

# Effect of Retear After Arthroscopic Rotator Cuff Repair on Return to Work and Sports in Nonathletes

## A Retrospective Cohort Study

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**Background:** The impact of retear after arthroscopic rotator cuff repair (ARCR) on clinical outcomes of patients remains controversial.

**Purpose/Hypothesis:** The purpose of this study was to determine the effects of retear on strength recovery, return to previous levels of work, and return to sports participation. It was hypothesized that retears (1) would not have a significant effect on patient-reported outcome measures (PROMs) and (2) would significantly inhibit strength recovery and return to previous work and sports.

**Study Design:** Cohort study; Level of evidence, 3.

**Methods:** The authors collected data from patients who underwent ARCR between January 2015 and December 2019. All included patients had undergone magnetic resonance imaging (MRI) and strength measurements 1 year postoperatively. Minimum 2-year postoperative PROMs (Constant score, pain visual analog scale, American Shoulder and Elbow Surgeons score, and Single Assessment Numeric Evaluation) and status on work and sports participation were collected, and PROM scores, strength recovery (percentage compared with the contralateral shoulder), return to work, and return to sports were compared between patients with versus without retear on 1-year postoperative MRI. Additionally, factors related to return to work and sports were identified through multivariable regression analysis.

**Results:** A total of 159 patients were included, of whom 19 (11.9%) had evidence of retear. Return-to-work and return-to-sports status was evaluated in 134 (84.3%) and 93 (58.5%) patients, respectively. There were no significant differences in PROM scores between patients with and without retears; however, patients with retears exhibited significantly worse supraspinatus strength recovery (73% vs 86%;  $P = .018$ ) and external rotation strength recovery (78% vs 88%;  $P = .030$ ) compared with patients with intact shoulders. There were no between-group differences in return to work or sports. Active workload was associated with unsuccessful return to work, whereas preoperative participation in shoulder sports was associated with successful return to work.

**Conclusion:** Patients with postoperative retears had significantly worse postoperative strength recovery than patients with intact shoulders. Active workload and preoperative shoulder sports participation were factors associated with ability to return to work.

**Keywords:** rotator cuff repair; retear; return to sports; return to work; strength

Arthroscopic rotator cuff repair (ARCR) is currently the gold standard treatment for patients with rotator cuff tears who do not respond to nonoperative treatments.<sup>46</sup>

Postoperative retear is a common complication of ARCR that has been reported to occur in 11% to 94% of all cases,<sup>10</sup> and many studies have identified factors associated with postoperative tendon healing.<sup>8,33,37,42</sup> Other studies have recognized that retear is not necessarily accompanied by poor outcomes and identified factors associated with symptomatic postoperative retears<sup>10,24,27,29,30,35,36</sup> using

patient-reported outcome measures (PROMs)<sup>47</sup> and range of motion (ROM)<sup>30</sup> as endpoints.

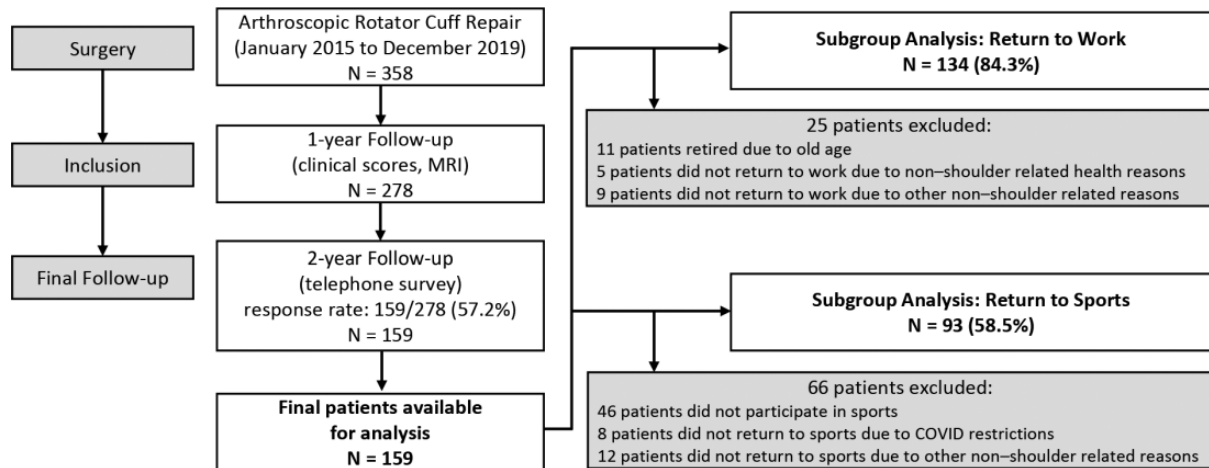
Previous literature has focused on the effects of ARCR on other aspects of patient outcome. ARCR has been shown to significantly improve strength outcomes of patients with rotator cuff tears. Several factors, including Goutallier grade,<sup>15</sup> biceps tenodesis, and repair technique, have been identified to be related to postrepair strength recovery.<sup>1,14,21,32</sup> However, the impact of post-ARCR retear on strength recovery remains poorly understood. Moreover, return to previous work after ARCR is an active area of research,<sup>17,18,20</sup> with a systematic review by Haunschild et al<sup>20</sup> finding that 62.3% of patients returned to their previous level of work. Return to previous sports after ARCR has also been extensively studied in young athletes, where

