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ORIGINAL ARTICLE

Speed of recovery after arthroscopic rotator cuff repair

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Background: The purpose of this study was to delineate the time taken to achieve maximum improvement (plateau of recovery) and the degree of recovery observed at various time points (speed of recovery) for pain and function after arthroscopic rotator cuff repair.

Methods: An institutional shoulder surgery registry query identified 627 patients who underwent arthroscopic rotator cuff repair between 2006 and 2015. Measured range of motion, patient satisfaction, and patient-reported outcome measures were analyzed for preoperative, 3-month, 6-month, 1-year, and 2-year intervals. Subgroup analysis was performed on the basis of tear size by retraction grade and number of anchors used.

Results: As an entire group, the plateau of maximum recovery for pain, function, and motion occurred at 1 year. Satisfaction with surgery was >96% at all time points. At 3 months, 74% of improvement in pain and 45% to 58% of functional improvement were realized. However, only 22% of elevation improvement was achieved ($P < .001$). At 6 months, 89% of improvement in pain, 81% to 88% of functional improvement, and 78% of elevation improvement were achieved ($P < .001$). Larger tears had a slower speed of recovery for Single Assessment Numeric Evaluation scores, forward elevation, and external rotation. Smaller tears had higher motion and functional scores across all time points. Tear size did not influence pain levels.

Conclusion: The plateau of maximum recovery after rotator cuff repair occurred at 1 year with high satisfaction rates at all time points. At 3 months, approximately 75% of pain relief and 50% of functional recovery can be expected. Larger tears have a slower speed of recovery.

Level of evidence: Level IV; Case Series; Treatment Study

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The torn rotator cuff remains a fairly ubiquitous problem in the orthopedic practice and its effects on patients can be debilitating. Over the years, innovations in surgical technique and

fixation devices have focused on improving the various methods for repair of the torn rotator cuff.⁶ Whereas advancements have been made, the indications for surgical repair and our ability to successfully manage this problem remain points of contention as our understanding of the factors affecting outcome continues to grow.^{5,9} This becomes even more important as the changing medical climate places a greater emphasis on patient satisfaction as a critical outcome. Consequently, appropriately defining patient expectations becomes critical as it greatly influences patient satisfaction and thus outcome.

This study was granted an Institutional Review Board exemption determination (protocol No. 2016-010-EX) before initiation of this research.

All work was performed at the Holy Cross Orthopedic Institute and Holy Cross Hospital.

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Recovery after arthroscopic rotator cuff repair can be a painful and lengthy proposition.⁴ Surgeons have ample evidence to help predict outcomes and healing rates based on numerous studies reporting 2-year follow-up data.^{14,21} However, there remains a paucity of data available that can help patients understand how fast they might recover and how improved they may be at various time points in the recovery process. A better understanding of the speed of recovery after arthroscopic rotator cuff repair surgery can go a long way to help define patient expectations and in turn have an impact on one of the critical elements of patient outcome.¹¹

The purpose of this study was to delineate the time taken to achieve maximum improvement (plateau of recovery) and the degree of recovery observed at various time points for pain and function after arthroscopic rotator cuff repair. Secondly, we sought to assess the effect of tear size on the speed of recovery and overall outcome. Our hypothesis was that recovery will plateau at a year but larger tears will have a slower recovery and poorer outcomes.

Materials and methods

A retrospective analysis of data prospectively collected for patients undergoing arthroscopic rotator cuff repair included in our institution's shoulder and elbow surgery registry between November 2006 and December 2015 was performed. As part of the standard registry protocol, assessments are collected preoperatively and at 3 months, 6 months, 1 year, and subsequent annual intervals postoperatively. At each time interval, shoulder motion is assessed using best-effort manual goniometer measurements, and patient-reported outcome measures (PROMs) are collected. PROMs include visual analog scale (VAS) score for pain and function, Simple Shoulder Test (SST) score, American Shoulder and Elbow Surgeons (ASES) score, and Single Assessment Numeric Evaluation (SANE) score. In addition, patient satisfaction with surgery is assessed as excellent, good, satisfactory, or unsatisfactory. Satisfaction was defined as a patient satisfaction rating of excellent, good, or satisfactory.

