Outcomes of Concomitant Glenohumeral Stabilization After Arthroscopic Rotator Cuff Repair in Military Patients Younger Than 40 Years

Clare K. Green,*† BS, John P. Scanaliato,‡ MD, Alexis B. Sandler,§ MD, Cole M. Patrick,§ MD, John C. Dunn,§ MD, and Nata Parnes,‖ MD
Investigation performed at Carthage Area Hospital, Carthage, New York, USA

Background: While concomitant rotator cuff and inferior labral tears are relatively uncommon in young civilians, military populations represent a unique opportunity to study this injury pattern.

Purpose: To (1) evaluate the long-term outcomes after combined arthroscopic rotator cuff and inferior labral repair in military patients <40 years and (2) compare functional outcomes with those after isolated arthroscopic rotator cuff repair.

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

Methods: Military patients who underwent arthroscopic rotator cuff repair between January 2011 and December 2016 and had a minimum of 5-year follow-up data were included in this study. The patients were categorized into those who had undergone combined arthroscopic rotator cuff and inferior labral repair (RCIL cohort) and those who had isolated arthroscopic rotator cuff repair (ARCR cohort). Pre- and postoperative outcome measures—visual analog scale for pain, Single Assessment Numeric Evaluation, American Shoulder and Elbow Surgeons shoulder score, Rowe Instability Score, and range of motion—were compared between the groups.

Results: A total of 50 shoulders (27 in the RCIL cohort and 23 in the ARCR cohort) were assessed. The RCIL and ARCR groups were similar in terms of age (mean, 33.19 years [range, 21-39 years] vs 35.39 years [range, 26-39 years], respectively) and sex (% male, 88.46% vs 82.61%, respectively). All patients were active-duty military at the time of surgery. The mean final follow-up was at 106.93 ± 16.66 months for the RCIL group and 105.70 ± 7.52 months for the ARCR group ($P = .75$). There were no differences in preoperative outcome scores between groups. Postoperatively, both groups experienced statistically significant improvements in all outcome scores ($P < .0001$ for all), and there were no significant group differences in any final postoperative outcome measures. At the final follow-up, 26 (96.30%) patients in the RCIL cohort and 20 (86.96%) in the ARCR cohort had returned to unrestricted active-duty military service ($P = .3223$).

Conclusion: The study findings indicate that concomitant glenohumeral stabilization does not prevent worse outcomes after arthroscopic rotator cuff repair in this military cohort. Combined repair produced statistically and clinically significant improvements in outcome scores at the long-term follow-up, indicating that simultaneous repair of combined lesions was an appropriate treatment option in this patient population.

Keywords: instability; labral repair; military; rotator cuff repair

While concomitant rotator cuff and inferior labral tears are relatively uncommon in young civilian patients, military populations represent a unique opportunity to study this challenging injury pattern. High-shoulder demand activities required as a part of routine military training place repetitive stress on the glenohumeral joint, predisposing soldiers to an array of shoulder pathologies.[1,6,7,10,12-14,20,23-26] The rate of labral tears experienced by military patients has been reported to significantly exceed that observed in civilian populations.[1,9,20,24,26] Although the precise incidence of rotator cuff pathology in military populations has not been described, 2 studies have suggested that young, active

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military patients are likely at greater risk for these lesions when compared with their civilian counterparts.[15,17]

There is currently a paucity of data regarding the operative management of concomitant rotator cuff and inferior labral tears. Our team[11] published midterm outcomes after combined arthroscopic rotator cuff and inferior labral repair in young military patients and demonstrated statistically significant improvements in all patient-reported outcome scores, with high rates of return to preoperative levels of military duty. However, this remains one of the few publications reporting on combined arthroscopic repair of these lesions.

This study aimed to evaluate the long-term outcomes after combined arthroscopic rotator cuff and inferior labral repair in a cohort of patients <40 years. We also compared these outcomes with those after isolated arthroscopic rotator cuff repair. We hypothesized that outcomes after combined procedures would not differ significantly from those after isolated rotator cuff repair.