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**Figure 1.** Flowchart of patient selection for the study population and subgroup analysis. MRI, magnetic resonance imaging.

Altintas et al<sup>3</sup> found that 70.3% of all athletes and 38% of overhead athletes successfully returned to their previous sports at the same or higher level after ARCR. However, the relationship between postoperative retear and return to previous work or sports remains poorly understood.

Despite several studies on the factors associated with integrity after rotator cuff repair, the effects of rotator cuff retear on patient outcomes remain controversial.<sup>7,13,19,35,41,43</sup> This study was designed to determine the effects of retear on strength recovery, return to previous levels of work, and return to sports participation in a nonathletic population. The hypotheses were that retears (1) would not have a significant effect on PROMs and (2) would significantly inhibit the successful return to previous work and sports.

## METHODS

### Patient Population

This was a retrospective cohort study involving patients with repairable rotator cuff tears who underwent ARCR at a tertiary referral hospital between January 2015 and December 2019. Institutional review board approval was obtained before the start of this study. Included in the study were patients who underwent routine postoperative magnetic resonance imaging (MRI) evaluation within 1 year of the operation and who had at least 2 years of follow-up data. Excluded were (1) patients who underwent concomitant superior capsular reconstruction, (2) those with postoperative trauma to the ipsilateral shoulder, and (3) those with no strength measurements at the 1-year follow-up.

This was a retrospective study that utilized routinely collected information, and informed consent was not required by the IRB.

Of 358 patients who had undergone ARCR during the study period, 278 satisfied the inclusion criteria. A telephone survey was conducted to collect information on postoperative work and sports status; 159 replied to the survey and were selected as the final study population (Figure 1).

### Surgical Technique and Postoperative Rehabilitation Protocol

All surgical procedures were performed by 2 surgeons (I.H.J. and K.H.K.) using the same technique. Subacromial decompression with acromioplasty and bursectomy was performed, and rotator cuff repair was conducted with a single- or double-row technique according to the tear type. Single-row repair was performed in cases of severe retraction, sufficient remnant tissue of the greater tuberosity, or small-sized tears. Double-row repair was performed when a large contact area was required for bone-to-tendon healing. Depending on the condition of the long head of the biceps, procedures such as debridement only, tenotomy, or tenodesis were applied. Small-sized partial-thickness subscapularis tears were treated with simple debridement; more than high-grade partial-thickness subscapularis tears were treated with subscapularis repair.

The sling was applied to all patients for 6 weeks. At 6 weeks, a gradual passive ROM was started, progressing

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Ethical approval for this study was obtained from Asan Medical Center (Approval No. S2021-1792-0001).

to resistive strengthening, which was continued for 3 to 4 months. Heavy labor activities and return to work were limited until 6 months postoperatively.

### Data Collection

Preoperative patient data, including age, sex, body mass index, diabetes status, smoking status, symptom duration (measured from time of aggravation), dominant hand, job history, and medical history (Charlson Comorbidity Index), were collected from each patient before surgery. Intraoperative data, including biceps procedure (ie, debridement only, tenodesis, or tenotomy), repair configuration (ie, single row or double row), the presence of subscapularis tear, and its repair status, were also collected.

Preoperative MRI was used to evaluate the initial tear size,<sup>39</sup> tangent sign,<sup>50</sup> and Goutallier fatty infiltration.<sup>12</sup> The initial tear size was classified into 3 groups (partial, small to medium, or large to massive) for analysis. Postoperative retears were defined as Sugaya type 4 or 5 on T2-weighted sagittal MRI at the 1-year follow-up as determined by a single researcher (S.H.).<sup>45</sup> The Constant score and rotator cuff muscle strength measured at the 1-year routine follow-up were used for the study.

