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Safe time frame of staged bilateral arthroscopic rotator cuff repair

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Background: Few studies have assessed the outcomes of staged bilateral arthroscopic rotator cuff repair (ARCR). This study aimed to determine the influencing factors related to the outcomes of patients who underwent staged bilateral ARCR and to verify an optimal interval for performing the second rotator cuff repair in staged bilateral ARCR.
Methods: We analyzed 166 shoulders that underwent staged bilateral ARCR. The average interval between the first- and second-side surgical procedures was 21.9 ± 19.7 months. The minimum follow-up period was 2 years.
Results: Clinical outcomes and retear rates were not significantly different according to the order of surgical procedures, sex, arm dominance, age, and tear size ($P > .05$ for all). The cutoff value for the optimal interval between the first and second surgical procedures for the University of California, Los Angeles score and American Shoulder and Elbow Surgeons score was 9 months, with the area under the curve equal to 0.815 ($P < .001$) for the University of California, Los Angeles score and 0.806 ($P < .001$) for the American Shoulder and Elbow Surgeons score. The group with an interval of 9 months or less between the first- and second-side surgical procedures showed significantly inferior clinical outcomes and a higher retear rate (35%) compared with the group with an interval greater than 9 months (retear rate, 10%) ($P < .05$).
Conclusion: Staged bilateral ARCR resulted in significant improvements in clinical outcomes regardless of the order of surgical procedures, sex, arm dominance, age, and tear size. To optimize clinical outcomes of staged bilateral ARCR, second-side surgery should be delayed until 9 months after the first-side surgical procedure.
Level of evidence: Level IV; Case Series; Treatment Study

Keywords: Shoulder; arthroscopic rotator cuff tear; bilateral; staged; interval; time frame

This study was retrospective in nature, and final approval of the informed-consent exemption was obtained from the Kyung Hee University Hospital Institutional Review Board (institutional review board no. KHUH 2016-11-018).

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As the population has aged and life expectancy has increased, the incidence of rotator cuff tear has grown with time.[18,30] Correspondingly, an increasing number of patients have bilateral rotator cuff tears.[21] Bilateral rotator cuff tears have been reported to account for 25.9% to 35.5% of all rotator cuff tears.[18,30] A previous study showed that in 35.5% of patients, a full-thickness symptomatic rotator cuff tear was accompanied by either a symptomatic or asymptomatic contralateral full-thickness rotator cuff tear.[30] Furthermore, about 51% of asymptomatic rotator cuff tears progressed to symptomatic rotator cuff tears after an average of 2.8 years.[31]

Arthroscopic rotator cuff repair is a well-established operative technique for bilateral rotator cuff tears.[21,23] After simultaneous bilateral rotator cuff repair, rehabilitation is difficult because both arms are used, and there may be some degree of difficulty with activities of daily living.[23] It is not uncommon for patients with bilateral rotator cuff tears to undergo staged rotator cuff repair surgery. However, to our knowledge, few studies have reported the outcomes of staged bilateral arthroscopic rotator cuff repair.

Rehabilitation is crucial to obtaining satisfactory range of motion (ROM) after bilateral rotator cuff repair.[13,17] However, there is a possibility of retear during postoperative rehabilitation.[13,17] To minimize postoperative complications and achieve satisfactory outcomes, a safe time frame is needed for the second rotator cuff repair after the index rotator cuff repair. To date, no study has evaluated the optimal interval between the index and second rotator cuff repairs.

The purpose of this study was to investigate the clinical and structural outcomes of patients who underwent staged bilateral arthroscopic rotator cuff repair and identify the factors that may affect these outcomes. Furthermore, we aimed to examine the optimal interval between the first and second rotator cuff repairs to obtain satisfactory clinical outcomes. We hypothesized that surgical outcomes would be favorable for both shoulders regardless of the order of surgical procedures (first- and second-side shoulders), sex, arm dominance, age, and tear size. In addition, we hypothesized that the interval between the first- and second-side rotator cuff repairs would affect the clinical outcomes of the first-side rotator cuff repair.

