Original Articles

Arthroscopic Rotator Cuff Repair, Manipulation Under Anesthesia, and Capsular Release for Concurrent Rotator Cuff Tear and Adhesive Capsulitis Maintain Improvements in Outcomes and Range of Motion at Minimum 5-Year Follow-Up

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Purpose: To characterize the outcomes and range of motion at a minimum 5-year follow-up in patients undergoing arthroscopic rotator cuff repair (ARCR) with simultaneous manipulation under anesthesia (MUA) and capsular release (CR) for concurrent RC and adhesive capsulitis and to compare active range of motion of the operative and nonoperative shoulder. **Methods:** Patients undergoing ARCR with MUA and CR by a single surgeon were retrospectively reviewed and prospectively evaluated at a minimum of 5 years postoperatively. Standardized surveys, examinations, and patient-reported outcomes were recorded pre- and postoperatively. Outcome measures included range of motion, American Shoulder and Elbow Surgeon Score (ASES), visual analog score (VAS) for pain, Simple Shoulder Test (SST), subjective shoulder value (SSV), functional level, and satisfaction. **Results:** Fourteen consecutive patients were evaluated at 7.5 ± 1.6 years' follow-up. At final follow-up, the affected shoulder had substantial improvements in ASES ($P < .001$), VAS ($P < .001$), SST ($P = .001$), and SSV ($P < .001$), with similar ASES, VAS, SST, and SSV compared with the contralateral side. Range of motion was also similar to the contralateral side at final follow-up for forward elevation and internal rotation, but external rotation was noted to be 10.77 ± 17.06° (95% confidence interval 0.46-21.08, $P = .042$) more limited. Two patients (14%) underwent revision MUA and CR for stiffness at 6 months and 12 months' postoperatively. **Conclusions:** This study highlights significantly improved and maintained patient-reported outcomes and range of motion at minimum 5-year follow-up in patients undergoing concomitant ARCR, MUA, and CR. These results provide further evidence that preoperative stiffness in the setting of rotator cuff tear can be managed concurrently; however, patients may remain at an increased risk for recurrent stiffness and external rotation loss. **Level of Evidence:** Level IV, therapeutic case series.

Stiffness is believed to be one of the most frequent complications after arthroscopic rotator cuff repair (ARCR), occurring at a rate of 4.9%, with a greater incidence noted in those with severe preoperative range of motion (ROM) deficits.[1-4] For this reason, preoperative stiffness has long been a relative contraindication to immediate surgical management, with an extended course of physical therapy being more routinely advocated. However, the resultant prolonged treatment course and the possible detriment to rotator cuff (RC) repairability have brought this approach into question.[5-12]

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In the interest of timelier ARCR, manipulation under anesthesia (MUA) and/or capsular release (CR) has been used as a concurrent adjunct to ensure improved postoperative motion. Two studies, including a recent prospective trial, have shown that RCR and MUA, for those with preoperative stiffness, results in similar outcomes and ROM compared with patients without preoperative stiffness undergoing RCR alone.[6,9] Multiple studies also have established the efficacy of CR with and without MUA, including a recent systematic review that concluded that MUA, CR, or both together are supported as treatment options for stiffness alongside early RCR.[5,7,8,10,11] Despite this conclusion, their remains a clear gap in the longevity of the outcomes associated with these techniques as there are presently no long-term studies, with the aforementioned recent systematic review having a mean follow-up of 21.7 ± 1.2 months.

Thus, the purposes of this study were to characterize the outcomes and ROM at a minimum 5-year follow up in patients undergoing ARCR with simultaneous MUA and CR for concurrent RC tear and adhesive capsulitis and to compare active ROM of the operative and nonoperative shoulder. It was hypothesized that patient-reported outcomes (PROs) and ROM would be maintained at long-term follow-up with high levels of patient satisfaction and that there would be no difference in ROM from the contralateral shoulder.

