



What factors are predictors of emotional health in patients with full-thickness rotator cuff tears?

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Background: The importance of emotional and psychological factors in treatment of patients with rotator cuff disease has been recently emphasized. Our goal was to establish factors most predictive of poor emotional health in patients with full-thickness rotator cuff tears (FTRCTs).

Methods: In 2007, we began to prospectively collect data on patients with symptomatic, atraumatic FTRCTs. All patients completed a questionnaire collecting data on demographics, symptom characteristics, comorbidities, willingness to undergo surgery, and patient-related outcomes (12-Item Short Form Health Survey, American Shoulder and Elbow Surgeons score, Western Ontario Rotator Cuff Index [WORC], Single Assessment Numeric Evaluation score, Shoulder Activity Scale). Physicians recorded physical examination and imaging data. To evaluate the predictors of lower WORC emotion scores, a linear multiple regression model was fit.

Results: Baseline data for 452 patients were used for analysis. In patients with symptomatic FTRCTs, the factors most predictive of worse WORC emotion scores were higher levels of pain (interquartile range odds ratio, -18.9; 95% confidence interval, -20.2 to -11.6; $P < .0001$) and lower Single Assessment Numeric Evaluation scores (rating of percentage normal that patients perceive their shoulder to be; interquartile range odds ratio, 6.2; 95% confidence interval, 2.5-9.95; $P = .0012$). Higher education ($P = .006$) and unemployment status ($P = .0025$) were associated with higher WORC emotion scores.

Conclusions: Education level, employment status, pain levels, and patient perception of percentage of shoulder normalcy were most predictive of emotional health in patients with FTRCTs. Structural data, such as

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tendon tear size, were not. Those with poor emotional health may perceive their shoulder to be worse than others and experience more pain. This may allow us to better optimize patient outcomes with nonoperative and operative treatment of rotator cuff tears.

Level of evidence: Level III; Cross-Sectional Study; Epidemiology Study

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Emotional health has been increasingly recognized to correlate with pain, function, and recovery from orthopedic injuries and operations. This effect has been demonstrated in joint replacement and spine disease as well as in a number of upper extremity disease states.^{1,2,4,9,11,12,18-22,25,29,30} In some cases, behavioral health interventions are even being offered in conjunction with treatment of the orthopedic condition or as a precondition for surgical treatment.^{2,7} In the shoulder, numerous studies have documented the profound impact of biopsychosocial stressors, coping mechanisms, and pain catastrophizing on perception of shoulder pain and disability.^{3,6,7,10,11,17,23,24} Emerging data have indicated that biopsychosocial factors may have a dramatic effect on post-operative recovery and final clinical outcomes after surgical repair of rotator cuff tears.^{13,26} To date, there have been no large studies to document predictors of poor emotional health in patients with full-thickness rotator cuff tears (FTRCTs).

Our multicenter group is a geographically diverse group of shoulder surgeons who have studied the responsiveness of FTRCTs to therapy as well as analyzed factors associated with successful and unsuccessful nonoperative management. Previous data from this group have demonstrated that up to 80% of patients with atraumatic FTRCTs can be treated effectively nonoperatively. In addition, tear chronicity, size of tear, retraction of tendon, and atrophy did not have any effect of responsiveness to physical therapy.^{5,16,28} Greater pain was documented in patients with more comorbidities, lower education level, and nonwhite race, but it was not correlated with size of tear or structural factors.

The goal of this study was to assess which patient-related factors correlated with emotional health, as measured by the Western Ontario Rotator Cuff Index (WORC) emotion score, of patients with atraumatic FTRCTs. The WORC emotion score is the emotional domain of the WORC score, a validated outcome tool for rotator cuff disease.