Materials and methods

Patient selection

From May 2005 to May 2015, 118 consecutive patients (236 shoulders) underwent bilateral staged rotator cuff repair for the treatment of full-thickness rotator cuff tears. The inclusion criteria were as follows: (1) bilateral arthroscopic rotator cuff repair, (2) primary rotator cuff repair, and (3) a minimum follow-up period of 2 years after the second surgical procedure. Patients who had partial rotator cuff tears, concomitant shoulder stiffness before surgery, or a history of shoulder surgery for any reason and patients who underwent open or arthroscopic partial rotator cuff repairs were excluded from the study. Of the 118 patients, 15 were lost to follow-up, and 7 patients were excluded from the study because of concomitant shoulder stiffness. Moreover, 5 and 8 patients were excluded for having undergone partial and open rotator cuff repairs, respectively. Finally, 83 patients (166 shoulders) were available for evaluation, comprising 45 male and 38 female patients. The mean age at the first-side shoulder surgical procedure was 61.6 $\pm$ 4.6 years. In 62 patients (75%), rotator cuff repair was performed on the dominant shoulder first. The average interval between the first- and second-side surgical procedures was 21.9 $\pm$ 19.7 months. No patient underwent revision surgery.

Clinical evaluations

For patients with symptomatic bilateral rotator cuff tears, the shoulder with more severe pain was chosen for the first-side surgical procedure. The second-side surgical procedure was performed at the patients' desired time. Patients were examined 1 day before the operation and during the follow-up period. Postoperative follow-up was performed at 2 weeks, 6 weeks, 3 months, 6 months, and 1 year postoperatively, as well as every year thereafter. All the operative results were analyzed at 2 years after the operation. Preoperative and postoperative pain during active shoulder motion was measured with a 10-point visual analog scale (VAS). To evaluate progress and outcomes, we used the University of California, Los Angeles (UCLA) score[29]; Constant score[3]; and American Shoulder and Elbow Surgeons (ASES) score.[22]

We considered the functional outcome favorable when the score components of the UCLA, Constant, and ASES scores were greater than 80%.[12,16] On the basis of the UCLA score assessment, we considered a functional outcome greater than 28 points (score $>$ 80% for each UCLA score component) favorable—when the pain score was greater than 8 points, the function score was greater than 8 points, the active forward flexion score was greater than 4 points, the strength score for forward flexion was greater than 4 points, and the satisfaction score of the patient was greater than 4 points. On the basis of the Constant score assessment, we considered a functional outcome greater than 80 points favorable—when the pain score was greater than 12 points, the activities–of–daily living score was greater than 8 points, the score for the ability to work at a specific level was greater than 8 points, the active forward flexion score was greater than 8 points, the active abduction score was greater than 8 points, the active external rotation score was greater than 8 points, the active internal rotation score was greater than 8 points, and the strength score was greater than 20 points. On the basis of the ASES score assessment, we considered a functional outcome greater than 80 points favorable—when the pain score was greater than 40 points and the activities–of–daily living score was greater than 40 points.

In addition, all clinical outcome measures were compared based on the order of surgical procedures (first- and second-side shoulders), demographic factors (sex, arm dominance, and age), and size of the rotator cuff tear.

Operative techniques

All operations were performed by the senior author with the patient in the beach-chair position. After diagnostic arthroscopy was performed through the posterior portal, the arthroscope was inserted through the posterior portal to the subacromial space, and

a lateral portal was made. To view the subacromial space and rotator cuff tear, an additional portal with a Grand Canyon view near the posterolateral corner of the acromion was created. The size of the rotator cuff tear was defined as the length of the greatest diameter measured with the probe during the operation. According to the classification of DeOrio and Cofield,[5] tear sizes were categorized as small (<1 cm), medium (1-3 cm), large (3-5 cm), and massive (>5 cm). After decortication of the rotator cuff insertion, a single-row rotator cuff repair was performed with a suture anchor.

Postoperative rehabilitation

All patients were provided a standard postoperative rehabilitation protocol composed of pendulum exercises with passive forward flexion and external rotation exercises. Active exercises were not allowed until at least 6 weeks after surgery or until full passive ROM was regained. Active-assisted exercises were started 6 weeks postoperatively, and muscle-strengthening exercises followed gradually. Recreational activities or demanding work was allowed only after 6 months.