Methods

Consecutive patients who underwent ARCR, CR, lysis of adhesions, and MUA from 2010 to 2014 by a single senior orthopaedic surgeon (S.S.B.) were included in this study, and a retrospective review of the medical record was performed with abstraction of demographic information and operative variables. Demographic data including age, sex, dominant shoulder, preoperative risk factors (diabetes, hypothyroidism, PASTA [partial articular supraspinatus tendon avulsion], calcific tendonitis, tear size/number of tendons) for stiffness were collected along with surgical variables (acromioplasty, distal clavicle excision, biceps tenotomy/tenodesis). Exclusion criteria were age younger than 18 years and concomitant labral repair. Patients were contacted and assessed at a minimum of 5 years postoperatively. PROs collected included American Shoulder and Elbow Scores (ASES), visual analog score (VAS) for Pain, Simple Shoulder Test (SST), subjective satisfaction, subjective shoulder value, and functional level. ROM (forward elevation [FE], external rotation [ER], internal rotation [IR]) measurements were obtained in clinic or via video tutorial-assisted questionnaires. Appendix Figure 1, available at www.arthroscopyjournal.org, presents a figure for how IR and functional level were scored. Outcome measures were collected preoperatively and at 3, 6, and 12 months, as well as 5 years and 10 years' postoperatively.

Surgical Technique and Rehabilitation

All procedures were performed with the patient in the lateral decubitus position with a bean bag. Passive ROM in FE and ER with the arm at the side and IR with the arm abducted to 90° (or maximum abduction) was documented by the operating surgeon. No manipulation was performed before arthroscopy. After sterile prepping and draping, the arm was placed into balanced suspension (Star Sleeve Traction System; Arthrex, Naples, FL) and a suprascapular nerve block was performed using a modified Nevaiser's portal. No patients had brachial plexus blocks. Diagnostic arthroscopy was performed followed by management of the biceps (tenotomy or tenotomy with suturing in preparation for arthroscopic tenodesis).[13] An arthroscopic CR was performed anteriorly (rotator interval, middle glenohumeral ligament), inferiorly (anterior and posterior bands of inferior glenohumeral ligament), and posteriorly using a hooked monopolar electrocautery probe (Fig 1). The arm was then brought out of balanced suspension and gently manipulated to achieve maximal ROM. After placing the arm back into balanced suspension, a diagnostic arthroscopy was performed to document that no iatrogenic damage was done during manipulation. Subsequently, the RCRs (and adjunct procedures) were performed as have been described previously.[14,15] The RCR constructs were chosen based on tear characteristics with knotless, single-row constructs (SpeedFix; Arthrex) and linked, double-row constructs (SpeedBridge; Arthrex). Arthroscopic acromioplasty, coracoplasty, and distal clavicle excision were done on a case-by-case basis. Postoperatively, sling immobilization was used for 6 weeks with passive

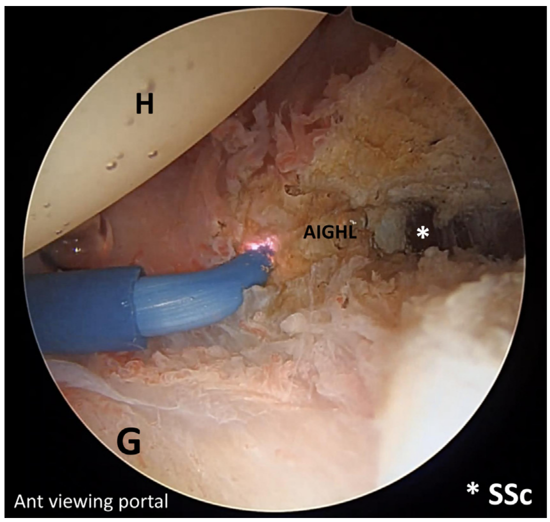

Fig 1. Arthroscopic picture viewing a left shoulder from the anterior viewing portal demonstrating anterior inferior capsular release being performed. The asterisk refers to the SSc which is annotated in the bottom right hand corner of the figure. (AIGHL, anterior inferior glenohumeral ligament; G, glenoid; H, humerus; SSc, subscapularis.)

