RESEARCH ARTICLE

Shoulder Synovitis Does not Affect Pain After Arthroscopic Rotator Cuff Repair

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Abstract

Background: The goal of this study was to determine if there is an association between glenohumeral synovitis and early post-operative pain after arthroscopic rotator cuff repair.

Methods: Fifty patients with symptomatic rotator cuff tears were prospectively enrolled prior to RCR. Baseline ASES score, VAS Pain score, forward elevation, and external rotation were recorded. Intra-operatively, synovitis was graded on a scale of zero to six as based on a previously validated scoring system. VAS Pain scores were obtained from patients post-operatively on days one through 14, week 6, and 3 months.

Results: Average intra-operative synovitis score was 2.4 ± 1.6. No significant correlation was found between synovitis score and pre-operative forward elevation (*P=0.171*), external rotation (*P=0.126*), VAS Pain (*P=0.623*), or ASES (*P=0.187*) scores. No significant correlation was found between synovitis score and post-operative VAS Pain level at any time point. There was a moderate correlation between both pre-operative VAS Pain and ASES scores and post-operative VAS Pain in the first post-operative week. Workers' compensation patients had worse pain at 3 months post-operatively compared to non-workers compensation patients (*P=0.038*).

Conclusion: This study reveals that macroscopically assessed glenohumeral synovitis does not have any significant correlation with pre-operative or post-operative pain in patients undergoing arthroscopic rotator cuff repair; although higher pre-operative pain levels, worse pre-operative ASES scores, and workers compensation status do influence post-operative pain levels in arthroscopic rotator cuff repair.

Level of evidence: III

Keywords: Postoperative pain, Rotator cuff repair, Synovitis

Introduction

Rotator cuff disease is a frequent source of acute and chronic shoulder pain in adults. The spectrum of rotator cuff disease includes tendinitis, bursal or articular sided partial thickness tears, and full thickness tears of varying sizes. The degree of pain associated with rotator cuff pathology is difficult to accurately predict based on the pathology. Many patients with full thickness rotator cuff tears function well and without pain, while other patients with low grade partial thickness tears or recurrent tendinitis may have debilitating pain.[1] There is little consensus on structural factors, repair technique, and repair integrity that relate to post-operative pain levels.[2,3] Ravindra et al. found that psychosocial and emotional factors, pre-operative function, and pre-operative pain levels best correlated with post-operative pain and function after rotator cuff repair.[4] The authors

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found weak or no correlation between structural factors such as tear size, mechanism of injury, retraction, and atrophy.[4]

The degree of bursitis and synovitis in the glenohumeral joint has been proposed as a source of shoulder pain and is associated with a number of intraarticular shoulder pathologies.[5] A recent study showed that synovitis is associated with 75% of rotator cuff tears.[6] Furthermore, Kim et al showed that duration of symptoms, tear size, and diabetes were associated with the degree of synovitis.[7] Higher grade subacromial bursitis has been correlated with pain and rotator cuff tears based on histologic analysis.[8,9] While the direct connection between intra-articular synovitis and pain levels has not been established in the shoulder, knee literature has shown significant correlation between synovitis severity, pain, and function.[10,11] The identification of patients at risk of worse post-operative pain is important for patient counseling and patient-specific pain management protocols.

The purpose of this study is to determine association between glenohumeral synovitis and post-operative pain following an arthroscopic rotator cuff repair, utilizing a validated synovitis scoring system.[12] The authors hypothesize that pre-operative synovitis score was associated with a higher post-operative pain level.

Materials and Methods

Patient Selection

After institutional review board approval was obtained, patients were prospectively enrolled after informed consent was obtained. Patients with clinical and magnetic resonance imaging (MRI) evidence of full thickness or high grade (greater than 50 percent thickness) partial thickness rotator cuff tears were eligible for inclusion. Surgical repair of the rotator cuff tear was indicated by one of three participating fellowship trained orthopedic surgeons. Patients with revision rotator cuff repair, concomitant labral repair or glenohumeral articular arthritis, and unwillingness to follow up were excluded. Fifty consecutive patients were enrolled.

