Clin Orthop Relat Res (2015) 473:3501–3510
DOI 10.1007/s11999-015-4513-5

Clinical Orthopaedics and Related Research®
A Publication of The Association of Bone and Joint Surgeons®

SYMPOSIUM: PSYCHOSOCIAL ASPECTS OF MUSCULOSKELETAL ILLNESS

One-year Patient-reported Outcomes After Arthroscopic Rotator Cuff Repair Do Not Correlate With Mild to Moderate Psychological Distress

Michael Q. Potter MD, James D. Wylie MD, Erin K. Granger MPH, Patrick E. Greis MD, Robert T. Burks MD, Robert Z. Tashjian MD

Published online: 21 August 2015

Abstract

Background Patients with shoulder and rotator cuff pathology who exhibit greater levels of psychological distress report inferior preoperative self-assessments of pain and function. In several other areas of orthopaedics, higher levels of distress correlate with a higher likelihood of persistent pain and disability after recovery from surgery. To our knowledge, the relationship between psychological distress and outcomes after arthroscopic rotator cuff repair has not been similarly investigated.

Questions/purposes (1) Are higher levels of preoperative psychological distress associated with differences in outcome scores (visual analog scale [VAS] for pain, Simple Shoulder Test, and American Shoulder and Elbow Surgeons score) 1 year after arthroscopic rotator cuff repair? (2) Are higher levels of preoperative psychological distress associated with less improvement in outcome scores (VAS for pain, Simple Shoulder Test, and American Shoulder and Elbow Surgeons score) 1 year after arthroscopic rotator cuff repair? (3) Does the prevalence of psychological distress in a population with full-thickness rotator cuff tears change when assessed preoperatively and 1 year after arthroscopic rotator cuff repair?

Methods Eighty-five patients with full-thickness rotator cuff tears were prospectively enrolled; 70 patients (82%) were assessed at 1-year followup. During the study period, the three participating surgeons performed 269 rotator cuff repairs; in large part, the low overall rate of enrollment was related to two surgeons enrolling only two patients total in the initial 14 months of the study. Psychological distress was quantified using the Distress Risk Assessment Method questionnaire, and patients completed self-assessments including the VAS for pain, the Simple Shoulder Test, and the American Shoulder and Elbow Surgeons score preoperatively and 1 year after arthroscopic rotator cuff repair. Fifty of 85 patients (59%) had normal levels of distress, 26 of 85 (31%) had moderate levels of distress, and nine of 85 (11%) had severe levels of distress. Statistical models were used to assess the effect of psychological distress on patient self-assessment of shoulder pain and function at 1 year after surgery.

Results With the numbers available, distressed patients were not different from nondistressed patients in terms of

One of the authors certifies that he (PEG), or a member of his immediate family, has or may receive payments or benefits, during the study period, an amount of less than USD 10,000 of research support funding from DePuy Mitek (Raynham, MA, USA). One of the authors certifies that he (RTB), or a member of his immediate family, has or may receive payments or benefits, during the study period, an amount of USD 10,000 to USD 100,000 of research support funding from DePuy Mitek. One of the authors certifies that he (RZT), or a member of his immediate family, has or may receive payments or benefits, during the study period, an amount of USD 100,000 to USD 1,000,000 of research support funding from the Department of Veterans Affairs.
All ICMJE Conflict of Interest Forms for authors and *Clinical Orthopaedics and Related Research*® editors and board members are on file with the publication and can be viewed on request.
Each author certifies that his or her institution approved the human protocol for this investigation, and that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.
This work was performed at the University of Utah, Salt Lake City, UT, USA.

M. Q. Potter
Department of Orthopaedics, Stanford University, Stanford, CA, USA

J. D. Wylie, E. K. Granger, P. E. Greis, R. T. Burks, R. Z. Tashjian (✉)
Department of Orthopaedics, University of Utah, 590 Wakara Way, Salt Lake City, UT 84108, USA
e-mail: robert.tashjian@hsc.utah.edu

postoperative VAS for pain (1.9 [95% confidence interval {CI}, 1.0–2.8] versus 1.0 [95% CI, 0.5–1.4], p = 0.10), Simple Shoulder Test (9 [95% CI, 8.1–10.4] versus 11 [95% CI, 10.0–11.0], p = 0.06), or American Shoulder and Elbow Surgeons scores (80 [95% CI, 72–88] versus 88 [95% CI, 84–92], p = 0.08) 1 year after arthroscopic rotator cuff repair. With the numbers available, distressed patients also were not different from nondistressed patients in terms of the amount of improvement in scores between preoperative assessment and 1-year followup on the VAS for pain (3 [95% CI, 2.2–4.1] versus 2 [95% CI, 1.4–2.9], p = 0.10), Simple Shoulder Test (5.2 [95% CI, 3.7–6.6] versus 5.0 [95% CI, 4.2–5.8], p = 0.86), or American Shoulder and Elbow Surgeons scale (38 [95% CI, 29–47] versus 30 [95% CI, 25–36], p = 0.16). The prevalence of psychological distress in our patient population was lower at 1 year after surgery 14 of 70 (20%) versus 35 of 85 (41%) preoperatively (odds ratio, 0.36; 95% CI, 0.17–0.74; p = 0.005).

Conclusions Mild to moderate levels of distress did not diminish patient-reported outcomes to a clinically important degree in this small series of patients with rotator cuff tears. This contrasts with reports from other areas of orthopaedic surgery and may be related to a more self-limited course of symptoms in patients with rotator cuff disease or possibly to a beneficial effect of rotator cuff repair on sleep quality or other unrecognized determinants of psychosocial status.

Level of Evidence Level I, prognostic study.

Introduction

In a variety of musculoskeletal conditions, psychosocial factors are important in mediating between objective pathophysiology and patients' subjective experience of pain or disability [33]. Higher levels of psychological distress correlate with greater pain and decreased function in patients with low back pain [3, 10], surgical spine conditions [1, 4, 31, 32], hip and knee arthritis [11, 14, 16], femoroacetabular impingement [22, 24], shoulder and rotator cuff pathology [6, 23, 27, 28], and orthopaedic hand and elbow conditions [17, 25, 33, 34].