Table 1. Patient Demographics and Surgical Data

Patient	Age, y	Sex	F/U, y	Repaired Tendons	Adjunct Procedures*	PASTA Repair	BMI	DM	Tobacco Use	Workers' Comp	Hx of Contralateral Surgery	Thyroid Condition	HLD	HTN	ASES Score, Final	SSV, Final	ER, Final	Contralat ER, final
1	63	M	10	SP, SSc	BTd, acromioplasty, coracoplasty	No	29	Yes	Yes	Yes	Yes	No	Yes	Yes	98	100	60^o	70^o
2	48	F	7	SP	DCE, acromioplasty	Yes	20	No	Yes	No	No	No	No	No	85	95	30^o	90^o
3	48	M	9	SP	–	Yes	28	No	No	No	No	No	No	No	100	100	90^o	90^o
4	53	M	10	SP, SSc, IS	BTd, DCE acromioplasty	Yes	34	Yes	Yes	Yes	No	No	Yes	Yes	100	100	90^o	90^o
5	61	M	8	SP	Acromioplasty	No	21	No	No	No	Yes	No	Yes	No	100	100	60^o	60^o
6	51	F	6	SSc	DCE, acromioplasty, coracoplasty	No	21	No	Former smoker	No	No	Yes	No	Yes	85	90	60^o	80^o
7	58	M	6	SP, SSc, IS	BTd, acromioplasty, coracoplasty	Yes	28	No	No	No	Yes	No	Yes	Yes	100	100	50^o	50^o
8	68	F	6	SP	BTt, acromioplasty	No	27	No	No	No	Yes	Yes	Yes	No	97	95	50^o	50^o
9	62	M	7	SP, SSc	BTd, DCE, acromioplasty, coracoplasty	No	29	Yes	Yes	No	No	No	Yes	Yes	100	95	60^o	60^o
10	61	F	6	SSc	BTd, DCE, acromioplasty, coracoplasty	No	22	No	Former smoker	No	No	No	Yes	No	83	95	80^o	90^o
11	67	M	6	SP	Acromioplasty	No	27	No	Former smoker	No	No	No	Yes	Yes	100	98	70^o	90^o
12	57	F	9	SP	Acromioplasty		22	No	No	No	Yes	No	No	No	100	90	90^o	90^o
13†	71	F	10	SP, IS	BTt	No	24	No	No	No	No	No	Yes	Yes	NA	60	NA	NA
14	67	M	6	SP, SSc	BTd, acromioplasty, coracoplasty	No	25	No	Former smoker	No	No	No	No	No	95	94	30^o	50^o

ASES, American Shoulder and Elbow Surgeons; BMI, body mass index; BTd, biceps tenodesis; BTt, biceps tenotomy; DCE, distal clavicle excision; DM, diabetes; ER, external rotation; F/U, follow-up; HLD, hyperlipidemia; HTN, hypertension; Hx, history; IS, infraspinatus; NA, not available; SP, supraspinatus; SSc, subscapulari; SSV, subjective shoulder value.

*All patients underwent capsular release, lysis of adhesions, and manipulation under anesthesia.

†History of previous 3-tendon rotator cuff repair.

