	18.2±18.4	53.8±14.7	<.001
IR (spinous process)	L4±2.5	Th9±2.7	<.001
VAS (cm)			
At night	6.2±2.0	0.3±1.0	<.001
During motion	6.9±1.7	0.5±1.0	<.001

Abd, abduction ; ER, external rotation at the side ; FF, forward flexion ; IR, internal rotation to the back ; JOA, the Japanese Orthopaedic Association ; ROM, range of motion ; VAS, visual analog scale.
*Data represent the mean±SD

Table 4. Clinical outcome of the nonstiffness group

Nonstiffness group*	Preoperative	Postoperative	*P*
JOA score	63.5±8.9	93.0±7.8	<.001
ROM			
FF (°)	158.0±11.4	164.7±12.2	0.007
Abd(°)	154.6±15.7	163.6±14.3	0.002
ER (°)	46.6±12.0	52.1±12.2	0.049
IR (spinous process)	Th12±2.7	Th9±1.7	<.001
VAS (cm)			
At night	6.9±1.9	0.2±0.8	<.001
During motion	7.6±1.5	0.9±1.6	<.001

Abd, abduction; ER, external rotation at the side; FF, forward flexion; IR, internal rotation to the back; JOA, the Japanese Orthopaedic Association; ROM, range of motion; VAS, visual analog scale.
*Data represent the mean±SD

group preoperatively ($p<0.001$). At 1, 3, 6, 12 and 24 months postoperatively, no significant differences were apparent in JOA score between the stiffness and non-stiffness groups (Fig. 1).

Range of Motion

When compared with the preoperative ROM, both groups showed significant improvement in all motions postoperatively (Table 3, 4).

Serial changes of ROM in the stiffness and nonstiffness groups. The periodic changes of ROM are shown in Figs. 2, 3, 4, and 5. Compared to non-stiffness group, forward flexion was significantly smaller for stiffness group before surgery ($p<0.001$) and 1 month ($p<0.001$) and 3 months after surgery ($p<0.001$). At 6, 12 and 24 months after surgery, no significant differences existed in forward elevation between the 2 groups (Fig. 2). Compared to non-stiffness group, abduction was significantly smaller for stiffness group before surgery ($p<0.001$), 1 month ($p<0.001$) and 3 months after surgery ($p<0.001$). However, at 6, 12 and 24 months after surgery, no significant difference in abduction existed between the 2 groups (Fig. 3). Compared to non-stiffness group, external rotation was significantly smaller for stiffness group before surgery ($p<0.001$) and 1 month after surgery ($p<0.01$). However, at 3, 6, 12 and 24 months after surgery, no significant difference in external rotation existed between the 2 groups (Fig. 4). Compared to non-stiffness group, internal rotation was significantly smaller for stiffness group before surgery ($p<0.001$) and 1 month after surgery ($p<0.01$). However, at 3, 6, 12 and 24 months after surgery, no significant difference in internal rotation existed between the 2 groups (Fig. 5).

Pain intensity

At 24 months after surgery, the mean VAS score at night was 0.3 cm in stiffness group and 0.2 cm in non-stiffness group. The mean VAS score during motion was 0.5 cm and 0.9 cm, respectively. Both groups showed significant improvement from preoperative levels (Table 3, 4).

Serial changes of pain in the stiffness and nonstiffness groups. No significant differences were apparent in VAS scores for pain at night and pain during motion between the 2 groups at any time of evaluation (Figs. 6, 7).

DISCUSSION

In cases in which a rotator cuff tear is associated with severe and persistent pain, shoulder stiffness may occur gradually over time, limiting both active and passive ROM. Tauro[10] has analyzed total preoperative passive ROM of 78 arthroscopic rotator cuff repairs. He observed that more than 40% of patients had at least 25° total ROM deficit, indicating frequent development of preoperative stiffness. Shoulder stiffness can be caused by soft-tissue contracture, which can be intra-articular or extra-articular[11]. However, it has been unclear how preoperative shoulder stiffness affects postoperative outcomes of ASD for rotator cuff tear. Thus, we thought comparing clinical results of rotator cuff tears between patients with shoulder stiffness and those without stiffness might be meaningful.