METHODS

This study was a retrospective analysis of military patients <40 years from a single base who underwent arthroscopic rotator cuff repair with or without concomitant inferior labral repair with the senior surgeon (N.P.) between January 2010 and June 2017. The study protocol received institutional review board approval, and written informed consent was obtained from all included patients after the nature of the procedure was explained.

Patient Population

The inclusion criteria were active-duty military patients <40 years who underwent arthroscopic rotator cuff repair for full-thickness tears and who had a minimum of 5-year follow-up data. By selecting a cutoff age of 40 years, we hoped to exclude patients with age-related degeneration of the rotator cuff tendons. Patients with a history of shoulder surgery, those with concomitant glenohumeral cartilage injuries, and patients with instability secondary to generalized hyperlaxity were excluded from the analysis. Patients with partial-thickness rotator cuff tears were also excluded. All patients were referred to our clinic after having failed a minimum of 3 months of conservative treatment, including anti-inflammatory medications, physical therapy, and home exercise. All patients had undergone 1.5-T magnetic resonance arthrogram evaluation before surgery.

From this cohort of eligible patients, we then identified all patients with concomitant glenohumeral instability who had undergone combined arthroscopic rotator cuff and inferior labral repair (RCIL cohort) versus those who had undergone isolated arthroscopic rotator cuff repair (ARCR cohort). Patients in the RCIL cohort were noted to have findings consistent with both rotator cuff pathology and glenohumeral instability on physical examination and frequently endorsed a traumatic cause. A labral tear was confirmed on diagnostic arthroscopy for all patients in the RCIL cohort.

Surgical Procedure

The senior surgeon's technique did not change significantly throughout the study. All patients were positioned in a modified beach-chair position after administration of general anesthesia and a presurgical interscalene block. An examination under anesthesia was performed to evaluate range of motion and glenohumeral stability. A Spider hydraulic arm holder (Smith & Nephew) was then used to stabilize the operative shoulder, and the patient was draped appropriately. A complete diagnostic arthroscopy was conducted, and any concomitant intra-articular pathology was addressed at this stage.

The torn labrum was then mobilized from the glenoid neck, and a small shaver was used to create a bleeding bed of bone along the neck of the glenoid. The drill guide for the 3.0 Gryphon PEEK anchor (DePuy Mitek) was introduced through the inferior cannula and positioned on the face of the glenoid close to the 6-o'clock position. A pilot hole was drilled, and the anchor was tapped into the glenoid. A suture passer was used to shuttle 1 of the suture limbs through the capsule and labrum. Low-profile sliding knots were tied arthroscopically, with care taken to keep the knots away from the glenoid face. All inferior (anterior, posterior, or combined) labral pathologies were addressed similarly. To fully evaluate the bursal side of the rotator cuff, a limited subacromial bursectomy was then performed, and the greater tuberosity and the edge of the rotator cuff tendon tear were prepared. A double-row repair technique was used for all medium or large rotator cuff tears (>1cm). A single-row repair technique was used for small tears (<1 cm).

Postoperative Rehabilitation

All procedures were performed on an outpatient basis. The rehabilitation protocol did not vary between groups, and

*Address correspondence to Clare K. Green, BS, The George Washington University School of Medicine and Health Sciences, 2300 I Street Northwest, Washington, DC 20052, USA (email: ckgreen@gwu.edu).
†The George Washington University, School of Medicine and Health Services, Washington, District of Columbia, USA.
‡Rush University Medical Center, Department of Orthopaedic Surgery, Chicago, Illinois, USA.
§William Beaumont Army Medical Center/Texas Tech University Health Sciences Center, Department of Orthopaedic Surgery, El Paso, Texas, USA.
‖Carthage Area Hospital/Claxton-Hepburn Medical Center, Department of Orthopaedic Surgery, Carthage, New York, USA.
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all patients attended physical therapy at the same military physical therapy group. Patients were immobilized in neutral rotation in a SmartSling (Ossur) for 4 weeks and were instructed to begin pendulum shoulder exercises out of their sling 1 to 3 times daily after the resolution of their interscalene block. At 1 month postoperatively, the sling was discontinued, and passive forward flexion was begun. An active range of motion and a gradual strengthening program were started 6 weeks postoperatively. Patients were allowed to return to unrestricted activity 6 months postoperatively, pending the observation of a negative apprehensive test result and endorsement of subjective readiness to return to full duty.