Surgical Technique

All rotator cuff repairs were performed in the upright beach chair position. Diagnostic arthroscopy of the glenohumeral joint was performed to assess for concomitant pathology and synovitis scoring. Biceps tenodesis was performed if indicated by severe degeneration of the biceps tendon or superior labrum. Subacromial bursectomy was performed in all cases, and subacromial decompression was performed if indicated by the surgeon. Size, retraction, and type of the rotator cuff tear was recorded. After rotator cuff mobilization and debridement, the torn rotator cuff tendons were repaired with either single or double row technique, again as indicated by the surgeon.

The standardized pain management protocol included a pre-operative interscalene nerve block. Post-operatively, patients were instructed to take an 81mg aspirin daily for thromboembolic prevention and acetaminophen. Patients were also routinely prescribed oxycodone for five post-operative days unless they had a listed allergy or intolerance. The post-operative rehabilitation protocol consisted of 4 weeks of immobilization, home passive range of motion (ROM) for weeks 4 to 6, active-assisted ROM for weeks 6 to 12, and strengthening after 12 weeks. Rehabilitation for massive rotator cuff tears included 6 weeks of immobilization, followed by progressive passive and then active//active-assisted motion from 6 to 12 weeks, and then strengthening at 12 weeks.

Synovitis Score

Intra-articular glenohumeral synovitis score was assessed by the treating surgeon based on the arthroscopic synovitis scoring system proposed and validated by Davis, et al [12]. The score involved 4 visual categories with a total score between 0 and 6 with increasing severity corresponding to increased score as shown [Table 1]. Examples of low and high synovitis scores are shown in [Figure 1].

Outcome Measures

Baseline visual analog scale (VAS) pain score, ASES score, forward elevation, and external rotation were collected for each patient pre-operatively. Intra-operative data included synovitis score, tear type (full-thickness vs partial thickness), tear width, number of tendons torn, and repair technique (single vs double row) [Table 1]. All intra-operative data was determined by the operating surgeon. All patients were discharged home on the same day of surgery and recorded their daily pain levels. Patients were also contacted by telephone at certain post-operative times to determine VAS scores and date of narcotic cessation: 5 days, 10 days, 2 weeks, 6 weeks, and 3 months.

Statistical Analysis

Strength of association between synovitis score and each ordinal variable was assessed using a Spearman rank-order correlation coefficient (Rs). The value for Rs of 0 to 0.3 was considered low correlation, 0.3 to 0.5 as moderate correlation, and greater than 0.5 as strong

Table 1. Grading rubric for intraoperative assessment of intra-articular glenohumeral synovitis as proposed by Davis, et al(9)

Criteria	Grades	Points
Capsular Coloration	Pale	0
	Pink	1
	Red	2
Villous Projections	None	0
	Few	1
	Extensive	2
Capillaries in Capsule	Scattered	0
	Hypertrophied	1
Axillary Recess	Normal	0
	Contracted	1
Total		/6

