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Impact of rotator cuff tendon reparability on patient satisfaction

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ARTICLE INFO

Keywords:

Rotator cuff
Tear size
Tendon reparability
Repair
Disability
Patient satisfaction

Level of evidence: Level III, Retrospective Cohort Design, Treatment Study

Background: The primary purpose of this study was to explore the relationship between patient satisfaction and rotator cuff tendon reparability.

Materials and methods: This was a secondary analysis of prospectively collected data of consecutive patients who underwent arthroscopic repair of full-thickness rotator cuff tear and were followed up for 2 years. The satisfaction level was rated on a 6-point Likert scale. Patient-oriented disability measures included the American Shoulder and Elbow Surgeons score, the short version of the Western Ontario Rotator Cuff index, the Constant-Murley score, and the Quick Disabilities of the Arm, Shoulder, and Hand. Partial repair was defined as repair with >1 cm residual gap.

Results: There were 145 patients (65 women, 80 men; mean age, 62 years) who met the inclusion criteria. There were 12 massive, 31 large, and 102 small or moderate rotator cuff tears. Of 43 large or massive tears, 23 had a partial repair. There was a statistically significant relationship between satisfaction and tendon reparability ($P = .01$). Patients with work-related shoulder injury reported less satisfaction with surgery ($P = .005$). Age, gender, or tear size did not affect satisfaction with surgery. Satisfaction was a predictor of all postoperative outcome scores after being adjusted for preoperative scores ($P = .001$ to $P < .0001$).

Conclusion: In this study, patients with partial repair and those with an active compensable injury were less satisfied with surgery than their counterparts were. Older age, female sex, or a larger tear was not a negative predictor of patient satisfaction.

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Patient satisfaction involves the patients' perspectives in the assessment of the treatment they have received.¹⁸ Satisfaction with surgical outcome and improvement in symptoms and functional ability are expected to have a linear relationship. This, however, is not always true. Williams et al⁴² reported that patients might express full satisfaction despite the negative outcome or failure of achieving cure. Carr-Hill¹⁰ noted that human satisfaction is a complex concept related to lifestyle, past experiences, and expectations as well as both individual and societal values. To date, a limited number of studies have examined patient satisfaction after rotator cuff repair. Whereas most investigators have based the success of surgery on patient-reported disability measures, only a few have used specific questionnaires to document satisfaction with surgery.^{14,23,28,33,38,40} Factors such as demographics, preoperative disability, tear size, preoperative fatty infiltration, and presence of an active compensation

claim have been noted to affect satisfaction after rotator cuff repair.^{14,28,33,38,40} However, the role of tendon reparability in patient satisfaction with surgery has not been specifically explored. The primary purpose of this study was to explore the relationship between patient satisfaction with surgery and tendon reparability. The impact of other important factors, such as age, sex, rotator cuff tear size, and a compensable work injury, was also explored. The difference in disability scores was examined within and between satisfaction categories.

Materials and methods

Patient population

Prospectively collected data of consecutive patients who had undergone a rotator cuff repair and were followed up for an average of 2 years were reviewed. The inclusion criteria were age ≥ 18 years, failure of conservative treatment including a structured rehabilitation program, and diagnosis of full-thickness rotator cuff tear requiring a repair. Exclusion criteria were previous surgery of the affected shoulder, evidence of infection, underlying metabolic or inflammatory disease, avascular necrosis, adhesive capsulitis, isolated

This study received ethics approval from the Human Ethics Research Board of the Sunnybrook Health Sciences Centre, Toronto, Canada: REB project #462-2014.

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<http://dx.doi.org/10.1016/j.jses.2017.03.003>

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subscapularis tear, and superior labral anterior and posterior or Bankart lesions requiring a repair.

Satisfaction with surgery

Patient satisfaction was rated on a 6-point Likert scale: very satisfied, somewhat satisfied, a little bit satisfied, a little bit dissatisfied, somewhat dissatisfied, and very dissatisfied. All patients provided this information at 2 years after surgery. Categories with zero or small cell numbers (ie, <5) were collapsed together.

