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Intersection of catastrophizing, gender, and disease severity in preoperative rotator cuff surgical patients: a cross-sectional study

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Hypothesis and background: Surgical outcomes are dependent on multiple clinical and patient factors. One patient factor is pain catastrophizing, which is associated with poorer outcomes in other surgical populations. Our purpose was to examine relationships between gender, patient-reported disease severity, and catastrophizing in patients in whom rotator cuff surgery is planned. We hypothesized that patients with more catastrophizing would report greater disease severity.

Methods: Patients undergoing surgery for unilateral symptomatic rotator cuff disease aged 35 to 75 years were prospectively evaluated. Data collected included demographic characteristics; imaging characteristics; range of motion; and Western Ontario Rotator Cuff Index (WORC), Pain Catastrophizing Scale (PCS), and Short Form 36 scores.

Results: A total of 156 patients (87 men and 69 women) aged 54 ± 8 years participated. The mean WORC score was similar between men and women (1286 ± 343 vs. 1327 ± 370, $P = .38$). The mean PCS score was 14.7 ± 10.6 for men and 17.9 ± 12.4 for women ($P = .08$). A moderate positive correlation was found between the WORC and PCS scores ($r = 0.59$, $P < .001$). Women had poorer WORC-Lifestyle subscale scores ($P = .012$). Range of motion, Short Form 36 scores, and tear severity were not related to measures of either the WORC or PCS.

Discussion and conclusions: The direct relationship between the WORC and PCS scores is consistent with research in other patient populations. Contrary to other work, no gender-based PCS score differences were observed. Differences on the WORC-Lifestyle subscale suggest that women may experience greater functional impacts to specific lifestyle elements than men. Catastrophizing is related to patient-reported disease severity in preoperative rotator cuff patients. Further research will clarify whether this relationship leads to poorer outcomes following surgery.

Level of evidence: Level III; Cross-Sectional Design; Epidemiologic Study

Keywords: Rotator cuff; shoulder reconstruction; catastrophizing; patient-reported outcomes; preoperative; gender differences

This study received ethical approval from the local Conjoint Health Research Ethics Board (REB15-1229).

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Symptomatic rotator cuff disease is characterized by pain and impaired function of the affected shoulder leading to difficulties with work, sleep, or participation in recreational activities.[1,4] Following rotator cuff surgery, 85% to 95% of patients have reported satisfaction at an average follow-up ranging from 32 months to 7 years.[6,8,11,18,20] Past research on improving outcomes has focused on improving the technical and biological factors associated with rotator cuff healing. Psychological factors such as catastrophizing may also be important in accounting for unsatisfactory outcomes in some patients.[7,15,16] Catastrophizing is a coping style characterized by an exaggerated negative mental outlook that comprises rumination, magnification, and feelings of helplessness when anticipating or experiencing pain.[17] Increased catastrophizing has been associated with a higher likelihood of chronic postoperative pain, lower patient satisfaction following surgery, and poorer patient-reported surgical outcomes for other orthopedic procedures including total knee replacement, anterior cruciate ligament reconstruction, and hand surgery.[2,9,13,18] The impact of catastrophizing coping styles on rotator cuff surgical patients has yet to be examined.

The primary aim of this study was to examine the relationship between pain catastrophizing and patient-reported rotator cuff disease severity in a preoperative patient group. Secondary aims examined the relationships between patient-reported disease severity and imaging studies, range of motion, and patient gender. We hypothesized that patients with more catastrophizing would self-report greater disease severity independent of the clinical features of their rotator cuff disease.

Methods

This was a cross-sectional study of preoperative rotator cuff surgical patients. This study complied with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) statement requirements for the reporting of observational studies.[19]

Participants

Patients with a symptomatic unilateral rotator cuff tear confirmed with ultrasound or magnetic resonance imaging were recruited by 2 high-volume fellowship-trained shoulder surgeons at a single center (February 2016 to June 2017). Eligible participants were patients aged 35 to 75 years electing to undergo surgery for unilateral symptomatic partial- or full-thickness rotator cuff tears. The exclusion criteria were bilateral symptomatic rotator cuff disease, prior rotator cuff–related surgery on the operative shoulder, rotator cuff arthropathy, significant alternate sources of pain such as cervical spine disease or a chronic pain disorder considered by the surgeon to be a significant confounding factor, and inability to complete questionnaires in English. Participants with known psychiatric diagnoses such as anxiety, depression, or related conditions were not excluded, nor were patients with potential gain issues such as workers' compensation claims, litigation, or motor vehicle collisions. Informed consent was obtained from all participants prior to enrollment.