All patients undergoing an arthroscopic primary repair of a full-thickness rotator cuff tear were included on the basis of availability of 6-month, 1-year, and 2-year follow-up data points. Patients undergoing a partial or revision rotator cuff repair were excluded.

The senior author (J.C.L.) performed all surgeries arthroscopically with the patient in a beach chair position. After an arthroscopic evaluation, the rotator cuff was classified by an intraoperative modification of the Patte classification,¹⁹ whereby intraoperative assessment of retraction was classified as grade 1 (no or minimal retraction), grade 2 (retraction to the level of the humeral head), and grade 3 (retraction to the glenoid).

Grade 1 tears were typically repaired using a single-row tension band technique similar to what has been described by Boileau et al.¹ Grade 2 and grade 3 tears were repaired using a double-row transosseous-equivalent technique^{17,18} after mobilization techniques to avoid tension on the repair. In cases in which mobilization could not be achieved for footprint coverage, the repair was medialized and the same double-row technique was used.

Postoperatively, all patients were maintained in a shoulder immobilizer for 6 weeks. However, patients were relegated into 1 of 2 rehabilitation groups based on the retraction grade of the tear. Pa-

tients with a grade 1 tears were started in a physical therapist-directed protocol that allowed early active assist and passive motion beginning at the first therapy visit within 1 week of surgery. However, patients with grade 2 and grade 3 tears were placed in a self-directed home program for the first 3 months that called for pendulum exercises only for the first 6 weeks, followed by active assisted stretching exercises for the subsequent 6 weeks. No strengthening exercises were prescribed for the first 3 months for all patients.

Plateau in maximal improvement

By use of methodology previously described,¹³ the plateau in maximal improvement was defined as the follow-up point at which no subsequent statistically significant improvement was observed compared with the immediately preceding follow-up interval.

Speed of recovery

Speed of recovery was defined as the percentage of the total improvement (achieved at the plateau point) attained at each follow-up interval for each outcome measure.¹³

Subgroup analysis was performed on the basis of the retraction grade of the rotator cuff tear by the Patte classification¹⁹ as well as the number of anchors used for the repair. Because more anchors were required to repair larger tears, this served as an additional proxy for tear size.

Differences in outcomes between time intervals and subgroups were determined using 1-way analyses of variance, repeated-measures analyses of variance, univariate regression analyses, and Pearson correlations. Post hoc *t*-tests were used when appropriate. Statistical analyses were performed using SPSS v.22 (IBM, Armonk, NY, USA). Significance was set at $P < .05$.

Results

There were 627 patients who met inclusion criteria. There were 383 men and 244 women with an average age of 62.0 years (range, 29-87 years). By the modification of the Patte classification,¹⁹ 34% of all tears were grade 1, 38% were grade 2, and 28% were grade 3 tears. A significant positive relationship was identified between retraction grade and the number of anchors used ($R = 0.353$; $P < .001$). A single anchor was used to repair the rotator cuff in 18% of patients; 2 anchors were used in 29% of patients, 3 anchors were used in 13% of patients, 4 anchors were used in 25% of patients, and 5 or more anchors were used in 15% of patients. Overall satisfaction with surgery was 97.4% at 3 months, 96.2% at 6 months, 96.1% at 1 year, and 99.2% at 2-year follow-up (Table I).

Table I Patient subjective satisfaction ratings at each time point during recovery after arthroscopic rotator cuff repair

	3 months	6 months	1 year	2 years
Excellent	58.1%	65.1%	72.5%	77.0%
Good	26.5%	23.4%	15.7%	16.7%
Satisfactory	12.9%	7.7%	7.8%	5.6%
Unsatisfactory	2.6%	3.8%	3.9%	0.8%

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