Disability outcome measures

The outcomes used to measure recovery within and between satisfaction categories were the American Shoulder and Elbow Surgeons (ASES) standardized shoulder assessment form,³⁶ short version of the Western Ontario Rotator Cuff (ShortWORC) index,³⁴ Constant-Murley score (CMS),¹² and Quick Disabilities of the Arm, Shoulder, and Hand (QuickDASH).² Active shoulder movements within pain-free range were measured in flexion, abduction, and external and internal rotation (with 0 being the most restricted and 40 being the full score).¹² Reliability and validity of all outcome measures have been established in patients with shoulder or rotator cuff disease.^{27,31,32,34,37}

Range of motion and strength assessments were completed before surgery and 2 years after surgery. Strength was measured as the maximum force that the patient could resist for 5 seconds without significant pain and discomfort from approximately 60° to 90° of elevation and in the scapular plane with an unsecured tensiometer.

Surgical procedures

Standard portals were used to examine intra-articular structures of the shoulder joint with the patient in the beach chair or lateral position. We used a calibrated probe to measure the medial to lateral and anterior to posterior dimensions of the tear. The largest dimension of rotator cuff tear size was categorized as small (<1 cm), moderate (1–3 cm), large (>3–5 cm), and massive (5 cm and larger).¹⁵

Rotator cuff repair to the bone was achieved by single-row or double-row fixations and margin convergence or side-to-side techniques along with lateral suture anchors. Partial repair was documented when the tear had a residual defect of >1 cm. Complete repair was either an anatomic repair or a repair over the articular margin with <1 cm residual gap. Anterior acromioplasty was performed for subacromial impingement. Moderate or severe degenerative changes (grades 3 and 4 of the Collins system)¹¹ of the acromioclavicular joint were managed by resection of the lateral end of the clavicle.

Postoperative rehabilitation

An UltraSling (DJO Global, Vista, CA, USA) was used to immobilize the shoulder joint for 6 weeks. Patients were given a standardized rehabilitation protocol with active assisted forward flexion and pendulum motions starting at 4 weeks postoperatively and submaximal isometric exercises starting at 6 weeks. Strength exercises against resistance were delayed for 12 weeks.

Statistical analyses

The sample size was calculated on the basis of the limited available literature.^{38,40} Tashjian et al⁴⁰ reported 95% satisfaction in patients after rotator cuff surgery. Shon et al³⁸ reported 52% satisfaction with surgery in patients who had a partial repair. With $P_1 = .95$, $P_2 = .52$, P (overall proportion) = .74, effect size (ES) = 0.98, and an appropriate

Z value for α (1.96) and power of 0.80 (0.84), a minimum sample of 16 patients per group was required.¹⁷

$$ES = \frac{|p_1 - p_2|}{\sqrt{p(1-p)}} \quad n_i = 2 \left(\frac{Z_{1-\alpha/2} + Z_{1-\beta}}{ES} \right)^2$$

The relationship between satisfaction (dependent variable) and independent categorical data (reparability, sex, tear size, compensable injury) and continuous variables (age) was examined through χ^2 statistics and univariable ordinary least squares regressions as appropriate. Analyses of covariance were used to examine the impact of satisfaction on postoperative disability outcome measures while adjusting for preoperative scores (between-group analysis). Paired t -tests examined within-group change over time. As a post hoc analysis, we examined the impact of outcomes that worsened over time in relation to reparability. Statistical analysis was performed using SAS version 9.1.3 (SAS Institute, Cary, NC, USA). Statistical results are reported using 2-tailed P values with significance set at $P < .05$.

Results

There were 145 patients who met the inclusion criteria (65 women and 80 men; mean age, 62 [9] years; minimum, 42 years; maximum, 81 years). Seven patients had small tears and 95 patients had moderate tears. Thirty-one had a large tear, with 12 having a massive tear. Of 43 large or massive tears, 23 had a partial repair. There were 107 (74%) patients who reported that they were very satisfied; 28 (19%) were somewhat satisfied, 6 (4%) were a bit satisfied, 1 was a little bit dissatisfied, 1 was somewhat dissatisfied, and 2 were very dissatisfied. Categories of a little bit satisfied and dissatisfied were collapsed together, leaving 3 categories (Table I).

Predictors of satisfaction

There was a statistically significant relationship between satisfaction and tendon reparability ($P = .01$). Patients with work-related shoulder injury reported less satisfaction with surgery ($P = .005$). Age, sex, or tear size did not have an impact on satisfaction with surgery.