JOA scores, ROM, and pain intensity significantly improved after ASD for rotator cuff tear,

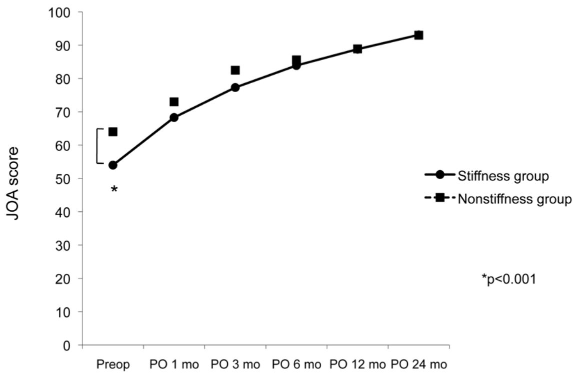

Fig. 1. Serial changes of JOA score in the stiffness and nonstiffness groups.
PO, postoperative ; Preop, preoperative.

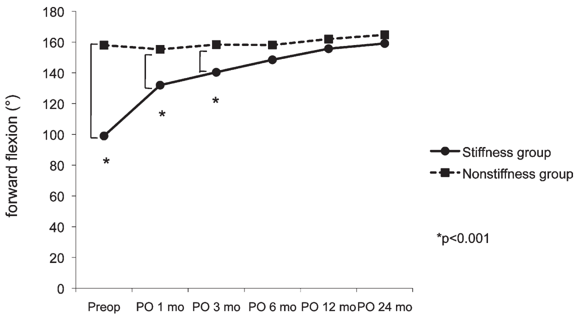

Fig. 2. Serial changes of forward flexion in the stiffness and nonstiffness groups.
PO, postoperative ; Preop, preoperative.

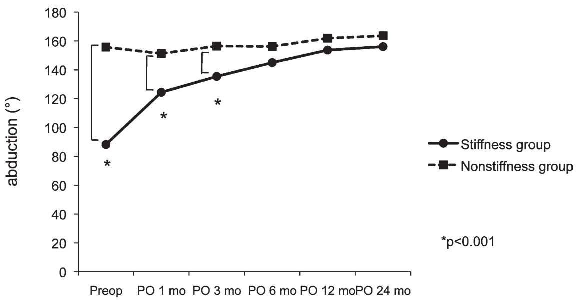

Fig. 3. Serial changes of abduction in the stiffness and nonstiffness groups.
PO, postoperative ; Preop, preoperative.

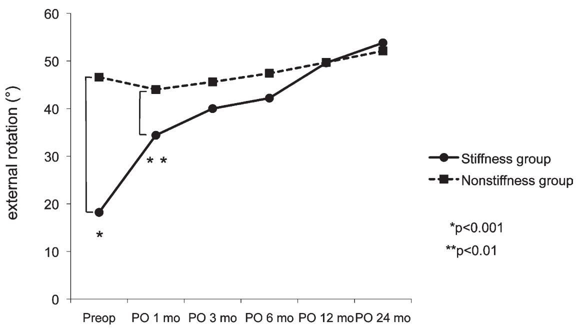

Fig. 4. Serial changes of external rotation in the stiffness and nonstiffness groups.
PO, postoperative ; Preop, preoperative.

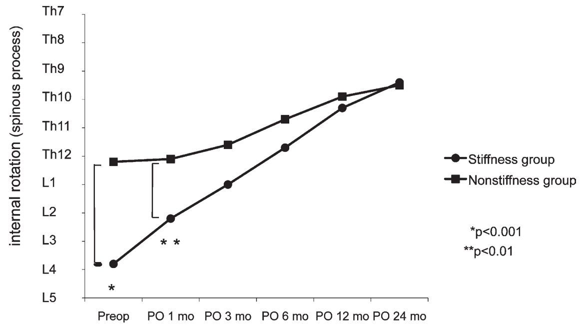

Fig. 5. Serial changes of internal rotation in the stiffness and nonstiffness groups.
PO, postoperative ; Preop, preoperative.

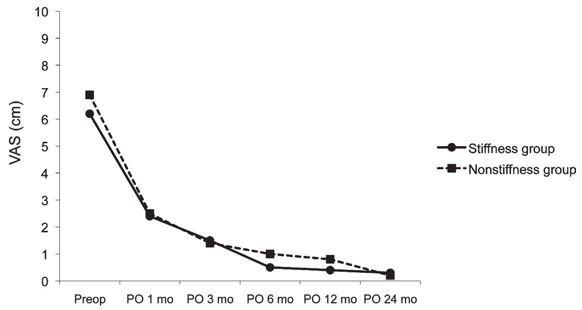

Fig. 6. Serial changes of pain at night in the stiffness and nonstiffness groups.
PO, postoperative ; Preop, preoperative.