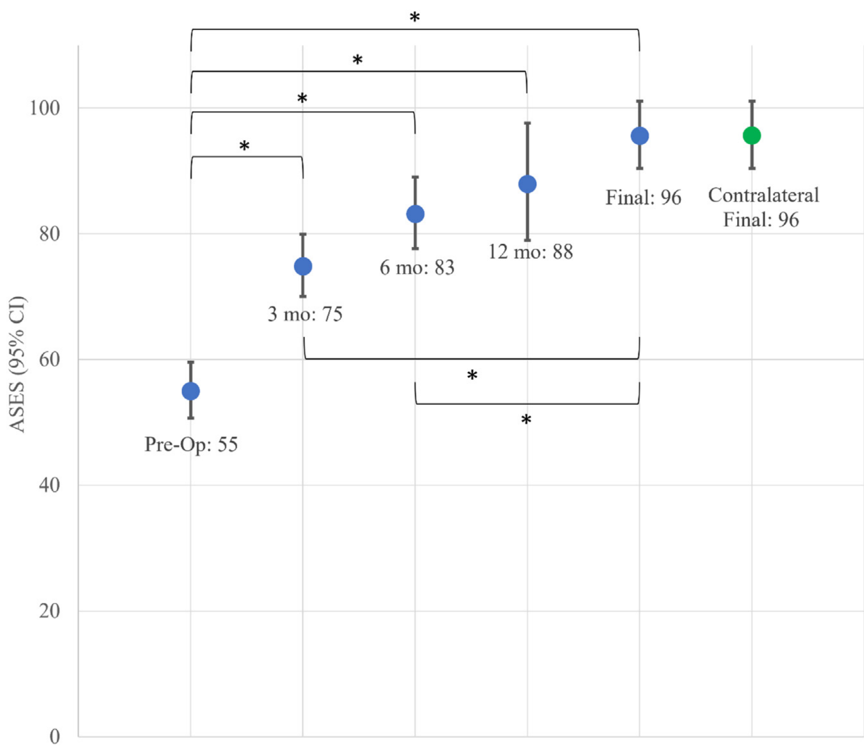

Fig 2. American Shoulder and Elbow Surgeons scores, $^{*}P < .01$. (ASES, American Shoulder and Elbow Surgeons; CI, confidence interval.)

ROM in FE (table slide) and ER using a wand (maximum 0° for massive repairs and full-thickness subscapularis repairs and 45° for all others). Between 6 and 12 weeks' postoperatively, full passive ER, IR, and overhead stretching with a rope and pulley were used.[16]

Statistical Analysis

Paired *t* and Wilcoxon signed-rank tests were used when comparing matched data from the operative and contralateral shoulder for the same patients, whereas unpaired *t* and Mann–Whitney *U* tests were used for other parametric and nonparametric comparisons.

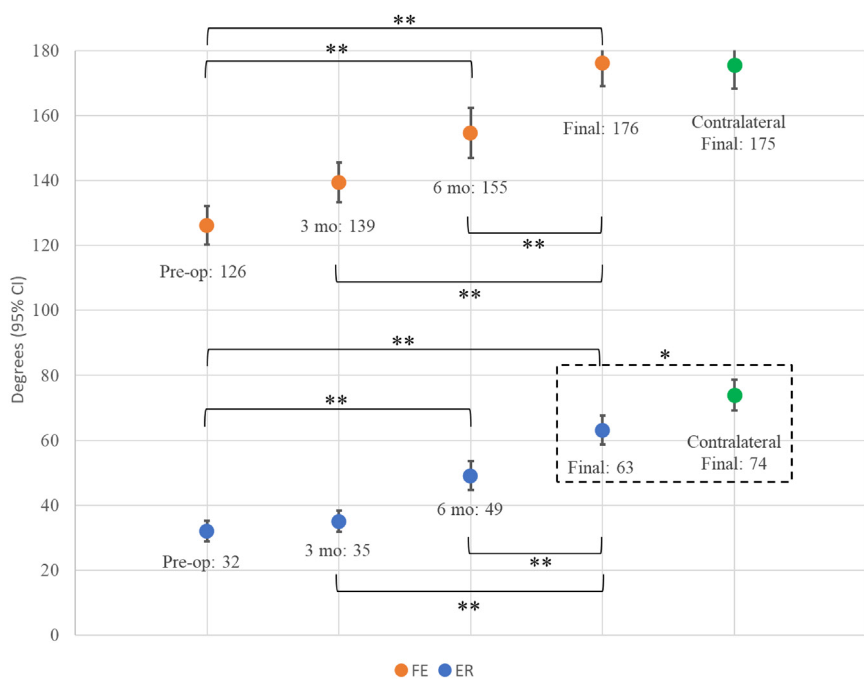

Fig 3. Forward flexion and external rotation, $^{*}P < .05$, $^{**}P < .01$. (ER, external rotation; FE, forward elevation.)