### Telephone Survey

A telephone survey was performed 2 to 7 years after rotator cuff repair by a clinical research nurse with >10 years of experience in the shoulder and elbow team who was not involved in this study and who was blinded to the re-tear status of the patients. One attempt was made to reach each patient, and nonresponders were not included in the study.

During the survey, patients provided final clinical scores including pain visual analog scale (pVAS), American Shoulder and Elbow Surgeons (ASES) score, Single Assessment Numeric Evaluation (SANE), and ROM. The survey also included questions on preoperative and postoperative work and sports status (Appendix Table A1). Patients' work status was categorized as "nonemployed" (eg, homemakers or retirees) or, if employed, as "sedentary" (low workload) or "active" (moderate, heavy, or very heavy workload) according to the US Bureau of Labor Statistics *Occupational Outlook Handbook*.<sup>44</sup> For those who participated in sports before injury, sports status was categorized as "non-shoulder" or "shoulder" depending on whether the shoulder was involved.

Patients were also asked to grade the degree to which they had been able to return to their previous level of work or sports (Appendix Table A1). Only patients who responded that they completely returned to their previous level were considered to have achieved return to work or sports. Those who could not achieve a complete return were asked whether it was because of their shoulder function. Patients who had retired because of advanced age or who quit sports for non-shoulder-related reasons were excluded from the return-to-work or return-to-sports analysis.

### Data Analysis

We investigated the relationship between presence of re-tear and 5 endpoints: PROMs (pVAS, SANE, and ASES score), ROM, strength recovery, return to work, and return to sports. Strength recovery was evaluated at the 1-year routine follow-up, while PROMs, ROM, return to work, and return to sports were evaluated through the telephone survey conducted 2 to 7 years after surgery. Dependent variables related to PROMs were the final scores, absolute improvement between preoperative and final follow-up scores, and Patient Acceptable Symptom State (PASS)<sup>28</sup> achievement. ROM included forward flexion, external rotation (ER), and internal rotation (IR) behind the back. IR was graded using the patient's ability to reach the vertebral spinous process with the tip of the thumb on a continuous scale: T1-12 (1-12 points), L1-5 (score 13-17 points), and buttock (18 points).<sup>30</sup> Strength recovery was defined as the percentage of operative shoulder strength compared with that of the contralateral shoulder at the 1-year follow-up. Factors relating to strength recovery were additionally analyzed through multivariable regression.

Dependent variables related to return to work and return to sports were analyzed through subgroup analysis. As this study was designed to investigate return to previous work activities rather than return to the previous job, patients with nonpaying work, such as nonemployed persons or homemakers, were included in the subgroup analysis for successful return to work. However, patients who did not return to their previous level of work for non-shoulder-related causes were excluded from the analysis. Subgroup analysis on factors related to successful return to previous sports was performed on all patients who participated in sports, excluding those who did not return to their previous sports for non-shoulder-related reasons. The subgroup analysis first analyzed the relationships between presence of re-tear and return to work or sports through group comparison techniques and then identified independent factors related to successful return through univariable and multivariable regression.

### Statistical Analysis

Statistical analysis was performed using R Version 4.1.2 (The R Foundation for Statistical Computing). The previously published PASS values for the pVAS, SANE, and ASES score were used.<sup>28</sup> Outcomes between the re-tear and intact groups (final and improvement values for pVAS, SANE, and ASES score, and strength recovery measures) were compared using the Wilcoxon rank-sum test. The chi-square test and odds ratio were used to compare return to work and return to sports. The Fisher exact test was used to compare PASS achievement status for pVAS, SANE, and ASES score. Multivariable logistic regression was performed to assess factors influencing return to work and sports, including factors that showed associations with  $P < .05$  in univariable logistic regression. Statistical significance was set at  $P < .05$ .