Assessment of repair integrity

All patients underwent a follow-up magnetic resonance imaging (MRI) evaluation to verify the postoperative repair integrity and healing status of the repaired tendon 9 months after the operation. The follow-up MRI scans were evaluated based on the Sugaya classification.[25] We defined retears of repaired rotator cuffs as types IV and V of the Sugaya classification.[25]

Statistical analysis

Mediolateral and anteroposterior tear sizes were compared by use of a paired *t* test. The Student *t* test or Mann-Whitney test was used to compare continuous variable outcomes between 2 groups. Categorical data between groups were evaluated with the χ^2 test or Fisher exact test. The Kruskal-Wallis test was performed to compare the clinical scores in relation to age and tear size.

To identify the optimal interval between the first and second surgical procedures, the receiver operating characteristic curve for clinical scores (UCLA, Constant, and ASES scores) was analyzed. The point at which the area under the curve (AUC) was the greatest was set as the cutoff value for the optimal interval between the first and second surgical procedures. SPSS software (version 20.0; IBM, Armonk, NY, USA) was used for all statistical analyses. $P < .05$ was considered statistically significant.

Results

Rotator cuff tear sizes

The mediolateral length of the rotator cuff tears in the first- and second-side shoulders was 2.8 ± 1.3 cm and 2.4 ± 0.9 cm, respectively ($P = .001$). The anteroposterior length of the tears was 2.0 ± 1.0 cm and 1.8 ± 0.9 cm, respectively ($P = .104$). The rotator cuff tear size based on the DeOrio and Cofield classification[3] showed no significant difference between the first- and second-side shoulders ($P = .162$) (Table I). Overall, 47 patients (57%) and 11 patients (13%) had small to medium tears and large to massive tears, respectively, in both shoulders. The bilateral shoulders of 58 patients (70%) belonged to the same size group. Rotator cuff tear size was closely correlated with the contralateral side ($P = .014$) (Table II).

First- and second-side arthroscopic rotator cuff repairs

The preoperative VAS pain and UCLA scores were 7.0 ± 1.2 and 12.5 ± 2.4, respectively, for the first side and 6.6 ± 1.4 and 13.6 ± 2.3, respectively, for the second side ($P = .033$ for VAS pain score and $P = .003$ for UCLA score) (Table III). The preoperative Constant and ASES scores were 27.2 ± 10.1 and 28.5 ± 11.2, respectively, for the first side and 29.0 ± 9.4 and 29.0 ± 9.9, respectively, for the second side ($P > .05$ for both).

Two years after the operation, the VAS pain, UCLA, Constant, and ASES scores were 1.1 ± 1.2, 30.5 ± 3.6, 80.9 ± 7.7, and 84.1 ± 6.5, respectively, for the first side and 1.5 ± 1.3, 30.6 ± 3.2, 81.3 ± 4.1, and 83.1 ± 3.0, respectively, for the second side. No significant differences in UCLA, Constant, and ASES scores were found at 2 years after surgery ($P > .05$ for all), whereas a significant difference in VAS pain score was found between the 2 groups ($P < .001$) (Table III). Retear rates did not significantly differ between the 2 groups, with 16 patients (19%) having a retear on the first side and 14 patients (17%) having a retear on the second side ($P = .835$).

Outcomes based on demographic factors

At 2 years after surgery, no significant differences in UCLA, Constant, and ASES scores for the first and second sides were found in relation to sex ($P > .05$ for all) (Table IV). Furthermore, no significant differences in retear rates between the first and second sides were noted in relation to sex ($P > .05$ for all) (Tables IV and V).

At 2 years after surgery, no significant differences in UCLA, Constant, and ASES scores for the first and second sides were found in relation to arm dominance ($P > .05$ for all) (Table IV). Furthermore, no significant differences in retear rates between the first and second sides were noted in relation to arm dominance ($P > .05$ for all) (Tables IV and V).