Data Collection

Patients' descriptive data—including sex, age, laterality, and military occupational specialty—were collected routinely during clinic visits. Combat arms was defined as nonadministrative, nonsupport infantry, artillery, or military police occupations. Preoperative imaging and operative reports were reviewed to determine concomitant pathology and procedures performed. The tear size was classified using the Southern California Orthopaedic Institute classification.[18] Preoperative and minimum 5-year postoperative evaluations included visual analog scale (VAS) for pain, Subjective Shoulder Value, American Shoulder and Elbow Surgeons (ASES) shoulder score, Rowe Instability Score, and range of motion. Return to active duty, complications, and revision procedures were collected as part of the postoperative follow-up.

Statistical Analysis

Statistical analysis was performed using SPSS Statistics Version 25.0 (IBM). Continuous data were described by a combination of mean, standard deviation, range, and 95% CI. The paired t test was used to compare differences between pre- and postoperative values and continuous variables between groups, and the chi-square and Fisher exact tests were used to compare categorical variables between groups. In addition, previously published [3,21] minimal clinically important difference (MCID), substantial clinical benefit (SCB), and Patient Acceptable Symptom State (PASS) values for the ASES, Single Assessment Numeric Evaluation (SANE), and VAS pain were used to compare the number of patients in each group who achieved these clinical significance thresholds (MCID: VAS pain, 2.4 points; SANE, 16.9 points; ASES, 11.1 points; SCB: SANE, 29.8 points; ASES, 17.5 points; PASS: SANE, 82.5; ASES, 86.7). For all comparisons, statistical significance was set at $P < .05$.

RESULTS

During the study period, the senior surgeon performed 498 arthroscopic rotator cuff repairs; 372 repairs were on nonmilitary patients and 65 were on military patients >40 years, leaving 61 arthroscopic rotator cuff repairs on military patients <40 years eligible for further inclusion. Of these patients, 4 were excluded—3 patients had concomitant glenoid osteochondral defects, and 1 patient had a humeral head osteochondral defect. Of the 57 eligible patients, 31 were in the RCIL cohort, and 26 were in the ARCR cohort.

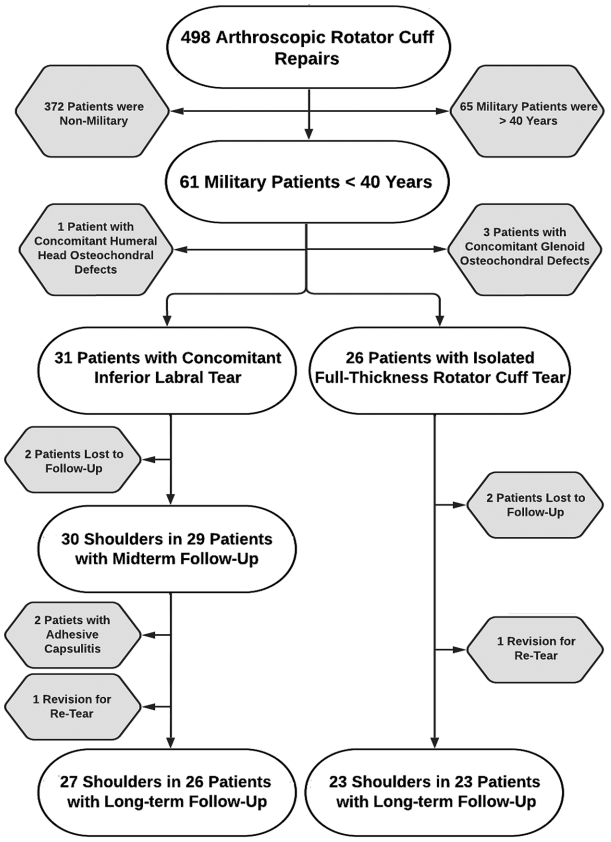

Figure 1. Flow chart of patient enrollment and evaluation.