TABLE 1  
Descriptive and Baseline Patient Characteristics (N = 159)<sup>a</sup>

Characteristic	Value	Characteristic	Value
Retear		Goutallier grade (teres minor)	
Intact	140 (88.1)	0	69 (43.4)
Retear	19 (11.9)	1	70 (44.0)
Sex		2	17 (10.7)
Female	77 (48.4)	3	3 (1.9)
Male	82 (51.6)	Goutallier grade (subscapularis)	
Age, y	61 ± 7	0	46 (28.9)
BMI	25.35 ± 2.93	1	84 (52.8)
Diabetes mellitus	20 (12.6)	2	26 (16.4)
Smoker	16 (10.1)	3	3 (1.9)
Dominant side affected	111 (69.8)	Workload	
Symptom duration, mo	27 ± 43	Nonemployed	67 (42.1)
Surgical method		Sedentary	42 (26.4)
Single row	45 (28.3)	Active	50 (31.4)
Double row	114 (71.7)	Sports type	
Subscapularis tear	79 (49.7)	None	46 (28.9)
Subscapularis repair	34 (21.4)	Nonshoulder	32 (20.1)
Initial tear size		Shoulder	81 (50.9)
Partial	26 (16.4)	Preoperative PROM score	
Small to medium	84 (52.8)	Constant	59 ± 13
Large to massive	49 (30.8)	pVAS	4.82 ± 1.86
Age-adjusted CCI	2.05 ± 1.10	SANE <sup>b</sup>	58 ± 19
Tangent sign	44 (27.7)	ASES	61 ± 16
Goutallier grade (supraspinatus)		Preoperative ROM	
0	54 (34.0)	FF, deg	147 ± 26
1	76 (47.8)	ER, deg	47 ± 16
2	21 (13.2)	IR, points <sup>c</sup>	12.2 ± 3.5
3	5 (3.1)		
4	3 (1.9)		
Goutallier grade (infraspinatus)			
0	37 (23.3)		
1	84 (52.8)		
2	30 (18.9)		
3	4 (2.5)		
4	4 (2.5)		

<sup>a</sup>Data are presented as n (%) or mean ± SD. ASES, American Shoulder and Elbow Surgeons; BMI, body mass index; CCI, Charlson Comorbidity Index; ER, external rotation; FF, forward flexion; IR, internal rotation; PROM, patient-reported outcome measure; pVAS, pain visual analog scale; ROM, range of motion; SANE, Single Assessment Numeric Evaluation.

<sup>b</sup>n = 151 patients.

<sup>c</sup>Behind-the-back score: T1-12 = 1 to 12 points; L1-5 = 13 to 17 points; buttock = 18 points.

## RESULTS

### Patient Characteristics

The baseline characteristics of the 159 study patients are shown in Table 1. Eight patients were missing preoperative SANE values. These patients were excluded from the postoperative analysis regarding the SANE but were included in all other analyses.

### Telephone Survey

The preoperative work and sports status of the patients is described in Figure 2. Housewives and other unemployed patients formed the nonemployed group. Patients included in the sedentary workload group included office workers,

transportation workers, professors, and florists. Patients included in the active workload group included barbers, restaurant workers, and farmers. Regarding sports, 29% of the patients did not participate in any sports before injury, 21% only participated in sports that did not involve the shoulder (eg, jogging, hiking, and yoga), and the remaining 50% participated in shoulder-related sports (ie, weight lifting, swimming, golf, tennis, and badminton).

### Comparison Between the Retear and Intact Groups

Overall, 19 of the 159 (11.9%) patients developed retears on 1-year postoperative MRI and were classified into the retear group. The remaining 140 patients had intact shoulders on MRI.

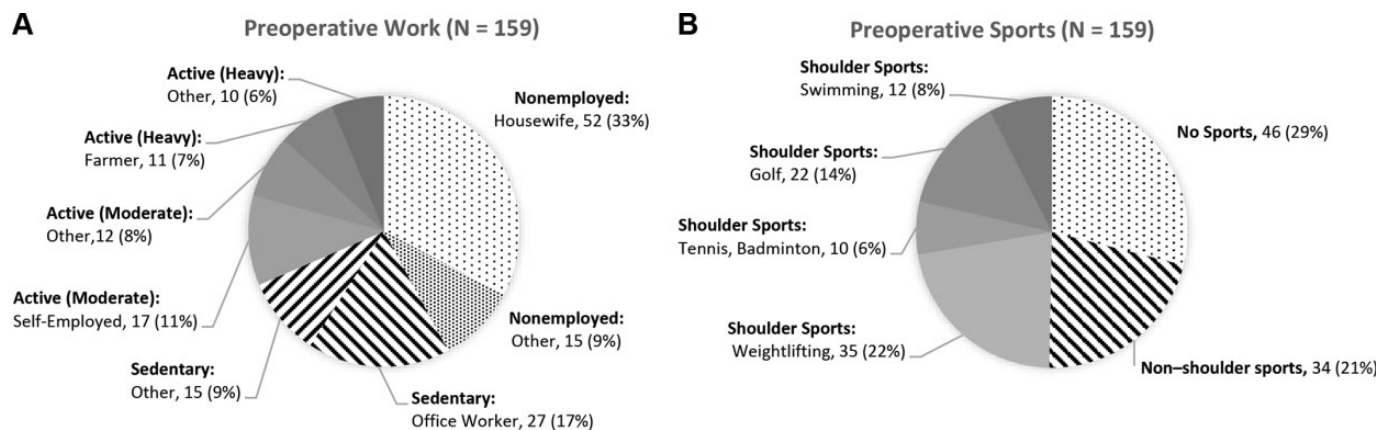


Figure 2. Preoperative (A) work and (B) sports status of all patients.