By contrast, the relationships between psychological distress and patient-reported outcomes after arthroscopic rotator cuff repair remain largely uncharacterized. Specifically, the degree to which the presence of psychological distress might be associated with differences in outcome scores and whether the prevalence of psychological distress in this patient population decreases after recovery from a procedure that seeks to decrease pain are, to our knowledge, unknown. Patients who undergo shoulder arthroscopy for the treatment of full-thickness rotator cuff tears commonly are assessed preoperatively with general and shoulder-specific measures of pain and function, including the visual analog scale (VAS) for pain, the Simple Shoulder Test [13], and the American Shoulder and Elbow Surgeons score [20]. Minimal clinically important differences, defined as a difference reflecting a change in a patient's condition large enough for that patient to perceive, for the VAS [30], Simple Shoulder Test [29], and American Shoulder and Elbow Surgeons score [29] have been reported. Baseline preoperative scores on the Simple Shoulder Test have been shown to correlate with psychosocial variables in patients with shoulder pain [28] and full-thickness rotator cuff tears [23]. Similarly, preoperative scores on the VAS for pain and the American Shoulder and Elbow Surgeons score correlate with scores on the Hospital Anxiety and Depression Scale [6] and the Distress Risk Assessment Method [23] in patients with rotator cuff disease. In addition to influencing preoperative self-assessment scores, higher levels of distress also correlate with inferior patient-reported outcomes after surgical intervention in several areas of orthopaedics [4, 16, 22, 31, 32, 34]. However, as noted earlier, whether a similar correlation between greater psychological distress and inferior postoperative outcome scores exists after arthroscopic rotator cuff repair has not, to our knowledge, been reported.

We therefore asked: (1) Are higher levels of preoperative psychological distress associated with differences in outcome scores (VAS for pain, Simple Shoulder Test, and American Shoulder and Elbow Surgeons score) 1 year after arthroscopic rotator cuff repair? (2) Are higher levels of preoperative psychological distress associated with less improvement in outcome scores (VAS for pain, Simple Shoulder Test, and American Shoulder and Elbow Surgeons score) 1 year after arthroscopic rotator cuff repair? (3) Does the prevalence of psychological distress in a population with full-thickness rotator cuff tears change when assessed preoperatively and 1 year after arthroscopic rotator cuff repair?

Patients and Methods

This was a prospective cohort study of patients undergoing shoulder arthroscopy for pain secondary to full-thickness rotator cuff tears. Approval was obtained from our institutional review board before beginning patient enrollment. Patients underwent arthroscopic rotator cuff repair with one of three surgeons (PEG, RTB, RZT) between October 2011 and December 2013. Data collection at scheduled followup 1 year postoperatively was completed between October 2012 and December 2014.

Inclusion criteria identified patients who were 18 years old or older and scheduled a shoulder arthroscopy for a primary symptom of shoulder pain secondary to a reparable full-thickness rotator cuff tear. Indications for surgery included patients with shoulder pain and weakness who had an MRI consistent with a reparable full-thickness rotator cuff tear. The treating surgeons were blinded throughout to the results of the Distress Risk Assessment Method questionnaires, and depression and anxiety scores therefore were not explicitly considered in the decision to offer surgery. Exclusion criterion included an inability to complete all questionnaires preoperatively (Distress Risk Assessment Method, VAS, Simple Shoulder Test, and American Shoulder and Elbow Surgeons score). Age at the time of surgery, sex, body mass index (BMI), smoking status, American Society of Anesthesiologists classification, tear size on sagittal MRI, and tear retraction on coronal MRI were recorded preoperatively for all enrolled patients.

Between October 2011 and December 2013, 89 patients were approached for inclusion and consented to participate in the study. Four of 89 patients (4%) did not complete all the questionnaires, leaving 85 of 89 patients (96%) who were included in the preoperative analysis [23]. During the study time period, the three participating surgeons performed 269 arthroscopic rotator cuff repairs as determined by a search of billing Current Procedural Terminology codes. There are several reasons for nonenrollment of patients. First, one surgeon (RZT) began enrolling patients in earnest in October 2011, whereas two others (PEG, RTB) enrolled only two patients total before December 2012. A substantial portion of the 269 possible study patients was lost during this 14-month period, but given that patients were almost universally not enrolled rather than being enrolled selectively by these two surgeons for this period, we do not believe this represents a major source of selection bias. Ultimately, 70 of the 85 patients (82%) included in the preoperative analysis [23] returned for scheduled followup 1 year after arthroscopic rotator cuff repair and again completed the same questionnaires. There were no statistically significant differences in preoperative Distress Risk Assessment Method group, age, sex, BMI, smoking status, American Society of Anesthesiologists classification, tear size, or tear retraction between patients who did and did not return for 1-year followup.

Patients filled out paper questionnaires before surgery; patients who returned for scheduled followup completed the same questionnaires in the office 1 year after surgery. Patients who did not return for followup were also contacted by phone, mail, or email and asked to complete questionnaires to improve the followup rate. These questionnaires were collected, scored, and entered into a database by a study coordinator (EKG) who was not involved in patient care. Patients were classified into "nondistressed" and "distressed" groups based on their responses to the Distress Risk Assessment Method questionnaire [18], which is described in greater detail in the section that follows subsequently. Patients categorized as "at risk", "distressed-depressive", or "distressed-somatic" were considered to be "distressed" and were treated as a single group that was compared with "nondistressed" patients in the statistical analysis. Patients who exceeded a score of 17 on the modified Zung (mZung) or a score of 12 on the Modified Somatic Perception Questionnaire (MSPQ) were included in the "distressed" group. To exceed a score of 17 on the mZung, patients would have to report experiencing daily or near daily symptoms like, "I feel downhearted or sad", "I feel nobody cares", or "I feel tired for no reason" in at least six of 20 categories. To exceed a score of 12 on the MSPQ, patients would have to report "extreme" levels of somatic symptoms such as "feeling faint", "sweating all over", or "muscles twitching" in at least five of 13 categories within the past week. The treating physicians and all others involved in patient care were blinded to enrolled patients' Distress Risk Assessment Method classifications during treatment and clinical followup. Authors who were not involved in the clinical care of enrolled patients (MQP, JDW, EKG) performed data entry and statistical analyses.