Instruments

Patient demographic characteristics, preoperative shoulder range of motion, imaging characteristics, and patient-reported questionnaires were collected. Demographic data included hand dominance, occupation, medical conditions, medications, and smoking status.

Range of motion of both shoulders was recorded for forward elevation, abduction, external rotation, and internal rotation by experienced physiotherapists following a set protocol executed with the patient in the supine position. The protocol was designed to isolate glenohumeral motion.

Tear severity was derived from pre-consultation imaging (either magnetic resonance imaging or ultrasound) and assigned according to the following scheme: any partial-thickness tear in a single tendon (group 1), any partial-thickness tears in 2 or more tendons (group 2), any full-thickness tear in a single tendon (group 3), any full-thickness tear in a single tendon and any partial-thickness tear in a second tendon (group 4), and full-thickness tears in 2 or more tendons (group 5). This arbitrary ranking system placed an increased value if there were more involved tendons and/or full-thickness tearing.

Three patient-reported outcome measures were administered: the Western Ontario Rotator Cuff Index (WORC), the Pain Catastrophizing Scale (PCS), and the Short Form 36 (SF-36). The WORC score is a validated, self-reported measure of disease severity.[9] It consists of 21 questions in 5 domains, each with a 100-mm visual analog scale (VAS). Higher total scores on the WORC are related to increased pain and functional disability.[9] The PCS is validated to assess catastrophic thinking using a 13-item questionnaire.[17] The scale evaluates 13 items using a 5-point Likert scale from 0 (''not at all'') to 4 (''all the time''). The scores range from 0 (no catastrophizing) to 52 (highest possible catastrophizing). The 3 components of catastrophizing measured on the PCS are rumination, magnification, and helplessness. The SF-36 is a validated measure of general health status, and it has been widely used in rotator cuff and orthopedic outcome research.[12] It contains 2 major domains: the physical component score and the mental component score.

Statistical analysis

Descriptive statistics were performed for demographic characteristics, range of motion, and patient-reported data. We used *t* tests and Pearson product correlations for univariate testing. Statistical analysis was completed using SAS Enterprise Guide (version 7.1; SAS Institute, Cary, NC, USA), and professional statistical advice was sought for multivariate analysis.

Results

A total of 217 patients were screened for eligibility in this study, and 156 (87 men and 69 women) participated. The most common reasons for nonparticipation were the

Table I Participant demographic characteristics

	Participants
Injury mechanism	
Acute or acute on chronic	118
Atraumatic	38
Operative shoulder on same side as dominant arm	105
Activity level	
Active	57
Sedentary	71
Retired	17
Disabled	1
Unemployed	6
Smoking status	
Current	18
Former	25
Never	113
Diabetes mellitus	12
Workers' compensation board claim	6
Motor vehicle collision	15
Litigation	7

Table II Participant disease characteristics

Criteria	Participants
Any partial-thickness tear in single tendon	18
Any partial-thickness tears in ≥2 tendons	5
Any full-thickness tear in single tendon	67
Any full-thickness tear in single tendon and any partial-thickness tear in second tendon	21
Full-thickness tears in ≥2 tendons	40
Biceps pathology	40
Acromioclavicular joint arthritis	14

presence of bilateral disease (n = 32) and unwillingness to complete 12 months of follow-up (n = 19). Demographic data and radiographic disease severity are shown in Tables I and II, respectively. Overall, no relationships between gender and patient-reported outcome measures were noted (Table III). Univariate testing revealed a positive correlation between the WORC and PCS scores (Fig. 1). A statistically significant difference was found between men and women on the WORC-Lifestyle subscale (men, 221.7 ± 93.3; women, 259.0 ± 87.4; $P = .012$) (Fig. 2).