When patients were divided into those younger than 65 years vs. those aged 65 years or older, we found no significant differences in UCLA, Constant, and ASES scores for the first and second sides between the 2 groups at 2 years after surgery. In addition, no significant differences in retear rates were found in relation to age (Tables IV and V).

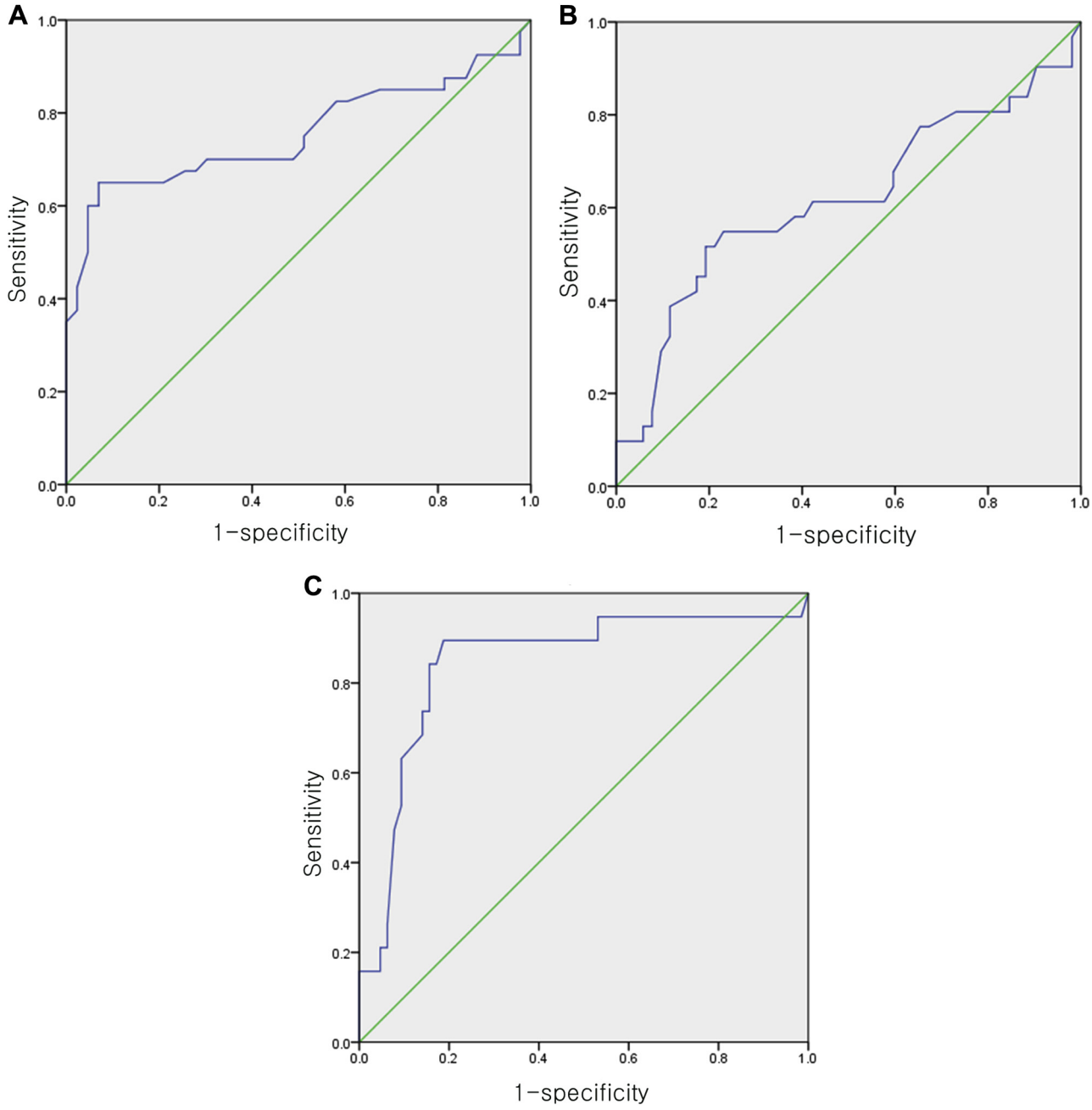

Figure 1 Receiver operating characteristic curves for clinical scores: University of California, Los Angeles score **(A)**; Constant score **(B)**; and American Shoulder and Elbow Surgeons score **(C)**.