All patients underwent shoulder arthroscopy by one of three surgeons (PEG, RTB, RZT). Arthroscopic rotator cuff repair was performed in the beachchair position under general anesthesia in all patients. Additional procedures performed at the surgeon's discretion included subacromial decompression, biceps tenotomy or tenodesis, glenohumeral débridement, and/or distal clavicle resection. Nondistressed and distressed patients had similar proportions of single- versus double-row repair, mean number of suture anchors used, and frequency of additional procedures performed (Table 1).

Description of Followup Routine

The Distress Risk Assessment Method is a 45-item patient questionnaire that is frequently used to quantify psychological distress in patients presenting for orthopaedic care [3, 7, 8, 21, 31]. It includes the modified Zung Depression Scale and the MSPQ, and the scores on these two questionnaires are combined to stratify patients into normal, at-risk, and distressed groups, which represent increasing levels of depressive and somatic symptomatology [18]. The Distress Risk Assessment Method has been validated and shown to correlate with worsening psychological distress as measured by the more comprehensive Minnesota Multiphasic Personality Inventory [9, 18]. As such, it represents a parsimonious method to stratify patients into groups of lower or higher psychological distress.

Table 1. Demographic and surgical characteristics by Distress Risk Assessment Method group

Demographic characteristic	Normal (n = 44)	Distressed (n = 26)	p value
Age (years)	62 ± 2 (95% CI, 59–65)	60 ± 2 (95% CI, 57–63)	0.33
Sex	10 female/34 male	8 female/18 male	0.46
Body mass index (kg/m^2)	30 ± 1 (95% CI, 29–32)	28 ± 1 (95% CI, 26–30)	0.06
Smoking status-active	4/44 (9%)	3/26 (12%)	0.74
American Society of Anesthesiologists classification	Class I 10 (23%)	Class I 4 (15%)	0.70
	Class II 23 (53%)	Class II 16 (62%)	
	Class III 11 (25%)	Class III 6 (23%)	
Tear size (cm)	2.3 ± 0.2 (95% CI, 2.0–2.7)	2.3 ± 0.2 (95% CI, 1.9–2.7)	0.82
Tear retraction (cm)	2.1 ± 0.2 (95% CI, 1.7–2.5)	2.2 ± 0.2 (95% CI, 1.7–2.6)	0.88
Double-row cuff repair	23/44 (52%)	12/26 (46%)	0.62
Number of suture anchors	3 ± 0.2 (95% CI, 3–4)	3 ± 0.3 (95% CI, 3–4)	0.46
Subacromial decompression	23/44 (52%)	10/26 (38%)	0.26
Biceps tenotomy or tenodesis	Tenotomy 12 (27%)	Tenotomy 9 (35%)	0.68
	Tenodesis 14 (32%)	Tenodesis 9 (35%)	
Distal clavicle resection	2/44 (4%)	1/26 (3%)	0.89
Other procedure	7/44 (14%)	7/26 (29%)	0.27

Baseline demographic and surgical characteristics are compared at 1-year followup for patients with normal Distress Risk Assessment Method scores versus those falling into one of three distressed categories. Age, body mass index, tear size, tear retraction, and number of suture anchors are reported as mean ± standard error of mean with 95% confidence intervals (CIs) below.

The Simple Shoulder Test and American Shoulder and Elbow Surgeons score are commonly used outcomes measures in shoulder surgery. The Simple Shoulder Test contains 12 yes/no questions that assess a patient's shoulder pain, function, and ability to perform activities of daily living. It is scored on a scale of 0 to 12 with higher scores correlating with decreased pain and increased function [13]. The minimal clinically important difference on the Simple Shoulder Test for patients with rotator cuff disease is 2 points [29]. The American Shoulder and Elbow Surgeons score is a validated, reliable, and responsive measure of shoulder function and pain. Fifty percent of the score is determined by a VAS of pain from zero to 10 with zero representing "no pain at all" and 10 representing "pain as bad as it can be." The remaining 50% of the score is determined by 10 questions that assess sports participation and activities of daily living on a Likert scale. The total score ranges from 0 (debilitating pain, poor function) to 100 (no pain, normal function) [20]. The minimal clinical important difference on the American Shoulder and Elbow Surgeons score is approximately 17 points [29]. The VAS for pain (range, 0–10) is also reported; for patients with rotator cuff disease, the minimal clinically important difference for this scale is 1.4 points [30].

Characterization of the Population

Of the 70 patients who completed 1-year followup, 44 patients (63%) were classified as "nondistressed" and 26 patients (37%) were classified as "distressed" based on their preoperative questionnaires. The average age was 62 years (range, 36–82 years) in the nondistressed group and 60 years (range, 42–75 years) in the distressed group (p = 0.33). The nondistressed group contained 77% male patients versus 69% male patients in the distressed group (p = 0.46). The nondistressed group contained 9% active smokers versus 12% active smokers in the distressed group (p = 0.74). The distribution of American Society of Anesthesiologists scores was not significantly different between groups (p = 0.70). The average BMI was 30 kg/m^2 (range, 22–45 kg/m^2) in the nondistressed group and 28 kg/m^2 (range, 19–45 kg/m^2) in the distressed group (p = 0.06). The mean size of the cuff tear measured on sagittal MRI was 2 cm (95% confidence interval [CI], 2.0–2.7 cm) in the nondistressed group and 2 cm (95% CI, 1.9–2.7 cm) in the distressed group (p = 0.82). The mean retraction of the cuff from its footprint measured on coronal MRI was 2 cm (95% CI, 1.7–2.5) in the nondistressed group and 2 cm (95% CI, 1.7–2.6) in the distressed group (p = 0.88; Table 1).