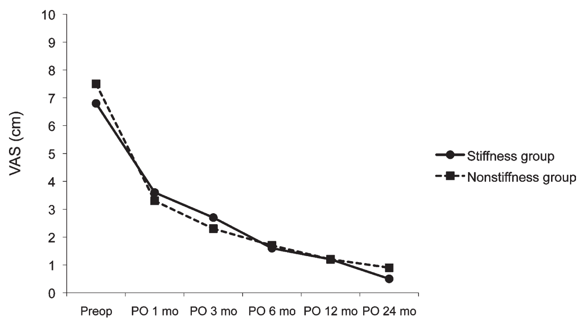

Fig. 7. Serial changes of pain during motion in the stiffness and nonstiffness groups.
PO, postoperative ; Preop, preoperative.

regardless of the presence of shoulder stiffness. The present results clarified that, when arthroscopic capsular release was performed for cases complicated by shoulder stiffness, no differences in serial changes for postoperative outcomes of ASD for rotator cuff tear were seen in terms of JOA scores and VAS scores for pain at night and pain during motion between the stiffness group and nonstiffness group. In other words, presence of preoperative shoulder stiffness does not affect improvement of postoperative JOA scores and VAS scores. However, compared to the non-stiffness group, forward flexion and abduction angles were significantly smaller for the stiffness group at 1 and 3 months after surgery. No significant differences existed in forward flexion and abduction between the 2 groups at 6, 12 and 24 months after surgery. Also, external rotation and internal rotation angles were significantly smaller at 1 month after surgery for the stiffness group than for the non-stiffness group. No significant differences existed in external rotation and internal rotation between the 2 groups at 3, 6, 12 and 24 months after surgery. That is, even if shoulder stiffness exists preoperatively, shoulder range of motion comparable to that in rotator cuff tear patients without shoulder stiffness can be achieved by 6 months after surgery. When performing ASD for rotator cuff tear patients, the differences in postoperative courses depending on shoulder stiffness need to be understood and explained to patients prior to surgery.

It was reported that main cause of a shoulder stiffness associated with rotator cuff tears was located at the shoulder joint capsule as with primary frozen shoulder[12]. However, shoulder stiffness is often accompanied by extra-articular pathology such as muscle contracture around the shoulder. Shoulder range of motion improved more slowly postoperatively in the stiffness group than in the non-stiffness group, possibly due to extra-articular pathology that was difficult to treat by arthroscopic release.

In the present arthroscopic capsular release, we did not release the inferior portion of the capsule to avoid axillary nerve injury. This could also have impacted postoperative range of motion for the shoulder. Further investigation is necessary to define effects of additional release of the inferior portion of the capsule.

Although arthroscopic release is considered minimally invasive, the surgical procedure is not easy, as shoulder stiffness makes it difficult to insert an arthroscope and ensure sufficient visual field inside the joint. As for complications, a risk of damaging the axillary nerve must be kept in mind[9]. When shoulder stiffness associated with rotator cuff tear is present preoperatively, conservative therapy is the basis for treating contracture. If shoulder stiffness remains unresponsive to conservative therapy, arthroscopic release together with ASD should be performed.

Our indications for ASD for rotator cuff tear with stiffness were persistent pain, limitation of range of motion and functional disability without improvement after conservative treatment for a minimum of 3 months. To the authors' knowledge and literature review, there are few reports regarding the outcome of ASD for rotator cuff tear with stiffness. Prospective studies defining the factors that can affect postoperative outcomes of ASD for rotator cuff tear with stiffness, including age, gender, presence of accompanying medical disease, duration of symptoms, and conservative treatment should be performed to determine indication for ASD. Furthermore, it has been unclear postoperative outcomes for ASD without same-stage arthroscopic capsular release for rotator cuff tear with shoulder stiffness. Future randomized controlled studies may be needed to verify the effect of same-stage arthroscopic capsular release for rotator cuff tear with shoulder stiffness.

CONCLUSIONS

Postoperative outcomes for ASD were compared between rotator cuff tear patients with and without shoulder stiffness. Even when shoulder stiffness existed preoperatively, arthroscopic capsular release achieved no marked differences in postoperative JOA score and VAS score. When measured 6 months after surgery, range of motion in the stiffness group and the non-stiffness group was similar.

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