Table I
Group differences in demographics and surgical findings

Variable	Highly satisfied (n = 107)	Somewhat satisfied (n = 28)	A bit satisfied/ dissatisfied (n = 10)	Statistics FET, P value
Sex				
Female: 65	53 (82)	10 (15)	2 (3)	FET = 0.005
Male: 80	54 (68)	18 (23)	8 (10)	$P = .12$
Age, mean (SD)	62 (9)	60 (9)	59 (11)	$F(2) = 0.96$ $P = .38$
Surgery on dominant side				
Yes	65 (61)	22 (79)	6 (60)	FET = 0.01
No	42 (79)	6 (21)	4 (40)	$P = .19$
Workers' compensation				
Yes: 20	9 (45)	8 (40)	3 (15)	FET = 0.001
No: 125	98 (78)	20 (16)	7 (6)	$P = .005$
Mechanism of injury				
Traumatic: 98	69 (70)	22 (23)	7 (7)	FTE = 0.02
Nontraumatic: 47	38 (81)	6 (13)	3 (6)	$P = .39$
Tear size				
Massive: 12	6 (50)	4 (33)	2 (17)	FTE = 0.001
Large: 31	22 (71)	8 (26)	1 (3)	$P = .14$
Small/moderate: 102	79 (77)	16 (16)	7 (7)	
Tendon reparability				
Partial: 23	12 (52)	10 (44)	1 (4)	FTE = 0.001
Full: 122	95 (78)	18 (15)	9 (7)	$P = .01$

FET, Fisher exact test; SD, standard deviation.

Variables are presented as number (%) unless otherwise indicated.

Table II
Disability outcome measures (preoperative, postoperative, and change over time)

Variable (paired <i>t</i> -test, <i>P</i> value)	Highly satisfied (<i>n</i> = 107)	Somewhat satisfied (<i>n</i> = 28)	Dissatisfied (<i>n</i> = 10)	Statistics (ANCOVA) F value, <i>P</i> value
Outcome measures				
Preoperative ASES	50 (18)	50 (19)	51 (16)	Preoperative: 9.25, <i>P</i> = .003
Postoperative ASES	92 (10)	71 (16)	64 (17)	Satisfaction: 63.18, <i>P</i> < .0001
Change	43.10, <i>P</i> < .0001	21.01, <i>P</i> < .0001	12.67, <i>P</i> = .14	
Preoperative ShortWORC (0-100)	39 (19)	41 (20)	33 (16)	Preoperative: 9.34, <i>P</i> = .003
Postoperative ShortWORC	90 (16)	61 (23)	48 (16)	Satisfaction: 52.24, <i>P</i> < .0001
Change	50.56, <i>P</i> < .0001	19.82, <i>P</i> = .0001	14.57, <i>P</i> = .005	
Preoperative ACMS (0-100)	40 (16)	39 (19)	33 (15)	Preoperative: 20.62, <i>P</i> < .0001
Postoperative ACMS	80 (12)	61 (15)	57 (14)	Satisfaction: 34.12, <i>P</i> < .0001
Change	39.94, <i>P</i> < .0001	22.03, <i>P</i> < .0001	24.40, <i>P</i> < .0001	
Preoperative QuickDASH (0-100)	46 (17)	43 (16)	51 (17)	Preoperative: 14.17, <i>P</i> = .0002
Postoperative QuickDASH	10 (14)	29 (18)	44 (16)	Satisfaction: 38.69, <i>P</i> < .0001
Change	-36.11, <i>P</i> < .0001	-13.60, <i>P</i> = .002	-7.72, <i>P</i> = .20	
Preoperative ROM (0-40)	23 (8)	20 (11)	19 (8)	Preoperative: 13.23, <i>P</i> < .0001
Postoperative ROM	38 (9)	32 (9)	33 (8)	Satisfaction: 15.13, <i>P</i> < .0001
Change	15.01, <i>P</i> < .0001	10.92, <i>P</i> < .0001	13.60, <i>P</i> = .0002	
Preoperative strength (lb)	11 (10)	16 (19)	17 (9)	Preoperative: 0.39, <i>P</i> = .53
Postoperative strength (lb)	12 (5)	9 (5)	8 (4)	Satisfaction: 6.97, <i>P</i> = .001
Change (lb)	1 (11), <i>P</i> = .29	-8 (12), <i>P</i> = .003	-9 (9), <i>P</i> = .01	

SD, standard deviation; ANCOVA, analysis of covariance; ASES, American Shoulder and Elbow Surgeons; ACMS, absolute Constant-Murley score; QuickDASH, Quick Disabilities of the Arm, Shoulder, and Hand; ROM, range of motion; ShortWORC, short version of the Western Ontario Rotator Cuff index. Variables are expressed as mean (standard deviation).