In the RCIL cohort, 2 patients were lost to follow-up, leaving 30 shoulders in 29 patients available for midterm outcome analysis. Two patients subsequently developed adhesive capsulitis and required arthroscopic capsular release, and 1 patient underwent revision rotator cuff repair for a retear, leaving 27 shoulders in 26 patients available for the final outcome analysis. In the ARCR group, 2 patients were lost to follow-up, and 1 patient underwent revision rotator cuff repair, leaving 23 shoulders in 23 patients for the final analysis (Figure 1). The final follow-up for all included patients was completed in December 2022 through either in-person clinic or telehealth appointments.

Preoperative Characteristics

The baseline characteristics of the included patients are summarized in Table 1. The mean patient age at the

TABLE 1
Baseline Characteristics According to the Study Group[a]

Characteristic	RCIL (n = 27)	ARCR (n = 23)	*P*
Age, y	33.19 ± 5.70 (21-39)	35.39 ± 4.62 (26-39)	.15
Male sex	23 (88.46)	19 (82.61)	>.99
Combat arms MOS	19 (73.08)	16 (69.57)	.95
Tobacco use	7 (26.92)	6 (26.09)	>.99
Dominant-extremity involved	14 (53.84)	14 (60.87)	.58
Right-side extremity involved	15 (57.69)	15 (65.22)	.57
Traumatic etiology	16 (59.26)	15 (65.22)	.67
Time to surgery, mo	27.30 ± 13.51	29.26 ± 33.23	.78
Midterm follow-up, mo	35.93 ± 9.37	NA	NA
Final follow-up, mo	106.93 ± 16.66	105.70 ± 7.52	.75
Preoperative outcome measures			
VAS pain	7.56 ± 1.54	7.96 ± 1.61	.37
SANE	52.22 ± 13.82	46.74 ± 18.50	.24
ASES	43.81 ± 10.08	41.22 ± 13.44	.44
Rowe	35.56 ± 11.79	NA	NA
Forward flexion, deg	153.89 ± 9.34	149.57 ± 6.89	.07
External rotation, deg	64.63 ± 8.87	65.43 ± 6.73	.72
Internal rotation[b]	T 9.85 ± 2.63	T 9.65 ± 3.21	.81
Rotator cuff tear size[c]			.78
Small (C1/C2)	14 (51.85)	11 (47.83)	
Large (C3/C4)	13 (48.15)	12 (52.17)	

[a]Data are reported as mean ± SD, mean ± SD (range), or (n) %. ARCR, arthroscopic rotator cuff repair; ASES, American Shoulder and Elbow Surgeons; MOS, military occupational specialty; NA, not applicable; RCIL, rotator cuff and inferior labral repair; SANE, Single Assessment Numeric Evaluation; VAS, visual analog scale.

[b]Reported as vertebral level.

[c]Based on the Southern California Orthopaedic Institute Classification[18]: C1 = small complete tear, pinhole-sized; C2 = moderate tear <2 cm of only 1 tendon without retraction; C3 = large complete tear with an entire tendon with minimal retraction, usually 3-4 cm; C4 = massive rotator cuff tear involving ≥2 rotator cuff tendons with associated retraction and scarring of the remaining tendon.

time of surgery was 33.19 years (range, 21-39 years) in the RCIL group and 35.39 years (range, 26-39 years) in the ARCR group (P = .15). The majority of patients in both groups were men (88.46% vs 82.61%; $P > .99$). There were no significant differences in baseline characteristics or preoperative outcome measures between the groups (Table 1).