Materials and methods

In 2007, our team of fellowship-trained orthopedic surgeons and research personnel from across the country began to prospectively collect data on patients with magnetic resonance imaging–documented, symptomatic, atraumatic FTRCTs. All patients completed a questionnaire collecting data on demographics, symptom characteristics, comorbidities, willingness to undergo surgery, and patient-related outcomes (12-Item Short Form Health Survey, American Shoulder and Elbow Surgeons score, WORC score, Single

Assessment Numeric Evaluation [SANE] score, Shoulder Activity Scale). Physicians recorded physical examination and imaging data. Further details on data collection, patient details, and protocols can be found in previous articles using this cohort of patients.^{5,8,16,28}

The WORC score is a validated outcome score that assesses functional outcomes in rotator cuff disease patients with 5 domains: pain and physical symptoms, sports and recreation, work function, social function, and emotional function.¹⁵ This survey was collected on 452 patients in this cohort at the initiation of treatment. The impact of the following patient-specific parameters on WORC emotion score was analyzed: visual analog scale for pain scores, SANE scores, education level, employment status, activity level, age, sex, comorbidities, body mass index, hand dominance, duration of symptoms, number of tendons torn, atrophy of the supraspinatus, and patient expectations.

Statistics

With open-source R statistical software,²⁷ a linear multiple regression model was fit using the previously listed parameters to determine predictors of poor emotional health (WORC emotion). Interquartile range (IQR) odds ratios (ORs) are given for continuous variables.

Results

In patients with symptomatic, atraumatic FTRCTs, worse WORC emotion scores were associated with higher pain levels (IQROR, −18.9; 95% confidence interval [CI], −20.2 to −11.6; $P < .0001$) and lower SANE scores (IQROR, 6.2; 95% CI, 2.5-9.95; $P = .0012$; **Table I**). Better WORC emotion scores were associated with higher levels of education and employment status (**Table II**). More specifically, compared with those with a high-school education or less, a college degree (OR, 9.9; 95% CI, 2.6-17.3; $P = .006$) or a graduate degree (OR, 12.2; 95% CI, 5.1-19.2; $P = .006$) correlated with a better WORC emotion score. Those who were working full-time or were retired had higher WORC emotion scores than

Table I Factors associated with worse WORC emotion score

Factor	IQROR	95% CI	P value
High pain level	−18.9	−20.2 to −11.6	<.0001
Lower SANE score	6.2	2.5-9.95	.012

WORC, Western Ontario Rotator Cuff Index; IQROR, interquartile range odds ratio; CI, confidence interval; SANE, Single Assessment Numeric Evaluation.

WORC emotion scores were significantly lower in patients with higher pain scores as well as lower SANE scores.

Table II Factors associated with better WORC emotion score

Factor	IQROR	95% CI	P value
College degree	9.9	2.6-17.3	.006
Graduate degree	12.2	5.1-19.2	.006
Full-time work/retired	8.5	2.8-14.2	.0025

WORC, Western Ontario Rotator Cuff Index; IQROR, interquartile range odds ratio; CI, confidence interval.

Patients with higher education levels had significantly higher WORC emotion scores. In addition, patients who were employed or retired had higher WORC emotion scores than patients who were unemployed.

those who were unemployed (OR, 8.5; 95% CI, 2.8-14.2; $P = .0025$).

There was no association between the WORC emotion score and the following patient-related factors: activity level, age, sex, comorbidities, body mass index, hand dominance, duration of symptoms, and patient expectations. In addition, there was no correlation between structural parameters (number of tendons torn, atrophy of the supraspinatus) and WORC emotion scores.

Discussion

In recent years, more emphasis has been placed on the role of biopsychosocial factors in pain, function, and outcomes of orthopedic illnesses. Rotator cuff disease provides an excellent disease process for investigation of these factors, given the prevalence of rotator cuff disease, the ongoing controversies in treatment and surgical indications, and the diversity in demographics of patients with rotator cuff disease. Previous authors have catalogued that a number of psychosocial variables have an effect on patients' perceptions of pain and function.^{6,10,11,13,17,23,24} This knowledge as well as extensive research by the WORC group in creating the WORC score led them to create a specific subgroup devoted to emotional parameters, the WORC emotion score. Despite evidence of the importance of the emotional state of the patient with a rotator cuff tear, no study has directly assessed which factors correlate with a better or worse WORC emotion score.

In this study, higher pain levels and lower SANE scores were correlated with lower WORC emotion scores. It is important to point out that this correlation exists despite a lack of any correlation of WORC emotion scores with any structural parameter related to the rotator cuff tear. This is in accordance with previous literature regarding the interaction of pain and emotional health. Badcock et al documented increased anxiety and depression correlating with increased pain scores in patients with chronic shoulder pain. In their study, this was especially true in the setting of disrupted sleep behaviors.³ Another study by Cho et al demonstrated that up to 82% of patients with chronic shoulder pain had sleep disturbance and that rates of depression were significantly elevated in patients with >3 months of shoulder pain.⁶ These data may indicate that increasing shoulder pain (higher pain levels) and

decreased shoulder function (lower SANE scores) lead to increased emotional distress.