Impact of satisfaction on disability scores

There was a statistically significant difference in postoperative outcome measures of disability between satisfaction categories after being adjusted for preoperative disability (Table II). The paired *t*-tests that examined change over time showed improvement in ShortWORC and absolute CMS in all 3 satisfaction groups (*P* values ranging from .005 to <.0001). However, the ASES (*P* = .14) and QuickDASH (*P* = .20) questionnaires did not detect improvement over time in the dissatisfied group. Pain-free range of motion in 4 directions improved significantly in all satisfaction groups. However, patients in the somewhat satisfied and dissatisfied groups deteriorated in strength over time (Table II). Further analysis of the strength in combination with satisfaction and reparability showed that both factors maintained their significance in relation to postoperative strength, being *F* = 5.50, *P* = .005 for satisfaction and *F* = 11.07, *P* = .001 for repair. This indicates that worsening of the strength over time is related to reparability and affects the overall patient satisfaction.

Discussion

Role of demographics in predicting satisfaction

Age or sex of the patient was not a predictor of satisfaction in this study. The impact of patients' demographics on satisfaction with rotator cuff surgery is controversial. Our results are consistent with those of Shon et al,³⁸ who found no significant differences with respect to patients' satisfaction in relation to age, sex, or side involvement. These authors categorized their patients, who all had a partial repair, into 2 groups: good satisfaction group (very satisfied or satisfied) and poor satisfaction group (rather the same or dissatisfied). Similarly, in a study by Youm et al,⁴³ demographic factors did not have an impact on patient satisfaction. On the other hand, Tashjian et al,⁴⁰ who used a binary question (yes/no) and a visual analog scale (VAS) to measure satisfaction in 112 patients with chronic rotator cuff tear, reported that younger age, being single, and being unemployed had a negative impact on patient satisfaction. Similarly, Kim et al,²³ who also used VAS to measure satisfaction in 180 patients, showed that younger age and lower education level had a negative impact on the satisfaction score. The discrepancy

among the studies may be related to variability of the population of patients included or the type of scale used to measure satisfaction.

Reparability and satisfaction

This study showed that patients with partial repairs were distributed fairly evenly between satisfied and somewhat satisfied groups (52% vs. 44%), but patients with full repair were more likely to be in the highly satisfied group (78% vs. 15%). The interesting finding of the study was the integrated relationship between postoperative strength, reparability, and satisfaction, which shows the impact of tendon reparability on strength and their combined role in the overall patient satisfaction with surgery. Our results are consistent with those of a previous study²⁰ that had compared strength in relation to reparability. The authors reported that strength of the shoulder was significantly less (*P* = .001) in patients with a partial repair. As Burkhart and colleagues noted, partial repairs improve symptoms and function by restoring the transverse force couple of the rotator cuff and improving the fulcrum of the glenohumeral joint.^{4,5,7,8} Bedi et al³ suggested that re-establishing this fulcrum may be more important than the complete closure of the defect. Among studies that have examined reparability and its impact on range of motion and disability, some have reported no statistically significant differences between complete and partial repairs,^{22,25} whereas others^{20,24,29,30,39} have reported inferior results in patients with partial repairs. In a study of 122 patients with large and massive tears,²⁰ the investigators compared partial and complete repair groups at 2 years postoperatively and showed improvement in range of motion, strength, and disability in both groups, with a slightly inferior result in the partial repair group. O'Holleran et al²⁸ reported that irreparable massive tears correlated with poorer satisfaction. Shon et al,³⁸ who studied the outcome of partial repair of large to massive cuff tears in 31 patients, showed that half of their patients who were satisfied at 1 year became dissatisfied over time (>2 years postoperatively) because of deterioration of outcomes, such as increased pain and disability as captured by subjective questionnaires (ASES and Simple Shoulder Test) and structural failure as measured by acromiohumeral distance. The dissatisfied group was more likely than the satisfied group to have teres minor fatty infiltration. Type of repair (single vs. double row), which may be indicative of difficulty in achieving a full repair, is also suggested to affect outcome.¹⁴

Tear size and satisfaction

Our study did not find a relationship between tear size and satisfaction. Impact of tear size on recovery remains controversial.^{1,6,9,24,26,29,30,35,39,41} There is evidence that patients with large tears report satisfaction with surgery.^{1,6,9,26,35,41} Whereas Tashjian et al⁴⁰ reported no correlation between satisfaction and tear size, some authors^{24,28–30,39} have argued that patients with larger tears report less improvement in function or satisfaction. O'Holleran et al,²⁸ who specifically examined satisfaction with surgery, reported that presence of large supraspinatus, infraspinatus, and subscapularis tears had a negative impact on satisfaction.