Statistical Analysis

Independent two-sample t-tests for equal variance and unequal sample size were used to evaluate the difference in means of continuous variables between nondistressed and distressed groups and 95% CIs were calculated. Proportions of binary variables were compared between groups

using the Pearson's chi square test and odds ratios with 95% CIs were calculated. The Mann-Whitney U test was used to compare the distribution of American Society of Anesthesiologists classification between groups. Multiple linear regression analysis using scores on the mZung and MSPQ as continuous variable predictors was performed to evaluate for correlation between these indices and changes in patient-reported outcome scores at 1-year followup.

Probability values < 0.05 were considered significant. Calculations were done using SPSS 22.0 (SPSS Inc, Chicago, IL, USA).

A post hoc power analysis was performed and found that the following differences in mean 1-year followup scores would be needed to have an 80% power to detect them based on our group sizes and SDs: VAS pain 1.5 points, Simple Shoulder Test 1.8 points, and American Shoulder and Elbow Surgeons 12.5 points.

Results

With the numbers available, distressed patients were not different from nondistressed patients in terms of scores on the VAS for pain, the Simple Shoulder Test, and the American Shoulder and Elbow Surgeons score 1 year after arthroscopic rotator cuff repair. The mean postoperative VAS for pain was 1.0 (95% CI, 0.5–1.4) in the nondistressed group versus 1.9 (95% CI, 1.0–2.8) in the distressed group (p = 0.10) when groups were stratified based on preoperative Distress Risk Assessment Method scores (Table 2); it was 1.1 (95% CI, 0.7–1.6) in the nondistressed group versus 2 (95% CI, 0.8–3.4) in the distressed group (p = 0.18) when groups were stratified based on postoperative Distress Risk Assessment Method scores (Table 3). The mean postoperative Simple Shoulder Test was 11 (95% CI, 10.0–11.0) in the nondistressed group versus 9 (95% CI, 8.1–10.4) in the distressed group (p = 0.06) when groups were stratified based on preoperative Distress Risk Assessment Method scores (Table 2); it was 10 (95% CI, 9.9–10.9) in the nondistressed group versus 9 (95% CI, 6.9–10.4) in the distressed group (p = 0.08) when groups were stratified based on postoperative Distress Risk Assessment Method scores (Table 3). The mean postoperative American Shoulder and Elbow Surgeons score was 88 (95% CI, 84–92) in the nondistressed group versus 80 (95% CI, 72–88) in the distressed group (p = 0.08) when groups were stratified based on preoperative Distress Risk Assessment Method scores (Table 2); it was 87 (95% CI, 83–90) in the nondistressed group versus 76 (95% CI, 67–86) in the distressed group (p = 0.13) when groups were stratified based on postoperative Distress Risk Assessment Method scores (Table 3).

With the numbers available, distressed patients also not different from nondistressed patients in terms of the amount of improvement in scores on the VAS for pain, the Simple Shoulder Test, and the American Shoulder and Elbow Surgeons score between preoperative assessment and assessment 1 year after arthroscopic rotator cuff repair. The mean improvement in VAS for pain was 2 (95% CI, 1.4–2.9) in the nondistressed group versus 3 (95% CI, 2.2–4.1) in the distressed group (p = 0.10) when groups were stratified based on preoperative Distress Risk Assessment Method scores (Table 2); it was 2.5 (95% CI, 1.8–3.2) in the nondistressed group versus 2.7 (95% CI, 1.5–4.0) in the distressed group (p = 0.76) when groups were stratified based on postoperative Distress Risk Assessment Method scores (Table 3). The mean improvement in the Simple Shoulder Test was 5.0 (95% CI, 4.2–5.8) in the nondistressed group versus 5.2 (95% CI, 3.7–6.6) in the distressed group (p = 0.86) when groups were stratified based on preoperative Distress Risk Assessment Method scores (Table 2); it was 5.1 (95% CI, 4.4–5.9) in the nondistressed

Table 2. Preoperative, 1-year postoperative, and change in scores by preoperative Distress Risk Assessment Method group

Preoperative Distress Risk Assessment Method group	Normal (n = 44)	Distressed (n = 26)	p value
Visual analog scale for pain (preoperative)	3 ± 0.4 (95% CI, 2–4)	5 ± 0.4 (95% CI, 4–6)	0.001
Simple Shoulder Test (preoperative)	6 ± 0.4 (95% CI, 5–6)	4 ± 1 (95% CI, 3–5)	0.03
American Shoulder and Elbow Surgeons score (preoperative)	58 ± 3 (95% CI, 53–63)	42 ± 3 (95% CI, 35–48)	< 0.001
Visual analog scale for pain (postoperative)	1 ± 0.2 (95% CI, 1–2)	2 ± 1 (95% CI, 1–3)	0.10
Simple Shoulder Test (postoperative)	11 ± 0.2 (95% CI, 10–11)	9 ± 1 (95% CI, 8–10)	0.06
American Shoulder and Elbow Surgeons score (postoperative)	88 ± 2 (95% CI, 84–92)	80 ± 4 (95% CI, 72–88)	0.08
Visual analog scale for pain (change in score)	−2 ± 0.4 (95% CI, −1 to −3)	−3 ± 1 (95% CI, −2 to −4)	0.10
Simple Shoulder Test (change in score)	5 ± 0.4 (95% CI, 4–6)	5 ± 0.7 (95% CI, 4–7)	0.86
American Shoulder and Elbow Surgeons score (change in score)	30 ± 3 (95% CI, 25–36)	38 ± 4 (95% CI, 29–47)	0.16

Preoperative, 1-year postoperative self-assessed pain and function scores (visual analog scale for pain, Simple Shoulder Test, and American Shoulder and Elbow Surgeons score), and the interval change in scores are compared for patients with normal Distress Risk Assessment Method scores versus those in the distressed categories as assessed preoperatively. Scores are reported as mean ± standard error of mean with 95% confidence intervals (CIs).