TABLE 2  
Comparison of Return to Work and Sports According to Presence of Retear<sup>a</sup>

Characteristic	Intact	Retear	P
Return to work	n = 118	n = 16	.917
Successful	68 (57.6)	9 (56.2)	
Failed	50 (42.4)	7 (43.8)	
Return to sports	n = 80	n = 13	.071
Successful	40 (50.0)	3 (23.1)	
Failed	40 (50.0)	10 (76.9)	

Data are presented as n (%) unless otherwise indicated.

Return to Work and Sports

During the follow-up period, 15 patients had retired or quit their work for non-health-related reasons, 5 had quit work for non-shoulder-related health reasons, and 5 had quit work for undisclosed non-shoulder-related reasons. All 25 patients were excluded from the return-to-work analysis, leaving 134 (84.3%) of the initial population patients for evaluation. Of the 134 patients analyzed for return-to-work status, 77 (57.5%) fully returned to their previous work without limitations in work intensity or time, 51 (38.1%) patients returned to their previous work with reduced work intensity or time, and 6 (4.5%) patients could not return to previous work for shoulder-related reasons. In our analysis, only patients who could fully return to their previous work were categorized into the “successful” return-to-work group, whereas those who had to reduce work intensity or time were categorized into the “failed” group. Results of the comparison according to retear are shown in Table 2. There were no significant differences between patients with versus without the presence of a retear.

Regarding sports participation, 46 patients did not participate in any sports, and 20 patients had not participated in sports for non-shoulder-related reasons, such as COVID-19, and were excluded from the return-to-sports analysis, leaving 93 (58.5%) patients for evaluation. Of these 93 patients, 43 (46.2%) returned to sports at their previous intensity, 45 (48.4%) returned with reduced intensity or

time, and 5 (5.4%) failed to return to their previous sports at all because of shoulder-related reasons. In the return-to-sports analysis, only patients who fully returned to their previous sports at their previous intensity were classified into the successful return-to-sports group. Results of the comparison according to retear are shown in Table 2. There were no significant differences between the retear and intact groups.

Postoperative PROMs, ROM, and Strength Recovery

The comparison of postoperative PROM scores, ROM, and strength recovery between the study groups is shown in Table 3. There were no significant differences regarding postoperative PROM scores, change in scores, PASS achievement, or ROM. Patients with intact shoulders were more likely to reach comparable strength to the contralateral shoulder at the final follow-up than those with retears. The supraspinatus, ER, and IR strength ratios at the final follow-up were 86% ± 23%, 88% ± 19%, and 100% ± 14%, respectively, for patients with intact shoulders after ARCR and 73% ± 21%, 78% ± 21%, and 93% ± 18%, respectively, for patients with retear (P = .018, .030, and .074, respectively) (Table 3).

Association of Retears With Return to Work

The association between retear and successful return to work was not statistically significant (OR, 1.058; P = .917) (Table 2).

In the univariable logistic regression, sex, workload, sports type, preoperative ASES score, abduction strength recovery, and supraspinatus strength recovery showed an association with return to work (P < .05). These variables in addition to retear status were analyzed in a multivariable regression model. In the multivariable logistic regression, active workload was significantly associated with unsuccessful return to previous work (P = .034), whereas preoperative participation in shoulder-related sports was significantly associated with successful return to previous work (P = .016) (Table 4). The likelihood ratio test indicated that workload and sports type were both significant predictors of successful return to work (P = .003 and P = .048, respectively).

TABLE 3  
Comparison of PROM Scores, ROM, and Strength Recovery According to Presence of Retear<sup>a</sup>