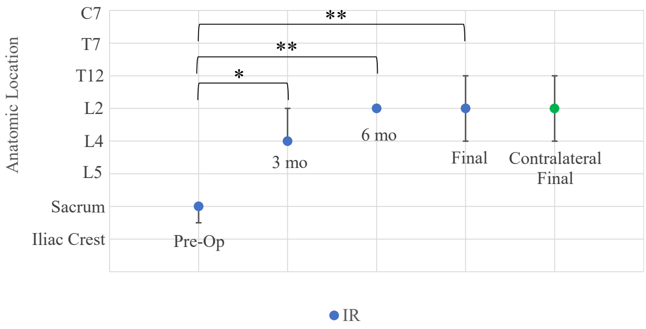

Fig 4. Internal rotation, **P* < .05, ***P* < .01; IQR is expressed as error bars. Refer to Appendix Figure 1 for numerical measurement scale for each anatomic location. (IQR, interquartile range; IR, internal rotation.)

Summary statistics were expressed as mean ± standard deviation or median (interquartile range [IQR]). For all statistical tests, $P < .05$ was considered significant. Statistical analysis was performed using StatsDirect statistical software (Version 3.2.7, StatsDirect software, Cheshire, UK).

Results

Demographics

Fourteen consecutive patients who underwent ARCR, CR, lysis of adhesions, and MUA met inclusion criteria. Mean age at time of surgery was 60 ± 7 years with follow-up of 7.5 ± 1.6 years (range, 6-10 years). Eight patients (57%) underwent repair of one RC tendon, 4 (29%) underwent repair of 2 tendons, and 2 (14%) underwent 3-tendon repair. One 2-tendon repair was a revision of a previous 3-tendon repair. Further demographic data, including risk factors for stiffness, and surgical data can be found in Table 1.

PROs and ROM

The mean preoperative ASES Score was 55 ± 15, with significant improvements from preoperative values at 3 months (75 ± 15, n = 12, $P = .005$), 6 months (83 ± 11, n = 10, $P < .001$), 12 months (88 ± 11, n = 4, $P = .002$), and final follow-up (96 ± 7, n = 13, mean difference: 40.62, 95% confidence interval [CI] 20.35-50.88; $P < .001$) as well as from 3 months ($P = .001$) and 6 months ($P = .003$) to final follow-up. No significant difference in ASES score was noted between the operative shoulder and contralateral shoulder at final follow-up, with both having excellent ASES scores ($P > .999$) (Fig 2). Similarly, SST scores showed significant improvements from preoperative values (n = 3) to final postoperative values (mean difference: 8 (95% CI 6.85-9.61), $P = .001$), with no significant difference between SST scores for the operative (n = 13) and contralateral side (n = 13) at final follow-up ($P = .776$).

The mean preoperative VAS for pain was 5.3 ± 2.7 (n = 11), which decreased significantly at 3 months (1.9 ± 1.9, n = 9, $P = .002$), 6 months (1.3 ± 1.6, n = 10, $P = .008$), 12 months (1.2 ± 1.6, n = 5, $P = .008$), and final follow-up (n = 13) (0.5 ± 0.9, mean difference: 4.7, 95% CI 2.98-6.49, $P < .001$). Significant decreases in VAS pain were also noted from 3 months and 6 months to final follow-up ($P = .0348$, $P < .001$). At final follow-up, no significant difference in pain was noted for the operative and contralateral side ($P = .844$).

Preoperative ROM included FE of 126 ± 35°, ER of 32 ± 18°, and IR of 2 (IQR 1.5-4) (Appendix Fig 1). A significant improvement was noted in IR by 3 months' postoperatively (4 [IQR 4-5], $P = .022$), with significant improvements in FE, ER, and IR at 6 months' postoperatively (FE: 155 ± 30°, $P = .047$, ER: 49 ± 15°, $P = .025$, IR 5, [IQR 5-5], $P = .010$). FE, ER, and IR were also substantially improved at final follow-up compared with preoperative values (mean difference FE: 51°, 95% CI 30.04-70.13, $P < .001$; mean difference ER: 31°, 95% CI 15.52-46.79, $P = .0004$, median difference IR: 3, [IQR 1-4], $P = .004$) (Figs 3 and 4). FE and ER also improved from 3 months' postoperatively to final follow-up (FE: 139 ± 37°, $P = .0026$, ER: 35 ± 20, $P = .002$). At final follow-up the operative side's FE (176 ± 7°) and IR (5 [4-6]) were similar to that of the contralateral side (175 ± 8°, 5 [4-6], $P = .673$, $P > .999$), but ER was notably limited (mean difference ER: 10.77 ± 17.06°, 95% CI 0.46-21.08, $P = .042$, Fig 3). Although 12 of 13 patients had improved ER at final follow-up compared with preoperative values (1 patient had the same ER), 5 had deficits compared with their contralateral arm (10° [n = 2], 20° [n = 3], and 60° [n = 1]).