In the RCIL group, 4 shoulders were classified as C1 tears, 10 shoulders as C2, 8 as C3, and 5 as C4. All C4 tears involved ≥2 tendons. This did not differ significantly from the distribution observed in the ARCR cohort. With regard to the direction of instability in the RCIL group, 11 (40.74%) patients had anterior instability, 9 (33.33%) had posterior instability, and 7 (25.93%) had combined anterior and posterior instability. Concomitant procedures did not vary between groups. In the RCIL group, 4 (14.81%) patients had concomitant arthroscopic distal clavicle resection, 5 (18.52%) underwent arthroscopic biceps tenotomy, and 4 (14.81%) had arthroscopic assisted subpectoral biceps tenodesis. In the ARCR cohort, 3 (13.04%) patients underwent arthroscopic distal clavicle resection, 3 (13.04%) had concomitant arthroscopic biceps tenotomy, and 5 (21.74%) had arthroscopic assisted subpectoral biceps tenodesis.

Postoperative Outcomes and Complications

Patients in the RCIL cohort experienced statistically significant improvements in all outcome scores at the final follow-up ($P < .0001$ for all) that did not differ from those observed in the ARCR group (Tables 2 and 3). Excluding the 2 patients who developed adhesive capsulitis before the long-term follow-up, there were no significant changes in range of motion postoperatively. Measurable but statistically nonsignificant decreases were observed between the midterm and final follow-up outcome scores in the RCIL group. The number of patients who achieved the clinical significance thresholds (MCID, SCB, and PASS) did not differ significantly between groups (Table 4).

Regarding complications, 2 patients in the RCIL cohort developed adhesive capsulitis, and 1 patient underwent revision rotator cuff repair between the mid and long-term follow-up. At the long-term follow-up, 1 patient underwent revision surgery for recurrent instability. In the ARCR cohort, 1 patient underwent revision rotator cuff repair. Also, 28 patients (93.33%) in the RCIL cohort had returned to preinjury levels of work at the midterm follow-up. At the final follow-up, 26 (96.30%) patients with long-term data available in the RCIL cohort and 20 (86.96%) patients in the ARCR group had maintained unrestricted active-duty military service (P = .3223) (Table 3).

DISUSSION

The results of this study indicate that combined arthroscopic rotator cuff and inferior labral repair produces

TABLE 2
Comparison of Preoperative, Midterm, and Final Postoperative Outcomes in the RCIL Group[a]

				Preop vs Final		Midterm vs Final	
Outcome Measure	Preop (n = 27)	Midterm (n = 30)	Final (n = 27)	MD	*P*	MD	*P*
VAS pain	7.56 ± 1.54	1.04 ± 1.40	1.22 ± 1.53	6.34	**<.0001**	0.18	.0961
SANE	52.22 ± 13.82	90.26 ± 9.76	88.52 ± 10.90	36.30	**<.0001**	–1.74	.0814
ASES	43.81 ± 10.08	90.04 ± 10.02	88.70 ± 11.09	44.89	**<.0001**	–1.34	.0883
Rowe	35.56 ± 11.79	92.59 ± 10.59	92.59 ± 10.59	57.03	**<.0001**	–3.15	.2422
Forward flexion, deg	153.89 ± 9.34	157.96 ± 3.74	156.67 ± 4.60	2.78	.1342	–1.29	.0502
External rotation, deg	64.63 ± 8.87	67.04 ± 4.65	67.59 ± 4.24	2.96	.0881	0.55	.1846
Internal rotation[b]	T 9.85 ± 2.63	T 9.41 ± 2.45	T 9.11 ± 2.61	0.74	.1945	–0.30	.1034

[a]Data are reported as mean ± SD. Bold *P* values indicate a statistically significant difference between groups ($P < .05$). ASES, American Shoulder and Elbow Surgeons; MD, mean difference; Preop, preoperative; RCIL, rotator cuff and inferior labral repair; SANE, Single Assessment Numeric Evaluation; VAS, visual analog scale.
[b]Reported as vertebral level.