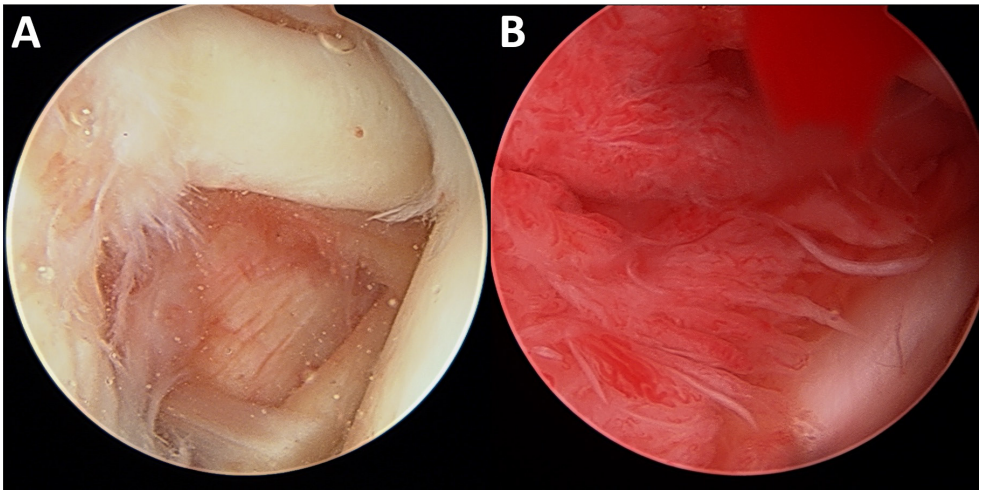

Figure 1. Intra-operative arthroscopic images during diagnostic arthroscopy demonstrating (A) mild synovitis, score 0 and (B) severe synovitis, score 6.

correlation. Differences between the means of continuous variables were calculated using a Mann-Whitney U test. Differences in categorical data were calculated using a Chi-Square test or Fisher's exact test. Lastly, a power analysis was performed for all parameters.

Results

Fifty patients with high grade partial thickness or full thickness rotator cuff tears were enrolled between September 2018 and June 2019. All 50 patients had intra-operative assessment of synovitis score and VAS pain scores for post-operative days one through ten. Thirty-four patients provided VAS pain scores at 6 weeks and 35 at three months post-operatively. The cohort of patients included 15 females and 35 males with an average age of 58.6 years.

The average pre-operative ASES score was 41.1 and average VAS pain score was 6.0. Average pre-operative passive forward elevation was 160 degrees, and average pre-operative passive external rotation was 63 degrees. The average synovitis score observed during diagnostic arthroscopy was 2.4, with 28 patients falling into mild synovitis with a score of 2 or less and 22 patients with moderate or severe synovitis with scores of 3 and higher [Table 2]. Repair techniques included 11 single row constructs, 38 double row constructs, and 1 double row with an acellular dermal allograft augment.

No significant correlation was found between synovitis score and pre-operative VAS pain score, although power analysis did reveal the sample was under powered (power of 0.18) [Table 3]. A weak negative correlation was found between synovitis score and pre-operative ASES score, forward elevation, and external rotation, but this did not reach our threshold of a significant relationship (Rs = 0.3). Synovitis score did not have any significant correlation with post-operative VAS pain score at any of recorded time points (post-operative days 1-14, 6 weeks, 3 months). Similarly, no relationship between synovitis score and time to narcotic cessation was discovered.

A significant correlation was found between patient's pre-operative VAS pain score and post-operative VAS pain score at each of the first 7 post-operative days [Appendix 1]. Additionally, pre-operative ASES score had a moderately negative correlation with VAS scores on post-operative days 5 through 7 [Appendix 2].

Table 2. Characteristics of the rotator cuff tear, synovitis, and repair technique

Characteristic	Category	Number
Laterality	Right	31
	Left	19
Thickness	Full	43
	Partial	7
Number of Tendons	1	25
	2	17
	3	8
	4	0
Tear Width	≤ 2 cm	27
	2 – 4 cm	19
	> 4 cm	4
Repair Technique	Single row	11
	Double row	38
	Allograft	1
Synovitis Score	0	7
	1	8
	2	13
	3	9
	4	8
	5	4
	6	1
	Average	*2.4*

Table 3. Summary of pre-operative scores; range of motion; post-operative VAS Pain scores at day 1, day 5, day 10, 6 weeks, and 3 months; and time until narcotic cessation

Score	Time	Number/Average	R_s*	*P-value*
VAS	1 day	5.28	-0.173	0.231
	5 days	5.90	0.226	0.118
	10 days	4.37	0.216	0.137
	2 weeks	3.70	0.185	0.203
	6 weeks	2.35	-0.017	0.927
	3 months	2.5	0.148	0.403
Time at narcotic cessation	0 - 3 days	12/49	-0.155	0.288
	4 - 7 days	18/49		
	8 – 14 days	9/49		
	> 14 days	10/49		
Pre-op VAS		6.03	0.081	0.623
Pre-op ASES		41.1	-0.225	0.187
Pre-op FE		159.5°	-0.224	0.171
Pre-op ER		62.6°	-0.249	0.126
Tendons Torn		1.66	0.168	0.244
Tear Width		2.42 cm	0.025	0.865

VAS=Visual analog Scale; ASES=American Shoulder and Elbow Surgeons score; FE=Forward elevation; ER=External rotation

*Correlation calculated via Spearman Correlation value (Rs). Rs greater than 0.3 or less than -0.3 was considered a significant relationship.