Variable	Intact (n = 140)	Retear (n = 19)	P
<b>Final score</b>			
Constant	69 ± 8	67 ± 8	.123
pVAS	1.32 ± 1.85	1.26 ± 1.63	.856
SANE <sup>b</sup>	86 ± 14	83 ± 13	.231
ASES	87 ± 15	85 ± 15	.337
<b>Improvement score</b>			
Constant	69 ± 8	66 ± 9	.131
pVAS	-4.14 ± 2.01	-4.26 ± 1.48	.711
SANE <sup>b</sup>	32 ± 24	24 ± 24	.235
ASES	26 ± 19	25 ± 24	.972
<b>Achieved PASS</b>			
pVAS	94 (67.1)	11 (57.9)	.424
SANE	119 (85.0)	14 (73.7)	.202
ASES <sup>b</sup>	115 (82.1)	13 (68.4)	.213
<b>Final ROM</b>			
FF, deg	151 ± 13	153 ± 11	.884
ER, deg	50 ± 11	48 ± 13	.826
IR, points <sup>c</sup>	10.98 ± 2.80	10.74 ± 2.68	.796
<b>Strength recovery, %</b>			
Abduction	84 ± 26	71 ± 26	.078
Supraspinatus	86 ± 23	73 ± 21	<b>.018</b>
ER	88 ± 19	78 ± 21	<b>.030</b>
IR	100 ± 14	93 ± 18	.074

<sup>a</sup>Data are presented as mean ± SD or n (%). Boldface P values indicate a statistically significant difference between groups ( $P < .05$ , Wilcoxon rank-sum test). ASES, American Shoulder and Elbow Surgeons; ER, external rotation; FF, forward flexion; IR, internal rotation; PASS, Patient Acceptable Symptom State; PROM, patient-reported outcome measure; pVAS, pain visual analog scale; ROM, range of motion; SANE, Single Assessment Numeric Evaluation.

<sup>b</sup>n = 151 patients.

<sup>c</sup>Behind-the-back score: T1-12 = 1 to 12 points; L1-5 = 13 to 17 points; buttock = 18 points.

### Association of Retears With Return to Sports

Although there were no significant differences between the intact and retear groups in the rate of return to sports, patients with intact shoulders were 3.3 times more likely to successfully return to sports than those with retears (OR, 3.333;  $P = .017$ ) (Table 2 and Figure 3).

In the univariable logistic regression analysis, subscapularis Goutallier grade, preoperative Constant score, and preoperative ASES score showed an association with return to sports ( $P < .05$ ). These variables along with retear status were analyzed in a multivariable regression model for return to work. Multivariable regression revealed that these factors were not statistically significant (Table 5).

## DISCUSSION

This study showed that patients with rotator cuff retear had significantly worse strength recovery. Despite this, there were no significant differences in return to work, return to sports, or PROMs between patients with and

TABLE 4  
Factors Associated With Return to Work (n = 134)<sup>a</sup>

Risk Factor	Univariable		Multivariable	
	OR (95% CI)	P	OR (95% CI)	P
<b>Shoulder status</b>				
Intact	—	—	—	—
Retear	0.95 (0.33-2.81)	.917	1.13 (0.33-3.98)	.843
<b>Sex</b>				
Female	—	—	—	—
Male	2.29 (1.14-4.67)	<b>.021</b>	2.55 (1.01-6.76)	.052
<b>Workload</b>				
Nonemployed	—	—	—	—
Sedentary	3.57 (1.35-10.7)	<b>.014</b>	2.20 (0.67-7.78)	.201
Active	0.46 (0.20-1.03)	.062	0.34 (0.12-0.90)	<b>.034</b>
<b>Sports type</b>				
None	—	—	—	—
Nonshoulder	1.20 (0.44-3.28)	.720	2.20 (0.70-7.16)	.182
Shoulder	2.57 (1.18-5.73)	<b>.019</b>	2.99 (1.25-7.49)	<b>.016</b>
Preoperative ASES score	1.03 (1.00-1.05)	<b>.022</b>	1.01 (0.99-1.04)	.267
Abduction strength recovery	1.02 (1.00-1.03)	<b>.040</b>	1.00 (0.98-1.02)	.955
Supraspinatus strength recovery	1.02 (1.00-1.04)	<b>.035</b>	1.02 (0.99-1.04)	.281

<sup>a</sup>Dashes indicate reference variable. Boldface P values indicate statistical significance ( $P < .05$ ). ASES, American Shoulder and Elbow Surgeons; OR, odd ratio.

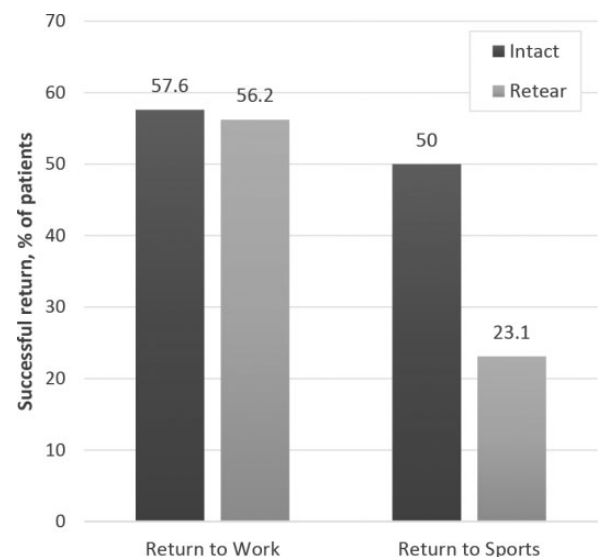


Figure 3. Graphical depiction of percentage of patients who returned to work and sports according to shoulder status.

without postoperative retear. Active workload and preinjury participation in shoulder-related sports were found to be associated with successful return to work.