By 3 months' postoperatively, 83% (10/12) of patients were subjectively satisfied with their shoulders and by 6 months, 90% (9/10) of patients were subjectively satisfied. At final follow-up, all patients but one were subjectively satisfied with their shoulder (93%, 13/14), with the 1 unsatisfied patient being the lone patient with a previous surgery, which included a 3-tendon repair. The mean subjective shoulder value at final follow-up for the operative shoulder was 94 ± 11 (n = 14), which was significantly improved from preoperative values (n = 3) (mean difference: 47, 95% CI 37.82-56.27, $P < .001$) and similar to that of the contralateral shoulder (97 ± 4, n = 14, $P = .372$).

Lastly, 9 patients rated their preoperative functional level (Appendix Fig 1, Table 2) as 3 (IQR 2-4) with significant improvements noted by 6 (5 [IQR 4-6], $P = 0.039$) and 12 months (5 [IQR 4-6], n = 5, $P = .043$) postoperatively.

Recurrent Stiffness

Two patients (14%) underwent revision procedures consisting of repeat CR and lysis of adhesions 6 months' and 1-year postoperatively. In both cases, the RCR

Table 2. Patient-Reported Outcomes and ROM

	Preoperative	3 mo	6 mo	12 mo	*P* Values: Pre operative p to 3 mo	Pre operative to 6 mo	Pre operative to 12 mo	Pre operative p to Final	3 mo to 6 mo	3 mo to 12 mo	3 mo to Final	6 mo to 12 mo	6 mo to Final	12 mo to Final	Final F/U	Contralateral Final F/U	P-values: Final (vs Contralateral)
ROM																	
FE	126.07 ± 34.48	139.29 ± 37.00	154.50 ± 29.67	–	.356	**.047**	–	**<.001**	.294	–	**.003**	–	**.048**	–	176.15 ± 6.50	175.38 ± 7.76	0.673
ER	31.92 ± 17.97	35.00 ± 20.31	49.00 ± 15.06	–	.686	**.025**	–	**<.001**	.082	–	**.002**	–	.083	–	63.08 ± 20.57	73.85 ± 17.58	**0.042**
IR*	2 (1.5-4)	4 (4-5)	5 (5-5)	–	**.022**	**.010**	–	**.004**	.149	–	.141	–	.972	–	5 (4-6)	5 (4-6)	>0.999
Outcomes																	
ASES score	55.00 ± 15.24	74.86 ± 15.43	83.17 ± 11.26	87.91 ± 11.50	**.005**	**<.001**	**.002**	**< .001**	.173	.146	**.001**	.492	**.003**	.107	95.62 ± 6.63	95.62 ± 6.10	>0.999
VAS	5.27 ± 2.69	1.92 ± 1.88	1.3 ± 1.57	1.20 ± 1.64	**.002**	**.008**	**.008**	**<.001**	**.035**	.471	**.010**	.910	**<.001**	.278	0.54 ± 0.88	0.46 ± 0.97	0.844
SST	3.00 ± 1.00	5.50 ± 2.89	10.00 (n=2)	–	.218	.2	–	**.001**	.133	–	**.002**	–	.191	–	11.23 ± 1.01	11.3 ± 0.85	0.776
SSV	46.67 ± 5.77	58.25 ± 20.95	82.50 ± 3.54	–	.358	–	–	**<.001**	–	–	**<.001**	–	–	–	93.69 ± 10.75	97.14 ± 3.82	0.372
Functional level*	3 (2-4)	5 (4-5)	5 (4-6)	5 (4-6)	.128	**.039**	**.043**	–	.573	.637	–	–	–	–	–	–	-

P values in bold; statistically significant.