Table 3. Preoperative, 1-year postoperative, and change in scores by postoperative Distress Risk Assessment Method group

Postoperative Distress Risk Assessment Method group	Normal (n = 56)	Distressed (n = 14)	p value
Visual analog scale for pain (preoperative)	4 ± 0.3 (95% CI, 3–4)	5 ± 0.5 (95% CI, 4–6)	0.03
Simple Shoulder Test (preoperative)	5 ± 0.4 (95% CI, 5–6)	4 ± 0.5 (95% CI, 3–5)	0.04
American Shoulder and Elbow Surgeons score (preoperative)	55 ± 3 (95% CI, 50–60)	38 ± 4 (95% CI, 31–46)	0.001
Visual analog scale for pain (postoperative)	1 ± 0.2 (95% CI, 1–2)	2 ± 1 (95% CI, 1–3)	0.18
Simple Shoulder Test (postoperative)	10 ± 0.2 (95% CI, 10–11)	9 ± 1 (95% CI, 7–10)	0.08
American Shoulder and Elbow Surgeons score (postoperative)	87 ± 2 (95% CI, 83–90)	76 ± 5 (95% CI, 67–86)	0.13
Visual analog scale for pain (change in score)	−3 ± 0.3 (95% CI, −2 to −3)	−3 ± 1 (95% CI, −2 to −4)	0.76
Simple Shoulder Test (change in score)	5 ± 0.4 (95% CI, 4–6)	5 ± 1 (95% CI, 3–7)	0.84
American Shoulder and Elbow Surgeons score (change in score)	32 ± 3 (95% CI, 27–37)	38 ± 6 (95% CI, 27–49)	0.37

Preoperative, 1-year postoperative self-assessed pain and function scores (visual analog scale for pain, Simple Shoulder Test, and American Shoulder and Elbow Surgeons score), and the interval change in scores are compared for patients with normal Distress Risk Assessment Method scores versus those in the distressed categories as assessed at 1-year followup. Scores are reported as mean ± standard error of mean with 95% confidence intervals (CIs).

group versus 4.9 (95% CI, 2.6–7.1) in the distressed group (p = 0.84) when groups were stratified based on postoperative Distress Risk Assessment Method scores (Table 3). The mean improvement in the American Shoulder and Elbow Surgeons score was 30 (95% CI, 25–36) in the nondistressed group versus 38 (95% CI, 29–47) in the distressed group (p = 0.16) when groups were stratified based on preoperative Distress Risk Assessment Method scores (Table 2); it was 32 (95% CI, 27–37) in the nondistressed group versus 38 (95% CI, 27–49) in the distressed group (p = 0.37) when groups were stratified based on postoperative Distress Risk Assessment Method scores (Table 3). In the multivariate analysis, scores on the mZung and MSPQ did not correlate with changes in scores on the VAS for pain, the Simple Shoulder Test, and the American Shoulder and Elbow Surgeons score between preoperative assessment and assessment 1 year after arthroscopic rotator cuff repair (Table 4). When stratified by preoperative Distress Risk Assessment Method group, 26 of 44 (59%) of nondistressed patients and 21 of 26 (81%) of distressed patients (odds ratio [OR], 2.91; 95% CI, 0.92–9.14; p = 0.06) reported a clinically important improvement on the VAS for pain scale; 39 of 44 (89%) of nondistressed patients and 21 of 26 (81%) of distressed patients (OR, 0.54; 95% CI, 0.14–2.07; p = 0.36) reported a clinically important improvement on the Simple Shoulder Test; 38 of 44 (86%) of nondistressed patients and 23 of 26 (88%) of distressed patients (OR, 1.21; 95% CI, 0.28–5.32; p = 0.80) reported a clinically important improvement on the American Shoulder and Elbow Surgeons score; and 39 of 44 (89%) of nondistressed patients and 22 out of 26 (85%) of distressed patients (OR, 0.71; 95% CI, 0.17–2.90; p = 0.36) reached an acceptable postoperative rating on the VAS for pain scale (Table 5). When stratified by postoperative Distress Risk Assessment Method group, 37 of 56 (66%) of nondistressed patients and 10 of 14 (71%) of distressed patients (OR, 1.28; 95% CI, 0.36–4.64; p = 0.70) reported a clinically important improvement on the VAS for pain scale; 49 of 56 (88%) of nondistressed patients and 11 of 14 (79%) of distressed patients (OR, 0.52; 95% CI, 0.12–2.35; p = 0.39) reported a clinically important improvement on the Simple Shoulder Test; 49 of 56 (88%) of nondistressed patients and 11 of 14 (79%) of distressed patients (OR, 0.52; 95% CI, 0.12–2.35; p = 0.39) reported a clinically important improvement on the American Shoulder and Elbow Surgeons score; and 50 of 56 (89%) of nondistressed patients and 10 of 14 (71%) of distressed patients (OR, 0.30; 95% CI, 0.07–1.26; p = 0.09) reached an acceptable postoperative rating on the VAS for pain scale (Table 6).

The prevalence of psychological distress in our patient population was 14 of 70 (20%) 1 year after arthroscopic rotator cuff repair as compared with 35 of 85 (41%) preoperatively (OR, 0.36; 95% CI, 0.17–0.74; p = 0.005). Fourteen of 26 patients (54%) changed categories from distressed to nondistressed versus two of 44 patients (5%) who changed categories from nondistressed to distressed (OR, 24.5; 95% CI, 4.9–123.1; p < 0.001).