The mean range of motion of the operative arm and the percentage difference from the contralateral uninjured arm are presented in Table IV. There was no relationship between range of motion and the WORC score ($R = –0.26$ to $R = –0.17$, $P = .03$), nor was there a relationship between range of motion and the PCS score ($R = –0.12$ to $R = –0.06$, $P = .41$).

The SF-36 mental component score did not correlate strongly with the PCS score ($R = –0.28$, $P = .001$). The

Table III PROMs by participant gender

	Men, mean ± SD	Women, mean ± SD	*P* value
WORC score	1286 ± 343	1327 ± 370	.38
PCS score	14.7 ± 10.6	17.9 ± 12.4	.08
SF-36			
Physical component score	41.5 ± 6.5	41.4 ± 6.5	.94
Mental component score	50.1 ± 11.5	51.8 ± 11.0	.34

PROMs, patient-reported outcome measures; *SD*, standard deviation; *WORC*, Western Ontario Rotator Cuff Index; *PCS*, Pain Catastrophizing Scale; *SF-36*, Short Form 36.

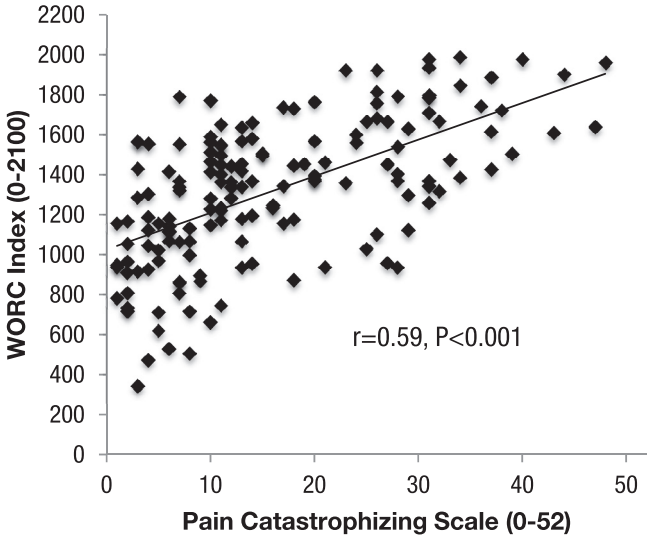

Figure 1 Western Ontario Rotator Cuff Index (*WORC*) vs. Pain Catastrophizing Scale. Higher scores on the Pain Catastrophizing Scale indicate a greater degree of catastrophizing, and higher scores on the WORC indicate a greater degree of functional disability.

WORC-Emotions subscale score correlated more strongly with the PCS score ($R = 0.62$, $P = .001$).

With respect to tear size and severity, there was no difference in WORC scores between the different tear size categories ($P = .21$). Tear severity groups 1 and 2 were combined because of low numbers in group 2 (n = 5). Figure 3 shows the WORC scores by tear category.

Discussion

Rotator cuff disease is a common problem affecting a diverse group of patients, leading to various functional deficits. This cross-sectional study examined 156 patients awaiting rotator cuff repair. The primary finding was that more catastrophizing correlated with a greater patient-reported disease burden. It may be important to consider