Of note, tear size and reparability may not always have a linear relationship. Some massive tears in patients with good-quality tendon and tear shapes that are more feasible to be fixed (eg, crescent shaped) may do better than large U-shaped tears in individuals with poor tendon quality. Therefore, tear size should not be considered a unifacted factor in predicting success or satisfaction with surgery.

Workers' compensation and satisfaction

The negative impact of a workers' compensation claim on overall recovery is well documented in patients with shoulder conditions.^{13,16,19,21} However, there is limited literature on injured workers' satisfaction with rotator cuff repair. Kim et al²³ showed that presence of an active compensation claim was an independent predictor of a poorer satisfaction score. Other authors³³ have reported a differential gender influence, with female injured workers' satisfaction being more affected than that of their counterpart male workers. Future studies should examine satisfaction with rotator cuff repair in injured workers in light of job demands, availability of modified duties, and an accommodating work environment.

Disability scores and satisfaction

In this study, patients who reported being highly satisfied or somewhat satisfied had a statistically significant improvement based on all patient-oriented outcome measures at 2 years after surgery. The groups that were a little bit satisfied or dissatisfied showed improvement only in the ShortWOCR and absolute CMS. Strength improved only in the highly satisfied group. The ShortWOCR is the shortened version of the WORC that is expected to be more specific to disability secondary to rotator cuff disease, and the CMS is a mixed subjective and objective measure that can document change over time in pain, inability to perform certain activities, and pain-free range of motion. The ASES and QuickDASH are shoulder-specific and upper extremity-specific scores, respectively, and may be slightly less sensitive for detection of change over time in a smaller sample of 10 patients.

Our findings are consistent with the previous literature.^{28,33,40,43} O'Holleran et al,²⁸ who measured patient satisfaction by a 10-point ordinal scale in 311 patients with rotator cuff tear who underwent a repair, found a significant relationship between pain, functional difficulty, and ASES score and the satisfaction level postoperatively. Tashjian et al,⁴⁰ who used a binary question (yes/no) and a VAS score to measure satisfaction in 112 patients with chronic rotator cuff tear, reported that higher preoperative disability was associated with less satisfaction. Razmjou et al,³³ who measured satisfaction with surgery using a 4-point Likert scale in 170 patients with rotator cuff disease (91 repair, 79 decompression), reported a relationship between poor satisfaction and higher disability as measured by ASES, WORC, and QuickDASH. In a retrospective study by Youm et al,⁴³ 84 patients with a rotator cuff tear who underwent a mini-open or arthroscopic repair were asked whether they were satisfied with the procedure and would recommend the procedure to

someone else. The level of disability was measured by the University of California–Los Angeles (UCLA) score in their study. Of 84 patients, 83 (98.8%) reported being satisfied with the procedure and also stated that they would recommend the operation to someone else with a similar condition. One patient with chronic neck and back pain had a poor UCLA score and was not satisfied with the procedure. In this study, because of lack of variability in satisfaction level, predictive value of other factors could not be examined.

In this study, there was a positive relationship between pain-limited range of motion and satisfaction. Similarly, O'Holleran et al²⁸ found a relationship between weakness in forward flexion and acromioclavicular joint tenderness and satisfaction at 1 year after surgery. In another study,³³ painful preoperative range of motion was associated with poorer satisfaction. However, strength measurement was correlated with satisfaction only in female patients, which may indicate the role of biologic factors on perception of disability and satisfaction.

Limitations

This study involved analysis of prospectively collected data of patients with full-thickness rotator cuff tears who were followed up for 2 years. Considering that postoperative imaging is not a part of routine care in all patients with rotator cuff tear, the information on postoperative fatty infiltration, muscle atrophy, or retear rate was not investigated.

Conclusion

Results of this study suggest that satisfaction with surgery is affected by reparability of rotator cuff tendon and having an active compensable injury. Older age, female sex, or a larger tear was not a negative predictor of patient satisfaction.

Disclaimer

The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

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