Predictors of Pain and Function in Patients With Symptomatic, Atraumatic Full-Thickness Rotator Cuff Tears : A Time-Zero Analysis of a Prospective Patient Cohort Enrolled in a Structured Physical Therapy Program

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Predictors of Pain and Function in Patients With Symptomatic, Atraumatic Full-Thickness Rotator Cuff Tears

A Time-Zero Analysis of a Prospective Patient Cohort Enrolled in a Structured Physical Therapy Program

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Background: Although the prevalence of full-thickness rotator cuff tears increases with age, many patients are asymptomatic and may not require surgical repair. The factors associated with pain and loss of function in patients with rotator cuff tears are not well defined.

Purpose: To determine which factors correlate with pain and loss of function in patients with symptomatic, atraumatic full-thickness rotator cuff tears who are enrolled in a structured physical therapy program.

Study Design: Cross-sectional study; Level of evidence, 3.

Methods: A multicenter group enrolled patients with symptomatic, atraumatic rotator cuff tears in a prospective, nonrandomized cohort study evaluating the effects of a structured physical therapy program. Time-zero patient data were reviewed to test which factors correlated with Western Ontario Rotator Cuff (WORC) index and American Shoulder and Elbow Surgeons (ASES) scores.

Results: A total of 389 patients were enrolled. Mean ASES score was 53.9; mean WORC score was 46.9. The following variables were associated with higher WORC and ASES scores: female sex ($P = .001$), education level (higher education, higher score; $P < .001$), active abduction (degrees; $P = .021$), and strength in forward elevation ($P = .002$) and abduction ($P = .007$). The following variables were associated with lower WORC and ASES scores: male sex ($P = .001$), atrophy of the supraspinatus ($P = .04$) and infraspinatus ($P = .003$), and presence of scapulothoracic dyskinesia ($P < .001$). Tear size was not a significant predictor (WORC) unless comparing isolated supraspinatus tears to supraspinatus, infraspinatus, and subscapularis tears ($P = .004$). Age, tear retraction, duration of symptoms, and humeral head migration were not statistically significant.

Conclusion: Nonsurgically modifiable factors, such as scapulothoracic dyskinesia, active abduction, and strength in forward elevation and abduction, were identified that could be addressed nonoperatively with therapy. Therefore, physical therapy for patients with symptomatic rotator cuff tears should target these modifiable factors associated with pain and loss of function.

Keywords: rotator cuff tear; nonoperative treatment; WORC score; ASES score

Rotator cuff injury is a common cause of shoulder pain and disability in adults as the prevalence of rotator cuff tears increases with age.[25] Based on ultrasound imaging, the prevalence of both partial- and full-thickness tears in shoulders of asymptomatic patients has been shown to be over 50% in those older than age 60 years and 80% in those older than age 80 years.[23] With use of magnetic resonance imaging (MRI), the prevalence of both partial- and full-thickness tears in asymptomatic patients was 54% in those older than age 60 years, 28% in those between 40 and 60 years of age, and 4% in those younger than age 40 years.[28] Rotator cuff tears are found in 23.1% of adult cadaveric shoulders.[25]

Magnetic resonance imaging and ultrasound studies reported in the literature suggest not all rotator cuff tears are symptomatic. Shoulder function in patients with an asymptomatic rotator cuff tear may not differ from shoulder function in patients with an intact rotator cuff, based on American Shoulder and Elbow Surgeons (ASES) and

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Simple Shoulder Test (SST) scores.[17] But symptoms can develop over time. Asymptomatic rotator cuff tears seen on ultrasound in patients with a known symptomatic contralateral rotator cuff tear became symptomatic in 23.1% of patients over a mean of 2.8 years.[36]

It is difficult to accurately predict which tears will progress and/or become symptomatic and/or require surgery. Several factors, including tear size,[34] patient age,[21] mean ASES scores,[36] lost active forward elevation,[15] abnormal glenohumeral kinematics,[35] fatty infiltration of rotator cuff muscles,[21] and hand dominance,[17] have been shown to be predictive of development of symptoms and poor prognosis with nonoperative management. Given that tears do not heal with time, any appearance of pain or disability related to the shoulder in patients with known asymptomatic tears may warrant a change in management.[36]

The factors that relate to function and pain with symptomatic, atraumatic tears are not completely known. Furthermore, the literature lacks high methodological quality prospective studies reporting the efficacy of nonoperative management with physical therapy for the treatment of rotator cuff tears. If there are modifiable factors that correlate with the Western Ontario Rotator Cuff (WORC) index and/or ASES scores, then correcting these factors with physical therapy could decrease patient pain and symptoms and potentially transform a symptomatic rotator cuff tear to an asymptomatic rotator cuff tear. Patients with nonmodifiable factors associated with worse WORC or ASES scores may be less likely to respond to a nonsurgical program and may be candidates for earlier surgical repair. Therefore, the purpose of this study was to determine the patient factors that are associated with function and pain, based on the WORC index and ASES score, in patients with symptomatic, atraumatic full-thickness rotator cuff tears.

METHODS

Investigational review board (IRB) approval was obtained at all participating institutions before study inception. Patients with unilateral, full-thickness, symptomatic, atraumatic rotator cuff tears were prospectively enrolled in the time-zero data of a multicenter group's nonoperatively treated full-thickness rotator cuff tear study. All tear diagnoses were made with physical examination and MRI.