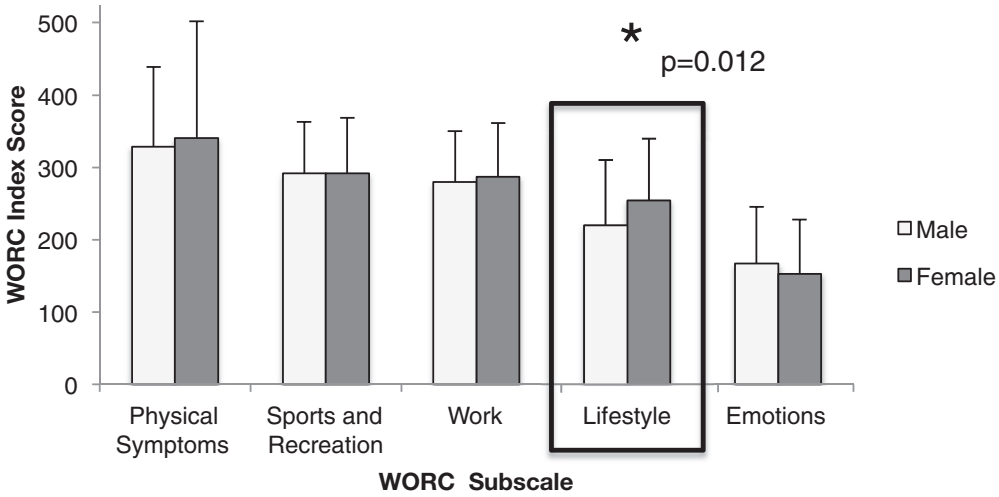

Figure 2 Gender differences in Western Ontario Rotator Cuff Index (*WORC*) subscores. *Bars* indicate standard deviations. *Statistically significant difference.

Table IV Participant ROM and percentage difference from contralateral shoulder

	ROM		% contralateral ROM
	Operative shoulder	Contralateral shoulder	
Forward elevation, mean ± SD, °	91 ± 31	126 ± 20	72
Abduction, mean ± SD, °	63 ± 24	99 ± 23	64
External rotation, mean ± SD, °	41 ± 18	54 ± 17	76
Internal rotation, median	L2	T11	—

ROM, range of motion.

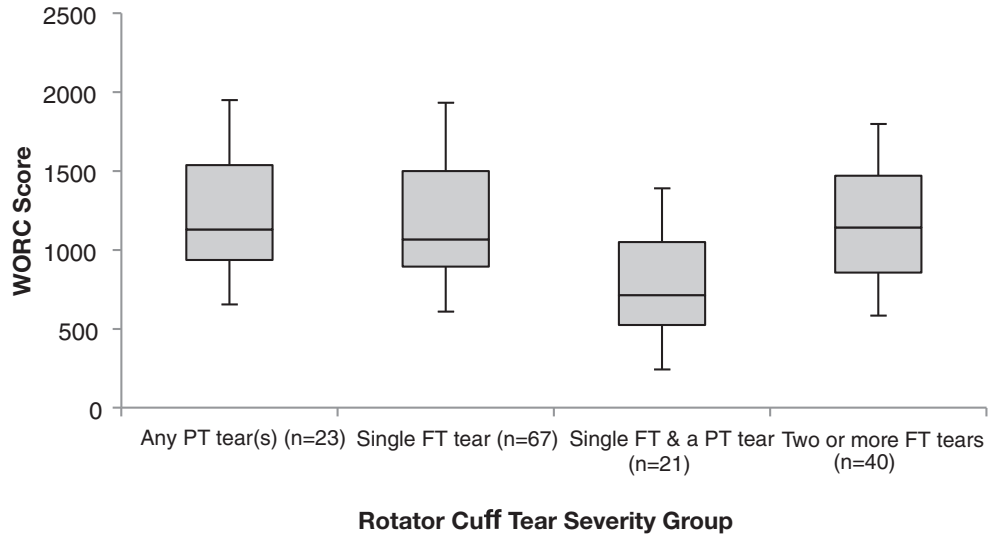

Figure 3 Self-reported disease severity (Western Ontario Rotator Cuff Index [*WORC*]) and rotator cuff tear severity from preoperative imaging. *PT*, partial thickness; *FT*, full thickness.

patient-related factors beyond clinical findings when considering patient-reported outcomes in rotator cuff surgical patients.

Several observations merit scrutiny. First, the moderate positive correlation found between the PCS and WORC scores is consistent with the findings of studies of other orthopedic surgical populations (eg, hand surgery patients and total joint replacement patients) that have investigated associations between catastrophizing and patient-reported disease severity.[2,21] This is an important new finding for

rotator cuff patients as it suggests that those presenting with higher catastrophizing scores report greater disease severity.