Another alternative interpretation of the current series of patients has been supported by several series. This interpretation is based on the fear avoidance model that has been used to describe psychological and emotional responses to pain. In this model, patients who have higher pain-related fear behaviors and pain catastrophizing have a more exaggerated response to painful stimuli, which can begin a vicious circle of pain avoidance and exacerbation. Lentz et al demonstrated that patients with higher pain-related fear scores had worse outcomes with nonoperative treatment of shoulder pain.¹⁷ However, this should still give reason for pause if proceeding with surgery because conversely, these same factors may also lead these patients to report a worse outcome and higher pain levels with operative treatment. Parr et al confirmed these findings, demonstrating that patients with higher pain-related fear scores and pain catastrophizing had higher reported levels of pain, longer duration of pain, and worse recovery after standardized acute muscle injury.²³ This indicates that the relationship of pain scores and SANE scores and emotional distress, as demonstrated in this study, may not be a truly linear relationship but is a "two-way street."

In contrast, higher WORC emotion scores were correlated with higher education status and better employment status. This may indicate that this population of patients has a higher level of emotional stability and that they may be better equipped to cope with health issues such as rotator cuff disease. In addition, this finding is interesting in light of a common perception of patients in the physician's office: that their job is the cause of their shoulder pain. This finding would suggest the opposite, that employment is correlated with improved emotional health in patients with rotator cuff disease. This study did not investigate the effect of different categories of occupation (laborers vs. sedentary workers), but the distinction is compelling nonetheless. A previous study from this group demonstrated that success of nonoperative management was not correlated with shoulder activity level but that type of occupation was associated with activity level.⁵ Ayers et al documented the importance of a number of factors, including employment status, in patients' perceptions of other upper extremity orthopedic syndromes.² This study confirms their finding, with a positive correlation between employment status and higher emotional scores.

This study has several important limitations. The most dramatic limitation is that interpretation of data regarding WORC emotion scores and the identified factors is challenging. As discussed, it is difficult to define the root cause and the outcome when untangling pain/function and emotional health. This limits the breadth and the clinical application of these results. In addition, whereas this large cohort follows nonoperatively treated patients closely, this study does not assess patients' outcomes after surgically treated rotator cuff tears. This limits the ability of the treating physician to use these data to influence surgical decision-making. Finally,

this study used the WORC emotion score as the outcome measure of interest for emotional well-being. There may be other scores that may be more accurate in assessing overall emotional health. A recent systematic review, however, demonstrated that the WORC score provided the best overall assessment of psychometric properties of rotator cuff disease patients.¹⁴

This study is a concise assessment of factors that may influence WORC emotion scores in patients with FTRCTs. Patients with more pain and lower subjective shoulder scores had worse WORC emotion scores. Patients with higher educational status and employed or retired patients had better WORC emotion scores. This may help to predict the responsiveness of patients to nonoperative management. However, this study does not include surgically treated patients. A previously written study assessed patients treated surgically and noted that married, currently working, and nondisabled patients had the best outcomes after surgically treated rotator cuff tear.²⁶ This creates a treatment challenge for the treating physician as the same factors that may lead to more effective nonoperative management will lead to more effective surgical management, and vice versa. Further work to elucidate more specific biopsychosocial parameters and their effects on operatively and nonoperatively treated rotator cuff tears is vital to help guide the physician's indications for surgery and nonoperative treatment protocols. Especially in the current era of value-based care and patient satisfaction and outcome-based reimbursement, it is imperative to outline the impact that emotional health does have on pain and function.

Conclusions

In a multicenter cohort of patients with atraumatic rotator cuff tears being treated nonoperatively, higher pain scores and lower SANE scores correlated with worse WORC emotion scores. Alternatively, higher employment status and education correlated with better WORC emotion scores. These factors may provide the treating physician insight into the emotional well-being of the patient.

Disclaimer

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