Outcomes based on rotator cuff tear size

Rotator cuff tear size did not have a statistically significant association with postoperative clinical outcomes. Regarding the clinical outcomes at 2 years after surgery, no significant differences in UCLA, Constant, and ASES scores for the first shoulder were found between small to medium tears and large to massive tears ($P > .05$ for all) (Table VI). The retear rate of the first shoulder was significantly higher for large to massive tears than for small to medium tears ($P = .004$).

Regarding the second shoulder, no significant differences in UCLA, Constant, and ASES scores were found between small to medium tears and large to massive tears at 2 years after surgery ($P > .05$ for all) (Table VI). The retear rate of the second shoulder was significantly higher for large to massive tears than for small to medium tears ($P = .001$).

Table I Distribution of rotator cuff tear size in first- and second-side shoulders

Tear size	First side	Second side	*P* value
Mediolateral size, mean ± SD, cm	2.8 ± 1.3	2.4 ± 0.9	.001
Anteroposterior size, mean ± SD, cm	2.0 ± 1.0	1.8 ± 0.9	.104
Tear size (based on DeOrio and Cofield classification[5]), n			.162
Small to medium	56	63	
Large to massive	27	20	

SD, standard deviation.
The rotator cuff tear size based on the DeOrio and Cofield classification showed no significant difference between the first- and second-side shoulders.

Outcomes based on interval between first- and second-side surgical procedures

The cutoff level for the optimal interval between the first- and second-side surgical procedures according to the UCLA score was 9.2 months (AUC, 0.815; $P < .001$; sensitivity, 90.3%; specificity, 77.0%). The cutoff level according to the Constant score was 8.6 months (AUC, 0.691; $P = .004$; sensitivity, 61.3%; specificity, 76.9%). The cutoff level according to the ASES score was 9.2 months (AUC, 0.806; $P < .001$; sensitivity, 100%; specificity, 81.3%) (Figure 1).

With 9 months used as the cutoff level, the UCLA, Constant, and ASES scores of the first-side shoulders with an interval of 9 months or less were 27.2 ± 2.1, 73.6 ± 3.3, and 78.2 ± 4.4, respectively, and those of the first-side shoulders with an interval of more than 9 months were 32.5 ± 2.8, 85.2 ± 6.2, and 89.3 ± 4.8, respectively ($P < .001$ for all) (Table VII). Furthermore, the retear rate of the shoulders with an interval of 9 months or less (35%) was significantly higher than that of the shoulders with an interval of more than 9 months (10%) ($P = .004$) (Table VII). Among the second-side shoulders, no significant differences in UCLA, Constant, and ASES scores and retear rates were found between the group with an interval of 9 months or less and the group with an interval greater than 9 months (Table VII).

Table II Distribution of rotator cuff tear size in 58 patients (70%) with bilateral shoulders belonging to same size group

Tear size*	Second side, n	
	Small to medium	Large to massive
First side		
Small to medium	47	9
Large to massive	16	11
P value	.014	

Rotator cuff tear size was closely correlated with the contralateral side ($P = .014$).
* Tear sizes are classified based on the DeOrio and Cofield classification.[5]

Table III Outcomes of first- and second-side arthroscopic rotator cuff repairs

	First side	Second side	*P* value
VAS pain score			
Preoperatively	7.0 ± 1.2	6.6 ± 1.4	.033
2 yr postoperatively	1.1 ± 1.2	1.5 ± 1.3	<.001
UCLA shoulder score			
Preoperatively	12.5 ± 2.4	13.6 ± 2.3	.003
2 yr postoperatively	30.5 ± 3.6	30.6 ± 3.2	.701
Constant score			
Preoperatively	27.2 ± 10.1	29.0 ± 9.4	.247
2 yr postoperatively	80.9 ± 7.7	81.3 ± 4.1	.580
ASES score			
Preoperatively	28.5 ± 11.2	29.0 ± 9.9	.780
2 yr postoperatively	84.1 ± 6.5	83.1 ± 3.0	.148
Retear rate, n (%)	16 (19)	14 (17)	.835

ASES, American Shoulder and Elbow Surgeons; *UCLA*, University of California, Los Angeles; *VAS*, visual analog scale.
Data are given as mean ± standard deviation unless otherwise indicated.