Second, no relationship was found between imaging characteristics and the participant scores on the WORC or PCS. Because our preoperative imaging modalities were heterogeneous, rigorous measurement of tear size was not feasible, necessitating an estimate of relative tear severity. Although not ideal with respect to our study, this does represent the ''real world'' scenario in the clinical environment. Routine preoperative magnetic resonance scanning is not feasible for all rotator cuff patients and would present a significant barrier to timely care in our care system. Even so, the findings of this study align with the findings of other rotator cuff studies. Dunn et al[3] showed that patient-reported pain was only associated with lower education and race, with no correlation seen between tear severity and pain measured on a VAS. Similarly, Wylie et al[22] found that measures of mental health according to the SF-36 mental component score had stronger correlations to VAS scores for shoulder function ($R = –0.33$, $P < .0001$) and pain ($R = –0.47$, $P < .0001$) than tear area and VAS scores for shoulder function ($R = 0.07$, $P < .007$) and pain ($R = 0.01$, $P = .77$).

Third, significant differences did exist by gender on the WORC-Lifestyle subscale even though the overall scores between men and women were very similar. The WORC-Lifestyle subscale queries activities such as personal grooming, rough or vigorous play, reaching movements, and sleep habits. We found that men and women may encounter different lifestyle impacts from the same disease process. Such gender differences have not previously been a primary interest in the rotator cuff literature. Importantly, this finding exceeded the known minimal clinically important difference on the WORC, which is 11.7%.[10] An inference from this finding is that existing patient-reported instruments may not discriminate well between subtle but important patient concerns. Specifically, women may struggle with or value more highly the ability to style hair and fasten clothing behind the back compared with men. Corroboration and further exploration of this finding are necessary before making definitive conclusions.

Fourth, it is important to carefully consider the selection of self-reported questionnaires administered to rotator cuff patients. Similar questionnaires may not measure similar factors. For example, the weak correlation seen between the SF-36 and PCS scores suggests that the 2 questionnaires evaluate different aspects of mental health. In contrast, a moderate correlation was seen between the WORC-Emotions subscale and PCS scores, suggesting some overlap. Striking a balance between obtaining the necessary data and avoiding burdensome quantities of questionnaires for participants is a delicate process. On the other hand, if one wants to quantify catastrophizing, one likely has to use a specific tool, not a general one.

Finally, this study reinforces the need to better understand factors that affect surgical patients. Although we observed a relationship between catastrophizing and the self-reported illness experience, it is unknown whether reducing catastrophizing preoperatively may represent an opportunity to improve postoperative outcomes. Whereas the link between high catastrophizing and poorer postoperative outcomes has been explored in other orthopedic surgery populations,[5,14] little has been explored about the effect of preoperative catastrophizing interventions on postoperative surgical outcomes. More specifically, this body of preliminary knowledge is valuable for surgeons with an eye toward characterizing the experiences of patients during surgical consultation and before their rotator cuff surgery. It is important that within this cohort, there was a disconnect between the biological characteristics of rotator cuff disease (measured by full- or partial-thickness tearing and the number of tendons involved) and the magnitude of patient-reported symptoms from the start of surgical care. Further work in rotator cuff and other surgical populations is needed to determine best clinical practice for management of these sometimes complex patients.

The main strengths of this study were that it presents data about a large cohort of preoperative rotator cuff surgical patients with diverse characteristics. These included traumatic and atraumatic injury mechanisms; various activity levels; and factors such as diabetes mellitus, smokers, patients injured in motor vehicle collisions, patients pursuing personal injury litigation, and patients with workers' compensation board claims. This serves to enhance the applicability and generalizability of the results. The limitations of this study are the exclusion of non–English-language speakers and the use of heterogeneous preoperative imaging modalities.

Conclusion

This study has shown that more pain catastrophizing is related to greater patient-reported disease severity in preoperative rotator cuff surgical patients. Patient gender was not important to patient-reported disease severity or catastrophizing. Tear severity was not related to patient-reported scores. Surgeons must understand that a disconnect exists between the biological characteristics of rotator cuff disease and patient symptoms. Although other patient populations have shown that catastrophizing levels affect postoperative results, it will be important to evaluate the implications of catastrophizing on postoperative patient-reported outcomes in rotator cuff patients.

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