ASES, American Shoulder and Elbow Surgeons; ER, external rotation; FE, forward elevation; FU, follow-up; IR, internal rotation; ROM, range of motion; SST, simple shoulder test; SSV, subjective shoulder value; VAS, visual analog scale for pain.

*Expressed as median (interquartile range); see Appendix Figure 1 for scale.

remained intact. No other patients required revision, and at final follow-up, each patient who underwent revision stated that they had no recurrence of their stiffness on the operative side.

Discussion

The results of this study demonstrate that despite severe preoperative stiffness, PROs and ROM improve substantially after ARCR, MUA, and CR, with comparable outcomes at a minimum of 5 years with that of the contralateral shoulder. However, patients may be at risk of residual ER loss and recurrent stiffness requiring revision surgery.

Stiffness before RCR has long been implicated as a risk factor for postoperative stiffness,[1-4] but the ideal treatment protocol remains a subject of debate. Historically, a staged approach has been promoted, wherein conservative management and/or injections are recommended first to help regain motion before ARCR. More recently, this approach has come under scrutiny, given its prolonged treatment course and debility, not to mention its implications on RC repairability. To avoid these drawbacks, an expedited approach to ARCR, with concomitant MUA and/or CR, has been advocated.[11,17] Thus far, the published short-term results have been overwhelmingly positive and the current study's PROs at a minimum of 5 years follow up parallel and expand upon that of the previous research.[5,6,8,9,11,17-19] A prospective study from Kim et al.[5] examined the most relevant clinical question, finding no benefit to delayed ARCR when compared with immediate ARCR and CR. Multiple short-term studies on the single-stage approach also demonstrated similar outcomes to that of nonstiff controls,[6,8,9,18-20] with a lone study from Mak et al.[21] finding that the stiff group had inferior outcomes, with worse forward flexion and Constant scores. However, notably, aside from the current study, there has only been 1 previous study to characterize outcomes with reference to the contralateral shoulder, but that study by Ho et al.[18] found no difference in ER compared with the contralateral shoulder, contrary to the current study's findings.

Although each of the PROs (ASES, SST, pain) within this study far exceeded their minimum clinically important differences[22] and ROM substantially improved from preoperative to postoperative values, an 11° loss of ER was observed compared with the contralateral shoulder. Although the minimum clinically important differences for ROM after ARCR have not yet been established, this magnitude of difference is likely noticeable. However, with a mean ER of 63°, it may not be functionally limiting, which is corroborated by the overall excellent clinical outcomes and subjective satisfaction. In the absence of more robust or long-term studies examining postoperative stiffness after ARCR with MUA and CR, several longitudinal studies examining the natural history of frozen shoulder and the effects of MUA and/or CR in this population can serve as useful comparators.[23-30] Although frozen shoulder has historically been thought of as a self-limiting condition, this may not be entirely true.[23] First, despite prolonged conservative treatment, injections and/or surgery, it appears that frozen shoulder may still result in some decrement to ROM, coinciding with the results of the current study.[23] Second, an observational study by Woods and Loganathan[31] found an 18% (141/792) revision rate for stiffness after MUA for frozen shoulder, which is similar to the revision rate for postoperative stiffness (14%, n = 2) in the current study. This indicates that patients with stiffness may remain at an increased risk of recurrence despite a tailored surgical protocol. Yet, surprisingly, none of the previous studies on ARCR, MUA, and CR have cited cases of recurrent stiffness requiring revision. Fortunately, the rates of stiffness after ARCR in nonstiff shoulders are somewhat lower (4-7%)[1-3] in comparison, which is hypothesized to be related to several risk factors predisposing to stiffness within the current study population, including PASTA repairs, diabetes, amplified inflammatory and pain responses, and the possibility of less rehabilitation compliance. With this in mind, greater attention must be paid to this cohort in the perioperative period, with medical optimization (diabetes management, pain control, physical therapy engagement) and close follow-up to ensure post-operative benchmarks are met. In addition, future studies must seek to compare long-term outcomes and revisions for stiffness among patients with preoperative stiffness undergoing delayed repair or immediate single-stage repair.