Discussion

Postoperative rehabilitation programs are crucial to obtaining satisfactory outcomes after arthroscopic rotator cuff repair.[13,17] Postoperative rehabilitation is also needed for staged bilateral rotator cuff repair. Because the first shoulder side must be used for the rehabilitation of the second shoulder side and daily activities after staged bilateral rotator cuff repair, there may be some adverse impact on the first shoulder side. Therefore, an appropriate time frame needs to be identified to lower the retear rate and achieve satisfactory outcomes after bilateral rotator cuff repair. However, there have been no reports regarding a safe time frame after the index rotator cuff repair to perform the second rotator cuff repair to achieve favorable outcomes. Morris et al[19] performed staged bilateral reverse total shoulder arthroplasty in patients with bilateral rotator cuff tear arthropathy and reported that the time between reverse total shoulder arthroplasties (≤3 months vs. >3 months) showed no significant difference between preoperative status and postoperative clinical outcomes. In a study of patients who underwent staged bilateral total shoulder arthroplasty for osteoarthritis, Fabricant et al[6] noted that performing the second-side surgical procedure within 6 months after the first-side surgical procedure might optimize postoperative clinical outcomes and satisfaction compared with a longer interval between surgical procedures. One of the suggested reasons was that once the pain-inducing first side of the destructed arthritic joint is

Table IV Outcomes of first-side shoulder according to demographic factors

Variable	First side			
	UCLA shoulder score	Constant score	ASES score	Retear(%)
Sex				
Male	30.6 ± 3.9	81.2 ± 8.2	83.9 ± 6.9	9 of 45 (20)
Female	30.4 ± 3.4	80.5 ± 7.2	84.2 ± 6.0	7 of 38 (18)
P value	.778	.675	.821	.856
Arm dominance				
Dominant	30.6 ± 3.6	80.8 ± 7.8	84.4 ± 6.2	12 of 62 (19)
Nondominant	30.1 ± 3.9	81.0 ± 7.8	83.0 ± 7.4	4 of 21 (19)
P value	.715	.862	.446	.975
Age				
<65 yr	30.5 ± 3.7	80.9 ± 8.0	84.1 ± 6.9	11 of 55 (20)
≥65 yr	30.5 ± 3.5	80.9 ± 7.4	84.0 ± 5.8	5 of 28 (18)
P value	.975	.977	.981	.815

ASES, American Shoulder and Elbow Surgeons; *UCLA*, University of California, Los Angeles.
Data are given as mean ± standard deviation or number (percentage).

replaced, it could aid recovery after the second-side surgical procedure, leading to less pain. Furthermore, a short interval between the 2 surgical procedures enables both shoulders to undergo postoperative rehabilitation during overlapping periods, which shortens the overall recovery time and reduces the recovery time burden for the patient. Nonetheless, 1 element of common ground between our study and the aforementioned studies is that staged bilateral shoulder surgery was performed; different factors must be considered to determine the timing of the second-side surgical procedure because arthroplasty and tendon repair vary in surgical features. For instance, owing to the tendon-to-bone healing time, rotator cuff repair is associated with a longer postoperative protection period for the repaired shoulder than that after shoulder arthroplasty. Patterns of postoperative pain, permitted active ROM during rehabilitation, and timing of postoperative rehabilitation are also different between the 2 procedures.