Discussion

Psychosocial factors have been shown to influence baseline scores on many commonly used upper extremity orthopaedic outcome scales [6, 17, 23, 25, 26, 28, 33]. Higher levels of psychological distress also correlate with inferior patient-reported outcomes after surgical intervention in other areas of orthopaedics [4, 16, 22, 31, 32, 34]. Here, we found that greater levels of pre- or postoperative psychological distress were not associated with clinically important differences in outcome scores (VAS for pain, Simple Shoulder Test, and American Shoulder and Elbow

Table 4. Multivariate correlations between mZung and Modified Somatic Perceptions Questionnaire scores, patient factors, and change in shoulder pain and function scores at 12 months after rotator cuff repair

Patient factors	Modified Zung Depression Scale	Modified Somatic Perceptions Questionnaire	Age	Female Sex	Body mass index	Smoking status	American Society of Anesthesiologists classification	Tear size	Tear retraction
Change in visual analog scale for pain	β = −0.18 p = 0.084	β = −0.10 p = 0.658	β = −0.14 p = 0.162	β = 2.09 p = 0.244	β = −0.12 p = 0.437	β = 0.81 p = 0.765	β = 3.01 p = 0.048	β = 0.25 p = 0.776	β = −0.66 p = 0.458
Change in Simple Shoulder Test	β = −0.002 p = 0.969	β = −0.03 p = 0.807	β = 0.03 p = 0.560	β = 0.66 p = 0.506	β = −0.04 p = 0.633	β = −0.28 p = 0.844	β = −0.73 p = 0.382	β = 0.68 p = 0.168	β = −0.13 p = 0.798
Change in American Shoulder and Elbow Surgeons score	β = 0.44 p = 0.262	β = −0.40 p = 0.645	β = 0.39 p = 0.315	β = −7.22 p = 0.289	β = 0.31 p = 0.593	β = 1.68 p = 0.872	β = −5.24 p = 0.359	β = −0.24 p = 0.942	β = 1.37 p = 0.68

Regression coefficients (β) and p values are reported for multiple linear regression predictors of change in scores from preoperatively to 12-month followup (visual analog scale for pain, Simple Shoulder Test, and American Shoulder and Elbow Surgeons score) with preoperative Modified Zung (mZung) Depression score, preoperative modified age, sex, body mass index, smoking status, American Society of Anesthesiologists classification, tear size, and tear retraction.

Surgeons score) 1 year after arthroscopic rotator cuff repair; similarly, higher levels of distress were not associated with less interval improvement in outcome scores (VAS for pain, Simple Shoulder Test, and American Shoulder and Elbow Surgeons score) at 1 year. Finally, we found that the prevalence of distress in our study population decreased from 35 out of 85 (41%) preoperatively to 14 out of 70 (20%) 1 year after surgery.

Our study has several limitations. First, the majority of our distressed patients had mild or moderate levels of distress (26 of 85 [31%]), and with our limited cohort of more severely distressed patients (nine of 85 [11%]), we had limited power to generalize our conclusions to patients with extreme levels of depression or anxiety. Second, 15 of 85 patients (18%) from the initial cohort [23] were not available for 1-year followup, potentially introducing bias; however, the rate of loss to followup did not differ between nondistressed and distressed groups (seven from the nondistressed group and eight from the distressed group, p = 0.10) and was within the 20% guidelines suggested for cohort studies [15]. Third, patients were enrolled at the time they scheduled shoulder arthroscopy rather than as they presented to the clinic, excluding patients treated conservatively without surgery and potentially introducing selection bias. Fourth, only 89 of 269 total patients who underwent cuff repairs in the study time period consented to enroll. In most cases, nonenrollment resulted from the physician not discussing the study with the patient or offering enrollment. One surgeon (RZT) began enrolling patients in earnest in October 2011, whereas two others (PEG, RTB) enrolled only two patients total before December 2012. Many of the 269 patients identified by rotator cuff repair Current Procedural Terminology codes were not enrolled during this 14-month period, but given that patients were almost universally not approached about the study by these two surgeons during this period, rather than being selectively enrolled, we do not believe this represents a major source of bias.

It is also worth noting that psychological distress was evaluated only with a self-administered questionnaire rather than a structured psychological interview, which could have led to misclassification of patients. However, structured interviews are impractical in an outpatient orthopaedic clinic, and the Distress Risk Assessment Method questionnaire is a validated [9, 18] and widely used [3, 7, 8, 19, 21–24, 31] instrument to assess psychological distress without overly burdening the patient or clinician. In addition, surgical treatment was not standardized, and patients had additional arthroscopic procedures performed at the discretion of the treating surgeon. However, the tear size, tear retraction, the number of anchors used, the frequency of double-row repairs, and the frequency of additional procedures did not differ substantially between

Table 5. Proportion of patients whose change in scores exceeds minimal clinically important difference thresholds stratified by preoperative Distress Risk Assessment Method group

Outcome scores	Normal (n = 44)	Distressed (n = 26)	p value
Visual analog scale for pain	26/44 (59%)	21/26 (81%)	0.06
Visual analog scale for pain–patient acceptable symptom state	39/44 (89%)	21/26 (81%)	0.36
Simple Shoulder Test	39/44 (89%)	21/26 (81%)	0.36
American Shoulder and Elbow Surgeons score	38/44 (86%)	23/26 (88%)	0.80

Proportion of patients for whom the improvement in outcome score between preoperative assessment and 1-year postoperative assessment exceeds the minimal clinically important difference for each scale is compared for patients with normal preoperative Distress Risk Assessment Method scores versus those falling into one of three distressed categories.

Table 6. Proportion of patients whose change in scores exceeds minimal clinically important difference thresholds stratified by postoperative Distress Risk Assessment Method group

Outcome scores	Normal (n = 56)	Distressed (n = 14)	p value
Visual analog scale for pain	37/56 (66%)	10/14 (71%)	0.70
Visual analog scale for pain–patient acceptable symptom state	50/56 (89%)	10/14 (71%)	0.09
Simple Shoulder Test	49/56 (88%)	11/14 (79%)	0.39
American Shoulder and Elbow Surgeons score	49/56 (88%)	11/14 (79%)	0.39

Proportion of patients for whom the improvement in outcome score between preoperative assessment and 1-year postoperative assessment exceeds the minimal clinically important difference for each scale is compared for patients with normal preoperative Distress Risk Assessment Method scores versus those falling into one of three distressed categories.

groups (Table 1), suggesting that degree of shoulder pathology was similar between groups. Finally, in some comparisons, p values approached significance ($p < 0.05$) and it is possible we were underpowered to detect differences because of insufficient sample size; however, given that none of the differences in means for our comparisons approach the threshold for a minimal clinically important difference on each scale, it seems unlikely we would detect a clinically important difference in a larger cohort, even if the statistics were to reach significance.