TABLE 3
Comparison of Final Postoperative Outcomes Between Groups[a]

Outcome Measure	RCIL (n = 27)	ARCR (n = 23)	*P*
VAS pain	1.22 ± 1.53	0.83 ± 1.15	.3204
SANE	88.52 ± 10.90	89.39 ± 14.91	.8131
ASES	88.70 ± 11.09	91.43 ± 10.50	.3785
Forward flexion	156.67 ± 4.60	156.09 ± 4.99	.6710
External rotation	67.59 ± 4.24	65.22 ± 9.94	.2658
Internal rotation[b]	T 9.11 ± 2.61	T 9.09 ± 2.52	.9782
Maintained unrestricted military activity			
At midterm follow-up	28/30 (93.33)	NA	NA
At final follow-up	26/27 (86.67)	20/23 (86.96)	.3223

[a]Data are reported as mean ± SD or n (%). ARCR, arthroscopic rotator cuff repair; ASES, American Shoulder and Elbow Surgeons; NA, not applicable; RCIL, rotator cuff and inferior labral repair; SANE, Single Assessment Numeric Evaluation; VAS, visual analog scale.
[b]Reported as vertebral level.

favorable long-term outcomes in patients <40 years that do not differ significantly from those observed after arthroscopic rotator cuff repair alone. Both groups experienced high rates of return to unrestricted active-duty military service at the final follow-up, and there was no difference in the number of patients who achieved the MCID, SCB, or PASS between cohorts. At the final follow-up, 13.33% of patients in the RCIL cohort and 3.85% in the ARCR cohort had undergone additional procedures. Our findings suggest that simultaneous arthroscopic repair of combined lesions is an appropriate treatment option in young, active military patients.

Concomitant glenohumeral instability and full-thickness rotator cuff tears are challenging injury patterns to manage. While uncommon in general civilian populations, military patients represent a unique opportunity to study this pathology. Soldiers are known to experience a significantly higher rate of instability when compared with nonmilitary patients, and previous studies have reported a similar distribution of instability patterns as those observed in this cohort.[1,9,20,24,25] While the incidence of rotator cuff pathology in young military patients has not been well described, male sex and acute-on-chronic injuries have been identified as risk factors for the development of traumatic cuff tears.[15,17] Furthermore, the high-shoulder-demand activities required as a part of routine military training place repetitive stress on the shoulder girdle. It is, therefore, logical to hypothesize that active duty servicemembers may be at greater risk for combined rotator cuff and inferior labral injuries when compared with their civilian counterparts.

While limited data are available regarding concomitant repair in young patient populations, several studies have reported on this injury pattern in older patient cohorts. Voos et al[22] reported on 16 patients with a mean age of 47 years who underwent concurrent Bankart and rotator cuff repair and found that arthroscopic repair yielded good clinical outcomes, with high patient satisfaction rates at a minimum 2-year follow-up. A study by Shields et al[16] looked at 13 patients with a mean age of 59 years and found that patients who underwent simultaneous arthroscopic repair of symptomatic, acute rotator cuff and Bankart lesions had functionally similar outcome scores when compared with their asymptomatic, contralateral shoulder.