In our study, the cutoff level for the optimal interval between the first- and second-side surgical procedures based on clinical scores was 9 months. The group with an interval of 9 months or less had significantly inferior outcomes to the group with an interval greater than 9 months. The group with an interval of 9 months or less had a significantly higher retear rate than the other group, which also would have resulted in corresponding significant differences in the clinical scores. If the second-side surgical procedure is performed without adequate healing after the first-side rotator cuff repair, it would be difficult to obtain adequate immobilization and protection of both shoulders during recovery, which would increase the risk of retear. Cuff et al[4] examined arthroscopic rotator cuff repair

Table V Outcomes of second-side shoulder according to demographic factors

Variable	Second side			
	UCLA shoulder score	Constant score	ASES score	Retear(%)
Sex				
Male	30.6 ± 1.5	81.2 ± 4.0	83.0 ± 3.0	7 of 45 (16)
Female	30.7 ± 1.3	81.3 ± 4.3	83.2 ± 3.1	7 of 38 (18)
P value	.911	.915	.754	.799
Arm dominance				
Dominant	30.5 ± 1.6	81.4 ± 3.9	83.3 ± 3.2	4 of 21 (19)
Nondominant	30.7 ± 1.4	81.0 ± 4.6	82.6 ± 2.4	10 of 62 (16)
P value	.879	.602	.451	.739
Age				
<65 yr	30.7 ± 1.5	81.0 ± 4.2	83.0 ± 3.0	10 of 55 (18)
≥65 yr	30.6 ± 1.4	81.9 ± 3.9	83.3 ± 3.2	4 of 28 (14)
P value	.888	.328	.666	.761

ASES, American Shoulder and Elbow Surgeons; *UCLA*, University of California, Los Angeles.
Data are given as mean ± standard deviation or number (percentage).

Table VI Outcomes according to rotator cuff tear size

Tear size	UCLA shoulder score	Constant score	ASES score	Retear(%)
First-side shoulder				
Small to medium	30.6 ± 3.7	80.7 ± 7.2	84.0 ± 6.3	6 of 56 (11)
Large to massive	30.4 ± 3.6	81.3 ± 8.9	84.2 ± 7.0	10 of 27 (37)
P value	.580	.875	.733	.004
Second-side shoulder				
Small to medium	30.7 ± 1.3	81.3 ± 3.9	83.0 ± 3.0	5 of 63 (8)
Large to massive	30.6 ± 1.8	81.4 ± 4.9	83.5 ± 3.0	9 of 20 (45)
P value	.788	.785	.641	.001

ASES, American Shoulder and Elbow Surgeons; *UCLA*, University of California, Los Angeles.
Data are given as mean ± standard deviation or number (percentage).

patients and compared the clinical outcomes of a group with early passive ROM, beginning on postoperative day 2, and a group with delayed passive ROM, beginning at 6 weeks postoperatively. They found no significant differences in clinical outcomes between the 2 groups after an average of 1 year; however, the delayed passive ROM group had a slightly higher rotator cuff healing rate (91%) than the early passive ROM group (85%). Lee et al[15] compared the outcomes of 2 rehabilitation protocols after arthroscopic rotator cuff repair and reported that the group with aggressive early passive rehabilitation had a heightened possibility of anatomic failure of the repaired cuff compared with the group with limited early passive rehabilitation. Thomopoulos et al[27] and Gimbel et al[10] suggested, through animal studies, that postoperative immobilization could improve tendon-to-bone healing and that a more optimal healing environment could be obtained by avoiding early ROM for the first 6 weeks after surgery. Considering these findings, a sufficient interval between the first- and second-side surgical procedures is essential during bilateral rotator cuff repair to reduce the retear rate and achieve further improvement in clinical outcomes. In our study, the optimal interval was found to be 9 months, suggesting that the second-side surgical procedure should be performed at least 9 months after the first-side surgical procedure.

Although no significant differences in clinical outcomes were found according to tear size, the group with small to medium tears showed slightly better results than the group with large to massive tears. However, the retear rates were significantly different between small to medium tears (8%-11%) and large to massive tears (37%-45%). According to previous studies, the MRI-diagnosed retear rate after rotator cuff repair ranges from 20% to 39%.[14,24,32] For large tears