We found that differing levels of preoperative and postoperative psychological distress were not associated with clinically important differences in pain or functional outcome scores 1 year after arthroscopic rotator cuff repair. If it is truly the case that distressed patients undergoing arthroscopic rotator cuff achieve similar levels of pain and function compared with nondistressed patients after surgery, this finding contrasts with the majority of previously reported results from other aspects of orthopaedic surgery. We [23] and others [6, 28] have reported that greater distress is associated with lower preoperative self-assessment scores in patients with shoulder pathology, but to our knowledge, this is the first investigation to consider the relationship of distress and outcome scores after arthroscopic rotator cuff repair. Results from populations undergoing total joint arthroplasty [16], surgery for degenerative spine conditions [19, 31, 32], hip arthroscopy [22], or upper extremity surgery [33] have suggested that for distressed patients, higher levels of pain and lower levels of function often persist after surgical intervention. It is possible that our results here differ from most prior studies because of an underlying difference in the nature of rotator cuff disease. A more waxing and waning disease course, rather than an acute trauma or a progressive degenerative condition, may be more susceptible to a self-limited course of symptoms and regression to the mean at followup, regardless of the intervention. Regardless of the mechanism, our results suggest that higher preoperative levels of psychological distress do not preclude patients from reporting similar pain and function to nondistressed patients after rotator cuff repair.

When considering our second question about the degree of improvement in outcome scores, the picture is more complicated. As mentioned before, Lavernia et al. [16] noted lower postoperative outcome scores in psychologically distressed patients undergoing arthroplasty, but scores improved by similar amounts from pre- to postoperatively in both nondistressed and distressed patients. Similarly, Maratos et al. [19] saw lower overall postoperative SF-36 scores in patients undergoing spine surgery but no difference in the amount of improvement between distressed and nondistressed patients. Chaichana et al. [4] reported on 67 patients who underwent discectomy for a single-level herniated lumbar disc. Similar to our study, they found the amount of improvement in pain scores (back pain or leg pain) 12 months after surgery did not vary with the degree of preoperative psychological distress; unlike our study, they saw less improvement among distressed patients on

functional measures such as the Oswestry Disability Index and the SF-36. Trief et al. [31] found that higher preoperative Distress Risk Assessment Method scores conferred a lower likelihood of patients returning to work, reporting improved pain, or reporting improved function 1 year after lumbar spine surgery. Here, our finding that distressed and nondistressed patients report similar improvements in pain and functional scores after arthroscopic rotator cuff repair aligns with much of the literature, which suggests similar amounts of improvement in scores after surgical intervention, even if final outcome scores are not equivalent.

Estimates of the prevalence of psychological distress in the general population range from 5% to 38% with most estimates falling between 15% and 20% [2, 5, 12]. Here, we saw the prevalence of distress in our population decrease from 35 out of 85 (41%) preoperatively to 14 out of 70 (20%) 12 months after surgical intervention, a number more in line with baseline population estimates. Maratos et al. [19] saw a similar effect in a population of 302 patients undergoing elective surgery for degenerative spine disease; 39% of patients reported high levels of anxiety or depression preoperatively compared with 17% 12 months after surgery. The evolution of traits or states of psychological distress in these populations over time is not well understood. The return of distress prevalence values to near population norms may simply represent regression to the mean; alternatively, it is possible that treatment of painful orthopaedic pathology may be associated with improved symptoms of depression and anxiety in some patients.

In conclusion, our cohort of 70 patients reported similar outcome scores 1 year after arthroscopic rotator cuff repair and similar interval improvement on the VAS for pain, the Simple Shoulder Test, and then American Shoulder and Elbow Surgeons scale regardless of their pre- or postoperative levels of psychological distress. Accordingly, we propose that mild to moderate psychological distress should not be an exclusionary factor in offering rotator cuff repair to patients with appropriate history, examination, and imaging findings; profound levels of depression or anxiety may still preclude certain patients from undergoing elective surgical treatment. Perhaps more surprisingly, more than half of patients who were treated in the course of this study showed improvement in their level of psychological distress after surgical intervention. This finding does not prove causality, but it does suggest that the interrelationship of pathology, psychosocial factors, and patient self-assessment is complex. Longitudinal psychosocial assessment of patients with rotator cuff pathology who do not undergo surgical treatment may clarify whether our observed improvement in distress status represents regression to the mean, an effect of surgical intervention, or some combination of the two.