One patient underwent a concomitant capsular release at the time of arthroscopic rotator cuff repair. This patient had a synovitis score of 4 and post-operative VAS pain score of 10 from post-operative day 1 through 6 weeks post-op, and a VAS score of 5 at 3 months post-operative. Thirty-one patients underwent 40 concomitant procedures during arthroscopic rotator cuff repair surgery including biceps tenodesis or tenotomy, subacromial decompression/acromioplasty, distal clavicle resection, capsular release, and loose body removal [1, 2, 15, 21]. No significant differences were found between patients with concomitant procedures and synovitis score or post-operative pain levels at any time point.

Twenty-two of the 50 patients were under workers compensation claims. In comparing workers compensation to non-workers compensation patients, no significant differences existed in VAS pain score (6.5 vs 5.7, *P= 0.407*), ASES score (36.3 vs 44.6, *P= 0.276*), forward elevation (158 degrees vs 161 degrees, *P= 0.601*), and external rotation (63.5 degrees vs 61.8 degrees, *P=0.815*) pre-operatively. Additionally, the distribution of synovitis scores demonstrated no difference between the two groups (*P= 0.634*). A trend towards higher post-operative VAS pain scores in the workers compensation patients existed after post-operative day 5, but this did not reach significance until 3 months post-operative (3.4 vs. 1.6, *P= 0.038*).

Seven patients had partial-thickness rotator cuff tears and 43 had full-thickness tears. There were no differences in pre-operative VAS Pain (5.3 vs. 6.1, *P= 0.717*), ASES (43.4 vs. 40.9, *P= 0.888*), forward elevation (166 degrees vs. 159 degrees, *P=0.177*), or external rotation (66.0 degrees vs. 62.1 degrees, *P= 0.414*) between partial and full-thickness tears respectively. Full thickness tears were associated with a significantly higher synovitis score (*P=0.028*); however no statistical differences were noted in post-operative VAS pain scores at any time point.

Discussion

The primary purpose of this study was to determine if post-operative pain in rotator cuff repair is related to severity of glenohumeral synovitis; this study showed no correlation between these two variables. Additionally, synovitis did not have any strong correlation with pre-operative pain or functional scores. Post-operative pain after rotator cuff repair was correlated with pre-operative pain level, pre-operative ASES score, and workers compensation status in this study.

From a practical standpoint, the findings in this study essentially show that macroscopic synovitis severity does not play a significant role in the reported severity of pain in patients with rotator cuff tears. Few studies exist that draw any correlations between shoulder pain and synovitis. However, a significant correlation between synovitis severity and joint pain has been discovered in the knee and temporomandibular joints in chronic disease states such as rheumatoid arthritis osteoarthritis.[10,11,13] Synovitis can be described in both a macroscopic and

microscopic fashion. The precedent for macroscopic synovitis scoring in this paper is based on a validated scoring system developed by Davis et al.[12] As the current study did not include microscopic synovitis evaluation, there may be factors that contribute to synovitis and pain on a microscopic level. Stahnke, et al. found associations between more severe glenohumeral synovitis and intra-articular pathology (large rotator cuff tears, cartilage damage) on a microscopic histopathologic basis.[14] Similarly, several studies have also correlated increased size of rotator cuff tear with increased histopathologic synovitis and higher concentration of inflammatory mediators.[15,16]