TABLE 4
Patients Who Met the MCID, SCB, and PASS for the ASES, SANE, and VAS Pain[a]

Score	RCIL (n = 27)	ARCR (n = 23)	*P*
ASES			
MCID[b]	27 (100)	23 (100)	>.9999
SCB[c]	27 (100)	23 (100)	>.9999
PASS[d]	16 (59.3)	16 (69.6)	.4492
SANE			
MCID[b]	24 (88.9)	22 (95.7)	.6144
SCB[c]	20 (74.1)	21 (91.3)	.1519
PASS[d]	18 (66.7)	18 (78.3)	.5289
VAS pain			
MCID[b]	25 (92.6)	23 (100)	.4931

[a]Data are reported as n (%). ARCR, arthroscopic rotator cuff repair; ASES, American Shoulder and Elbow Surgeons; MCID, minimum clinically important difference; ND, not determined; PASS, Patient Acceptable Symptomatic State; RCIL, rotator cuff and inferior labral repair; SANE, Single Assessment Numeric Evaluation; SCB, substantial clinical benefit; VAS, visual analog scale.
[b]MCID values: VAS, 2.4 points; SANE, 16.9 points; ASES, 11.1 points.
[c]SCB values: SANE, 29.8 points; ASES, 17.5 points.
[d]PASS scores: SANE, 82.5; ASES, 86.7.

Interestingly, a significant portion of the patients in their study went on to have retears or persistent rotator cuff tears; however, these did not appear to affect outcome scores. With regard to isolated cuff tears in young military patients, Scanaliato et al[15] demonstrated favorable long-term outcomes after arthroscopic repair of traumatic full-thickness rotator cuff tears in military patients <40 years. These findings align with the results of our study, which suggest that combined repair is a viable treatment option in young patients. While we[11] previously demonstrated promising improvements in pain and function after combined repair at the midterm follow up, there was uncertainty regarding the longevity of these results given the high demands of military training. Strenuous physical labor has been associated with a higher likelihood of unsatisfactory outcomes after arthroscopic rotator cuff repair in older populations.[2,4,5,8] However, our findings suggest that arthroscopic RCIL repair continues to produce favorable outcomes at a minimum 5-year follow-up that do not differ significantly from those after repair of isolated rotator cuff tears.

These results are of particular interest given the greater severity of combined lesions and support the findings of previous studies, which have suggested that younger tissue may be better able to tolerate manipulation and repair.[15] Interestingly, relatively few patients in either cohort required revision rotator cuff repairs, further supporting this hypothesis. While 2 patients did develop adhesive capsulitis and subsequently required arthroscopic capsular release, we did not observe any significant changes in range of motion postoperatively among the remaining patients with long-term outcome scores available for analysis, and there were no differences in postoperative range of motion between groups. A study by Sperling et al[19] had previously raised concerns regarding long-term loss of motion in young patients after rotator cuff repair. Furthermore, it would be reasonable to expect higher rates of stiffness after more extensive repairs. However, our findings suggest that concerns regarding loss of motion postoperatively should not deter surgeons from simultaneous repair of concomitant lesions in young patients.

Limitations

This study was not without its limitations. The retrospective nature of our study and our limited sample size represent sources of bias. In addition, our population was composed of primarily male, active-duty military patients, and all surgeries were performed by a fellowship-trained shoulder and elbow specialist, potentially limiting the generalizability of our findings to the broader populations. Because of the nature of our database, we were unable to collect further details regarding the mechanism of injury in patients who endorsed a traumatic cause, nor were we able to collect data on a number of instability events. Our comparison lacked a true gold standard, as we did not include a cohort of patients who underwent cuff repair without refixation of a concomitant inferior labral tear. However, we do not feel that it would be ethical to leave symptomatic pathology unaddressed in a young, highly active cohort. We did not compare our findings to a cohort of patients who underwent isolated labral repair. No follow-up imaging was obtained to evaluate the incidence of asymptomatic rotator cuff retears. Last, clinical significance values (PASS, SCB, MCID) have not been defined for combined rotator cuff and inferior labral repair and, therefore, previously published values for arthroscopic rotator cuff repair were used.

CONCLUSION

The findings of this study suggest that concomitant glenohumeral stabilization does not portend worse outcomes after arthroscopic rotator cuff repair in military patients <40 years. Combined repair produced statistically and clinically significant improvements in patient-reported outcome scores at the long-term follow-up, indicating that simultaneous repair of combined lesions is an appropriate treatment option in this patient population.

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