We found no significant differences in the Constant score, pVAS, SANE, ASES score, or shoulder ROM between patients with and without retear. Previous literature has remained divided on the impact of retear on PROMs, with some reports finding significant impairments associated with

TABLE 5  
Factors Associated With Return to Sports (n = 93)<sup>a</sup>

Risk Factor	Univariable		Multivariable	
	OR (95% CI)	P	OR (95% CI)	P
Shoulder status				
Intact	—		—	
Retear	0.30 (0.06-1.07)	.083	0.26 (0.05-0.96)	.060
Goutallier grade (subscapularis)	0.53 (0.27-0.97)	<b>.046</b>	0.55 (0.27-1.05)	.080
Preoperative Constant score	1.05 (1.01-1.10)	<b>.010</b>	1.05 (1.00-1.11)	.085
Preoperative ASES score	1.03 (1.00-1.06)	<b>.042</b>	1.00 (0.96-1.04)	.898

<sup>a</sup>Dashes indicate reference variable. Boldface *P* values indicate statistical significance ( $P < .05$ ). ASES, American Shoulder and Elbow Surgeons; OR, odd ratio.

retears<sup>23,48,49</sup> but others finding the difference to not be statistically significant.<sup>13,30,35</sup> This study further adds to the view that tendon integrity after ARCR is not significantly associated with functional outcomes unrelated to strength. In contrast, we found that patients with postoperative reter had significantly worse strength recovery versus the contralateral shoulder with regard to the supraspinatus ( $P = .018$ ) and ER ( $P = .030$ ). In addition, higher supraspinatus Goutallier grades were associated with worse ER strength, and better preoperative ASES scores were associated with better IR strength ( $p = .025$ , and  $p = .024$ ). These results agree with previous literature, which showed that strength recovery is associated with intact repair,<sup>1,23,48,49</sup> muscle atrophy, and fatty infiltration.<sup>14</sup> Although this relationship did not result in worse return to work or sports in this study, worse strength recovery may have effects on return to work or sports over a longer time frame. We suggest that more aggressive discovery and repair of retears must be considered for patients who are more concerned with successful return to previous work and sports.

We found no significant differences in return-to-work rate between patients with and without reter. However, in the multivariable analysis, active workload was significantly associated with unsuccessful return to work ( $P = .034$ ), whereas preoperative participation in shoulder-related sports was associated with successful return to work ( $P = .016$ ). Previous studies have identified heavy physical labor,<sup>9,16,18,20,22,38</sup> involvement of the dominant arm,<sup>16,18</sup> older age,<sup>11,22</sup> female sex,<sup>9</sup> less participation in sports,<sup>22</sup> and low postoperative PROMs<sup>16,36</sup> to be associated with poor return to previous work after rotator cuff repair. The findings of this study are consistent with those of these previous studies and additionally identified preoperative participation in shoulder sports as an independent factor that aids successful return to previous work. A study identified several socioeconomic and psychological factors that hinder return to work, such as less education, negative job characteristics, and higher levels of depression.<sup>40</sup> However, this study did not account for these nonphysical factors affecting return to work. Additionally, unlike many

previous studies, we included patients with nonpaying jobs, such as housekeeping, in our return-to-work analysis, which may have introduced variability to the analysis. Further studies that measure and correct for the socioeconomic status of the patients may be necessary to more accurately investigate the effects of reter on return to work.