Rotator cuff repair is traditionally viewed as one of the more painful shoulder procedures, although the true source of pain is unclear. Maher, et al. found that supraspinatus involvement and concomitant labral pathology were associated with more baseline pain in rotator cuff tears, and tear size, tear retraction, and biceps pathology were not associated with increased pain.[17] Studies by Ravindra, et al. and Jain, et al. suggested that emotional well-being, fear avoidance, and alcohol intake had much stronger correlations with pain in rotator cuff repairs than any structural factors.[7,18] The findings in our study echo the findings in these articles in that synovitis severity along with tear size, tear characteristics, and repair technique did not have any effect on post-operative pain scores. The only factors that did correlate with worse post-operative pain were higher pre-operative pain level, lower pre-operative function, and workers compensation status. This again supports the conclusion that psychosocial factors and individual perception of pain are larger factors in post-operative pain after rotator cuff repair than any structural features. The concept that pain may be more of an individualized psychological state than a measurable somatic or structural issue is difficult to demonstrate. Williams, et al. introduced the Ouch! Test as a potential measure of a patient's tolerance of pain prior to rotator cuff repair by recording patient-reported pain during a painful stimulus.[19] The authors found a significant correlation between the Ouch! Test pain level and post-operative pain levels.

Based on the findings in the present study, the authors suggest that the presence of severe synovitis should not alter a surgeon's operative plan during rotator cuff repair. While it is unclear what the true cause of severe versus mild synovitis is, no studies have ever linked synovitis to any sort of post-operative measure. Patients with worse pre-operative function and pain levels should be counseled that they may have more difficulty with post-operative pain controlled for at least the first week. Additionally, providers treating workers compensation patients should be aware that pain may be more difficult to manage post-operatively.

Limitations

This study has several limitations. The cohort size of 50 patients is relatively small, and a larger cohort may have led to statistically significant findings particularly between synovitis grade and pre-operative motion. However, the clinical implications of any differences would likely be minimal. Second, the synovitis score in this study utilizes only macroscopic factors and may be missing certain histopathologic features and inflammatory markers present in the synovitis. Third, this cohort had a large component of workers compensation patients [22 of 50]. Workers compensation status is a known risk factor for poor outcomes and may have been a confounding variable in the study.[20] Finally, no distinction was made in the chronicity of the rotator cuff tears in the study. Synovitis is a clear factor in chronic inflammatory diseases, and evaluating differences in acute and chronic rotator cuff tears may have shown differences in synovitis levels.[21]

Glenohumeral synovitis as evaluated by intra-articular arthroscopy does not appear to have any correlation with pre-operative pain or pre-operative function. Additionally, synovitis severity does not have any relationship with post-operative pain scores after rotator cuff repair. Higher pre-operative pain levels, worse pre-operative ASES scores, and workers compensation status do appear to influence post-operative pain levels in arthroscopic rotator cuff repair.

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Declaration of informed consent: There is no information (names, initials, hospital identification numbers or photographs) in the submitted manuscript that can be used to identify patients.

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Appendix 1. Correlation between pre-operative VAS pain score and post-operative VAS pain scores at each time point

Post-operative time	R_s*
Day 1	0.408
Day 2	0.398
Day 3	0.253
Day 4	0.349
Day 5	0.374
Day 6	0.423
Day 7	0.415
Day 8	0.278
Day 9	0.243
Day 10	0.278
Day 11	0.145
Day 12	0.173
Day 13	0.151
Week 2	0.236
Week 6	0.155
3 Month	0.110

*Correlation calculated via Spearman Correlation value (Rs). Rs greater than 0.3 or less than -0.3 was considered a significant relationship.

Appendix 2. Correlation between pre-operative ASES score and post-operative VAS pain scores at each time point

Post-operative Time	R_s
Day 1	-0.289
Day 2	-0.238
Day 3	-0.202
Day 4	-0.285
Day 5	-0.352
Day 6	-0.330
Day 7	-0.322
Day 8	-0.201
Day 9	-0.152
Day 10	-0.145
Day 11	-0.041
Day 12	-0.103
Day 13	-0.116
Week 2	-0.196
Week 6	-0.072
3 Month	-0.004

*Correlation calculated via Spearman Correlation value (Rs). Rs greater than 0.3 or less than -0.3 was considered a significant relationship.