Although Kim et al.[5] found no difference in outcomes for stiff shoulders undergoing delayed ARCR or immediate ARCR with CR, a longer duration of symptoms for rotator cuff tears has been negatively correlated with outcomes.[12] Thus, proceeding to repair instead of undergoing a prolonged course of therapy may be preferable. In addition, since preoperative stiffness is another known risk factor for worse postoperative outcomes and motion,[2-4] attempting to address both the RC and stiffness concurrently is likely prudent.

Finally, even after deciding to pursue single-stage management, there is still no consensus as to the best surgical treatment for stiffness in the setting of ARCR, whether MUA, CR, or both. However, in the opinion of the authors, performance of both MUA and CR together is advisable, with one study showing superiority of a combined approach, compared with MUA alone.[10] This is also in view of the limitations of MUA and CR in isolation, which for MUA includes the possibility of slower recovery[9] and persistent anterior capsule tightness,[8] whereas CR may be limited inferiorly by adjacent neurovascular structures and adhesions outside of the glenohumeral joint.[7] Future studies should aim to compare the effect of MUA and CR together and in isolation while considering the fundamental comparison of interest, similar to Kim et al.[5], of delayed ARCR versus immediate ARCR (with CR and/or MUA).

Limitations

This study is not without limitations. This study is limited in its ability to draw conclusions regarding demographic and surgical risk factors (diabetes, thyroid conditions, number of tendons torn/repaired, other procedures performed, etc) for stiffness, given the relatively small cohort. Incomplete surveys and/or inconsistent follow-up also limit the completeness of the data set. Self-assessment of ROM is another potential limitation, particularly in elderly individuals, although detailed video tutorials were used to ensure accuracy.[32] Similarly, clinical assessment of ROM was performed by the treating surgeon without the use of a goniometer. Lastly, using the patient's contralateral side as an internal control may make for a more apt comparison than that of a separate population of nonstiff shoulders, as it minimizes heterogeneity and bias, but there are also limitations to this approach, including instances of patients requiring surgery on their contralateral shoulder.

Conclusions

This study highlights significantly improved and maintained PROs and ROM at minimum 5-year follow-up in patients undergoing concomitant ARCR, MUA, and CR. These results provide further evidence that preoperative stiffness in the setting of rotator cuff tear can be managed concurrently; however, patients may remain at an increased risk for recurrent stiffness and ER loss.

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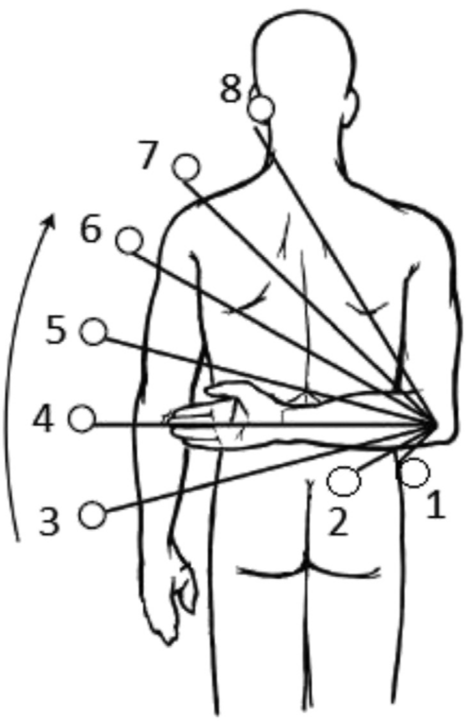
Appendix 1

Functional Level (0-6):

1. Unable to use limb
2. Only light activities possible
3. Able to do light housework or most activities of daily living
4. Able to do most housework, shopping, and driving possible, able to do hair, dress, undress (for women-including fastening a brassiere)
5. Slight restriction only, able to work above shoulder level
6. Able to do normal activities



Appendix Fig 1. Internal rotation diagram (1-8): 1: iliac crest; 2: sacrum; 3: L5; 4: L4; 5: L2; 6: T12; 7: T7; and 8: C7.