In this study, 50% of patients with intact shoulders after repairs fully returned to their previous sports, whereas only 23.1% of those with reter could do so. However, this difference was not significant ( $P = .071$ ). Additionally, higher Goutallier grade of the subscapularis ( $P = .046$ ), lower preoperative Constant score ( $P = .010$ ), and lower preoperative ASES score ( $P = .042$ ) were associated with poor return to previous sports in the univariable regression. However, none of these factors were statistically significant in the multivariable regression model. Studies have identified participation in overhead sports,<sup>3,31</sup> extended preoperative pain,<sup>4</sup> professional participation,<sup>3,31</sup> and lower preoperative ASES scores<sup>26</sup> as factors potentially affecting poor return to previous sports after ARCR. This study did not find any of these factors to be significantly associated with return to sports. However, these previous studies were mainly focused on young athletes whose return to sports is likely to be primarily associated with shoulder function, whereas this study predominantly consisted of elderly patients participating in non-competitive noncontact sports. Although there have been studies investigating factors related to return to sports after shoulder repair in recreational athletes,<sup>2,4,34</sup> the impact of reter on return to sports for recreational athletes is not well understood. We suggest that this difference in patient population characteristics was the reason why reter was not found to be associated with return to sports in this study. Our patient population mainly engaged in sports that did not competitively challenge shoulder strength, which may have limited the effect of strength recovery on return to sports. Moreover, our patient population may have returned to sports less aggressively than young athletes, which may obscure the relationship between shoulder function and return to sports. Our patient population was also more exposed to age-associated factors affecting return to sports, such as osteoarthritis and chronic obstructive pulmonary disease. We suggest conducting a further study that more closely controls for these confounding factors.

By the time of the telephone survey, nearly all patients had returned to their previous work (94.8% of analyzed population) and sports (94.6% of analyzed population) in some capacity. However, only 57.6% of the intact group and 56.2% of the reter group in our study population could fully return to their previous work without limitations in intensity or time, and only 50.0% of the intact group and 23.1% of the reter group could fully return to their preinjury level of sports. These rates are lower than previously reported in other studies that reported return-to-work rates of approximately 62.3% to 89.6%<sup>17,20</sup> and return-to-sports rates of approximately 65.9% to 93%.<sup>3-6,31</sup> This difference may be because of our study design, which had patients self-report their work and sports status without controlling for personal bias or secondary gain. Moreover, not all studies differentiated between full and partial return to work or sports, which may have led to higher

return percentages being reported. Our study population also tended to be older (mean age, 61 years) than that of many other studies, and old age has been previously associated with worse return to work.<sup>22</sup> Our study population consisted of elderly recreational athletes, which may have influenced return to sports. A systematic review by Altintas et al<sup>3</sup> found recreational sports participation to be associated with higher return to sports, and previous studies on elderly recreational athletes showed a rate of return to the previous level of sports of 68%<sup>4</sup> to 77%.<sup>6</sup> Finally, our study only included Korean patients who underwent ARCR at a single hospital in Seoul, which is not a population that has been studied for return to work or sports before. Our results stress that ARCR may not be as beneficial for return to work and sports as had been thought.

### Limitations

This study had some limitations. First, the sample size of the retear group in this study was limited. Second, the telephone survey asked the patients to retrospectively self-report their previous and current participation in work and sports, which may have introduced recall bias to the outcomes. Third, the variability in postoperative timing of the telephone survey may have influenced functional outcomes. Fourth, as this study excluded patients who either did not have a complete strength measurement or did not respond to our telephone survey, the percentage of follow-up loss was high. Fourth, this study excluded patients who did not return to work or sports for non-shoulder-related reasons, which was deemed necessary to reduce confounding factors. Fifth, PASS values used for pVAS, SANE, and ASES score were derived from a past study that did not fully adhere to recommendations made by Karhade et al,<sup>25</sup> which may have led to inconsistent results. Finally, this study included patients from 2 surgeons, which may have introduced some intraoperative differences. However, both surgeons used the same approach to perform the repairs.

### CONCLUSION

Retear was not significantly associated with Constant score, pVAS, SANE, ASES score, ROM, or return to work. However, patients with retear showed significantly worse postoperative strength recovery, specifically regarding the supraspinatus and ER. Sedentary workload and shoulder-related sports participation before shoulder injury were associated with successful return to previous work.

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## APPENDIX

## TABLE A1

## Questions Related to Work and Sports Status on the Telephone Survey

## Work-related questions

1. What was your job before your injury?
2. Have you been able to return to your previous work after shoulder repair?
  - (A) Did not return to previous work
  - (B) Returned to previous work at a reduced load or time
  - (C) Completely returned to the previous level of work
 2-1. (If A or B) Why were you not able to completely return to your previous work?
3. What is your current job?

## Sports-related questions

1. Which sports did you participate in before your injury?
2. Have you been able to return to your previous sports after shoulder repair?
  - (A) Did not return to previous sports
  - (B) Returned to previous sports at a reduced load or time
  - (C) Completely returned to the previous level of sports
 2-1. (If A or B) Why were you not able to completely return to your previous sports?
3. Which sports do you currently participate in?