Table VII Clinical outcomes according to operative interval

Variable	Interval ≤ 9 mo	Interval > 9 mo	*P* value
Demographic factors			
Age, yr	61.7 ± 4.9	61.5 ± 4.4	.891
Sex (male/female), n	17/14	28/24	.930
Dominant shoulder, %	64.5	82.7	.061
Preoperative tear size (small to medium/large to massive), n			
First side	20/11	37/15	.528
Second side	21/10	42/10	.179
Outcomes of first-side shoulder			
UCLA shoulder score	27.2 ± 2.1	32.5 ± 2.8	<.001
Constant score	73.6 ± 3.3	85.2 ± 6.2	<.001
ASES score	78.2 ± 4.4	89.3 ± 4.8	<.001
Retear, n (%)	11 of 31 (35)	5 of 52 (10)	.004
Outcomes of second-side shoulder			
UCLA shoulder score	30.5 ± 1.3	30.8 ± 1.5	.363
Constant score	81.4 ± 3.9	81.2 ± 4.3	.297
ASES score	82.6 ± 2.6	83.4 ± 3.2	.825
Retear, n (%)	5 of 31 (16)	9 of 52 (17)	.890

ASES, American Shoulder and Elbow Surgeons; *UCLA*, University of California, Los Angeles.
Data are given as mean ± standard deviation unless otherwise indicated.

(>3 cm), the retear rate at 2 years after surgery is reported to be about 41% to 94%.[7,8,26] However, in most studies, patients showed a significant improvement in symptoms at about 12 months postoperatively even after a repair failure,[28] and patients with an intact repair had a significantly better outcome.[8,9]

In our study, clinical and structural outcomes showed no significant differences according to the order of surgical procedures (first- and second-side shoulders), sex, arm dominance, and age, although the VAS pain score for the first-side shoulder was significantly lower than that for the second-side shoulder. In a report on staged bilateral arthroscopic rotator cuff repair in 55 patients, Aleem et al[1] stated that clinical scores were favorable for both shoulders regardless of hand dominance and the order of surgical procedures.

We found a correlation for rotator cuff tear size between the bilateral shoulders in about 70% of the patients with similar rotator cuff tear sizes in this study. Similarly, a previous study reported that 36 of 51 patients who underwent bilateral arthroscopic rotator cuff repair showed similar tear sizes in both shoulders.[21] In a study of patients with full-thickness rotator cuff tears and their siblings, Harvie et al[11] noted that genetic factors play a major role in the development of full-thickness tears of the rotator cuff. Chaudhury et al[2] suggested that human gene expression profiles are significantly different between a group of normal shoulders and groups with small and large rotator cuff tears, which in turn are associated with different pathogeneses of rotator cuff tears and healing potential. These findings signify that there are individual differences in the tendency for tearing and healing of the rotator cuff tendon, which may explain the results of our study. Further studies are required to substantiate this.

This study has the following limitations: First, this was a retrospective study; therefore, careful prospective analysis of symptoms was not performed. We were only able to retrospectively investigate selected patients. Second, this study investigated the clinical outcomes at 2 years after surgery, and outcomes may differ in longer follow-up periods. Third, we did not perform a histologic evaluation on bone-to-tendon healing according to the duration after surgery. A previous study performed a microscopic evaluation of adult sheep that underwent patellar tendon reattachment.[20] It reported that fibrous integration occurred in the tendon at 12 weeks postoperatively and was completed between the bone and tendon at 26 weeks postoperatively. Subsequent studies need to perform histologic evaluation on bone-to-tendon healing after cuff repair. However, as there are insufficient studies on bilateral rotator cuff repair, we believe that our findings based on various clinical scoring systems and structural outcomes are also meaningful.

This study has several strengths: First, it is the largest study to date comprehensively examining clinical outcomes after staged bilateral arthroscopic rotator cuff repair. Second, it is the first study aiming to determine the appropriate timing of the second-side surgical procedure after the first-side arthroscopic rotator cuff repair.

Conclusion

To optimize clinical outcomes of staged bilateral arthroscopic rotator cuff repair, second-side surgery should be delayed until 9 months after the first-side surgical procedure. Staged bilateral arthroscopic rotator cuff repair resulted in a significant improvement in clinical outcomes regardless of the order of surgical procedures, sex, arm dominance, age, and tear size. Data from this study provide a valuable resource to the shoulder surgeon when engaging with patients with bilateral symptomatic rotator cuff tears considering staged surgical repair.

Disclaimer

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