References

1. Block AR, Ohnmeiss DD, Guyer RD, Rashbaum RF, Hochschuler SH. The use of presurgical psychological screening to predict the outcome of spine surgery. *Spine J*. 2001;1:274–282.
2. Caron J, Fleury MJ, Perreault M, Crocker A, Tremlay J, Tousignant M, Kestens Y, Cargo M, Daniel M. Prevalence of psychological distress and mental disorders, and use of mental health services in the epidemiological catchment area of Montreal South-West. *BMC Psychiatry*. 2012;12:183.
3. Carragee EJ, Alamin TF, Miller JL, Carragee JM. Discographic, MRI and psychosocial determinants of low back pain disability and remission: a prospective study in subjects with benign persistent back pain. *Spine J*. 2005;5:24–35.
4. Chaichana KL, Mukherjee D, Adogwa O, Cheng JS, McGirt MJ. Correlation of preoperative depression and somatic perception scales with postoperative disability and quality of life after lumbar discectomy. *J Neurosurg Spine*. 2011;14:261–267.
5. Chittleborough CR, Winefield H, Gill TK, Koster C, Taylor AW. Age differences in association between psychological distress and chronic conditions. *Int J Public Health*. 2011;56:71–80.
6. Cho CH, Seo HJ, Bae KC, Lee KJ, Hwang I, Warner JJP. The impact of depression and anxiety on self-assessed pain, disability and quality of life in patients scheduled for rotator cuff repair. *J Shoulder Elbow Surg*. 2013;22:1160–1166.
7. Daubs MD, Hung M, Adams J, Patel AA, Lawrence B, Woodbury A, Brodke DS. Clinical predictors of psychological distress in patients presenting for evaluation of a spinal disorder. *Spine J*. 2013;13:1982–1987.
8. Daubs MD, Patel AA, Willick SE, Kendall RW, Hansen P, Petron DJ, Brodke DS. Clinical impression versus standardized questionnaire: the spinal surgeon's ability to assess psychological distress. *J Bone Joint Surg Am*. 2010;92:2878–2883.
9. Deyo RA, Walsh NE, Schoenfel LS, Ramamurthy S. Studies of the Modified Somatic Perceptions Questionnaire (MSPQ) in patients with back pain: psychometric and predictive properties. *Spine*. 1989;14:507–510.
10. Gatchel RJ, Polatin PB, Mayer TG. The dominant role of psychosocial risk factors in the development of chronic low back pain disability. *Spine*. 1995;20:2702–2709.
11. Giesinger JM, Kuster MS, Behrend H, Giesinger K. Association of psychological status and patient-reported physical outcome measures in joint arthroplasty: a lack of divergent validity. *Health Qual Life Outcomes*. 2013;11:64.
12. Gispert R, Rajmil L, Schiaffino A, Herdman M. Sociodemographic and health-related correlates of psychiatric distress in a general population. *Soc Psychiatry Psychiatr Epidemiol*. 2003;38:677–683.
13. Godfrey J, Hamman R, Lowenstein R, Briggs K, Kocher M. Reliability, validity and responsiveness of the simple shoulder test: psychometric properties by age and injury type. *J Shoulder Elbow Surg*. 2007;16:260–267.
14. Kim KW, Han JW, Cho HJ, Chang CB, Park JH, Lee JJ, Lee SB, Seong SC, Kim TK. Association between comorbid depression and osteoarthritis symptom severity in patients with knee osteoarthritis. *J Bone Joint Surg Am*. 2011;93:556–563.
15. Kristman V, Manno M, Cote P. Loss to follow-up in cohort studies: how much is too much? *Eur J Epidemiol*. 2004;19:751–760.
16. Lavernia CJ, Alcerro JC, Brooks LG, Rossi MD. Mental health and outcomes in primary total joint arthroplasty. *J Arthroplasty*. 2012;27:1276–1282.
17. Lindenhovius AL, Buijze GA, Kloen P, Ring DC. Correspondence between perceived disability and objective physical impairment after elbow trauma. *J Bone Joint Surg Am*. 2008;90:2090–2097.

18. Main CJ, Wood PL, Hollis S, Spanswick CC, Waddell G. The distress risk assessment method: a simple patient classification to identify distress and evaluate the risk of poor outcome. *Spine*. 1992;17:42–52.
19. Maratos EC, Trivedi R, Richards H, Seeley H, Laing RJ. Psychological distress does not compromise outcome in spine surgery. *Br J Neurosurg*. 2012;26:466–471.
20. Michener LA, McClure PW, Sennett BJ. American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form, patient self-report section: reliability, validity, and responsiveness. *J Shoulder Elbow Surg*. 2002;11:587–594.
21. Patton CM, Hung M, Lawrence BD, Patel AA, Woodbury AM, Brodke DS, Daubs MD. Psychological distress in a Department of Veterans Affairs spine patient population. *Spine J*. 2012;12:798–803.
22. Potter MQ, Sun GS, Fraser JA, Beckmann JT, Swenson JD, Maak TG, Aoki SK. Psychological distress in hip arthroscopy patients affects postoperative pain control. *Arthroscopy*. 2014;30:195–201.
23. Potter MQ, Wylie JD, Greis PE, Burks RT, Tashjian RZ. Psychological distress negatively affects self-assessment of shoulder function in patients with rotator cuff tears. *Clin Orthop Relat Res*. 2014;472:3926–3932.
24. Potter MQ, Wylie JD, Sun GS, Beckmann JT, Aoki SK. Psychological distress negatively impacts self-assessment of hip function in hip arthroscopy patients. *Clin Orthop Relat Res*. 2014;472:1886–1892.
25. Ring D, Kadzielski J, Fabian L, Zurakowski D, Malhotra LR, Jupiter JB. Self-reported upper extremity health status correlates with depression. *J Bone Joint Surg Am*. 2006;88:1983–1988.
26. Ring D, Kadzielski J, Malhotra L, Lee SP, Jupiter JB. Psychological factors associated with idiopathic arm pain. *J Bone Joint Surg Am*. 2005;87:374–380.
27. Roh YH, Lee BK, Noh JH, Oh JH, Gong HS, Baek GH. Effect of depressive symptoms on perceived disability in patients with chronic shoulder pain. *Arch Orthop Trauma Surg*. 2012;132:1251–1257.
28. Roh YH, Noh JH, Oh JH, Baek GH, Gong HS. To what degree do shoulder outcome instruments reflect patients' psychologic distress? *Clin Orthop Relat Res*. 2012;470:3470–3477.
29. Tashjian RZ, Deloach J, Green A, Porucznik CA, Powell AP. Minimally clinically important differences in ASES and Simple Shoulder Test scores after nonoperative treatment of rotator cuff disease. *J Bone Joint Surg Am*. 2010;92:296–303.
30. Tashjian RZ, Deloach J, Porucznik CA, Powell AP. Minimal clinically important differences (MCID) and patient acceptable symptomatic state (PASS) for visual analog scales (VAS) measuring pain in patients treated for rotator cuff disease. *J Shoulder Elbow Surg*. 2009;18:927–932.
31. Trief PM, Grant W, Fredrickson BE. A prospective study of psychological predictors of lumbar surgery outcome. *Spine*. 2000;25:2616–2621.
32. Trief PM, Ploutz-Snyder R, Fredrickson BE. Emotional health predicts pain and function after fusion: a prospective multicenter study. *Spine*. 2006;31:823–830.
33. Vranceanu AM, Barsky A, Ring D. Psychosocial aspects of disabling musculoskeletal pain. *J Bone Joint Surg Am*. 2009;91:2014–2018.
34. Vranceanu AM, Jupiter JB, Mudgal CS, Ring D. Predictors of pain intensity and disability after minor hand surgery. *J Hand Surg Am*. 2010;35:956–960.