Inclusion criteria for this prospective cohort were patients between 18 and 100 years of age, MRI findings of a full-thickness rotator cuff tear, significant weakness ($\leq$4/5 manual muscle strength testing), pain with activities of daily living (ADLs) or pain at rest, and impingement symptoms for greater than 3 months. Patients were enrolled if they elected to participate in the nonoperative treatment physical therapy program. If desired, patients were allowed to elect for initial primary surgical intervention. Patients who elected to have primary surgery were excluded from the study. Other exclusion criteria were acute rotator cuff tears (acute defined as a diagnosed tear that was symptomatic for less than 3 months); bilateral rotator cuff tears; associated fracture of the proximal humerus, clavicle, or scapula; pain from the neck or scapula; previous shoulder surgery; glenohumeral joint osteoarthritis; and adhesive capsulitis/frozen shoulder (see Figure 1).

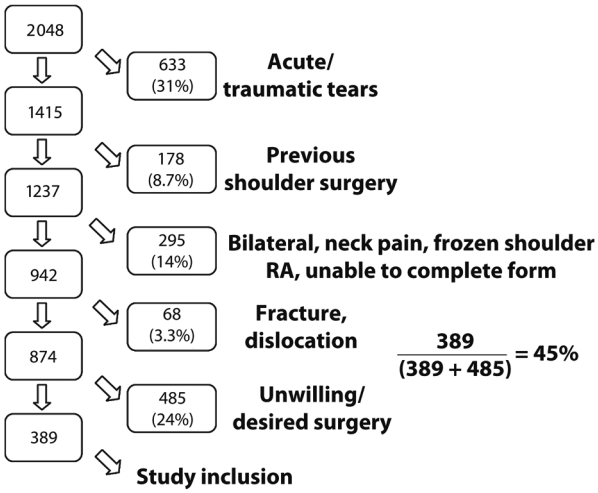

Figure 1. Flowchart illustrating application of study inclusion and exclusion criteria. RA, rheumatoid arthritis.

Informed consent, written and oral, was obtained from each patient. Upon acceptance of enrollment, patients completed a self-administered outcome questionnaire that included their demographics, WORC index, and ASES scores. Patients underwent routine physical examination.

WORC index scores were completed by each patient. The WORC index is a valid, reliable, and disease-specific, 21-question outcome measurement tool with each question scored 0 to 100 (maximum raw score 2100, then scaled to 100).[19] It was validated using the University of California at Los Angeles (UCLA) Shoulder Scale, ASES Index, the DASH (Disabilities of the Arm, Shoulder, and Hand), and SF-36.[13] Domains analyzed include physical symptoms (6 items), sports and recreation (4 items), work (4 items), lifestyle (4 items), and emotions (3 items). The minimal clinically important difference (MCID) for the WORC index is 245.26 (11.7%, or 11.7 points on the scaled index with maximum value of 100). The moderate difference change in total score was 371.3 (17.68%, or 17.7 points on the scaled index), and the large difference change in total score was 773.4 (36.82%, or 36.8 points on the scaled index).[19]

The ASES scores were completed by each patient. The ASES score is a valid and reliable outcome tool scored 0 to 100.[26] Domains analyzed include pain (1 item, 10-point visual analog scale [VAS]), ADLs (10 items, each on a 4-point scale), active and passive range of motion (0-3), strength (0-5), and instability (0-3). The MCID for the ASES score is 6.4, and the minimal detectable change (MDC) is 9.4 (90% confidence interval).[22]

In addition to WORC index and ASES scores, other variables analyzed included patient age, duration of symptoms, sex, smoking status, presence of Bureau of Workers' Compensation (BWC) claim, amount of education/

schooling, employment status (presence or absence of any type of employment), race, size of tear based on which tendons are torn and amount of tear retraction (via standard MRI coronal, sagittal, and axial sequences; Boileau classification[2]), presence of scapulothoracic dyskinesis (yes/no binary diagnosis),[32] presence of humeral head migration (via anteroposterior radiograph with a decreased acromiohumeral distance [less than 7 mm], yes or no), forward elevation strength, supraspinatus strength (Jobe test/supraspinatus test),[16] abduction strength, external rotation strength (with arm adducted at side), degrees of active abduction, degrees of active forward elevation, degrees of passive external rotation, presence of supraspinatus atrophy, and presence of infraspinatus atrophy. Strength testing was measured via manual muscle strength scales of 0 to 5, and range of motion was measured via visual assessment. Supraspinatus and infraspinatus atrophy was assessed via visual assessment upon physical examination.

Descriptive statistics were calculated for the variables analyzed. Continuous variable data were reported as mean ± standard deviation from the mean and data range reported as minimum to maximum. Categorical variable data were reported as frequency with percentages. For all statistical data, $P < .05$ was deemed statistically significant.

With use of the statistical software STATA 9.0 (StataCorp LP, College Station, Texas), multivariable linear regression was used to determine if the chosen variables were associated with our primary outcome, WORC score. A regression model was created using forward selection. All variables were evaluated individually to determine their association with the WORC score. All of the significant variables were then added to the model. Subsequently, each variable was individually removed from the model, and the likelihood ratio (LR) test was performed. A significant LR test indicates that the variable adds significant information to the model and cannot be removed. If the LR test was not significant, the variable tested was dropped from the model. Testing was repeated until it was determined that the model containing the fewest number of variables was still predictive of the WORC score. Assumptions, collinearity, and outliers were tested and violations reported. Change in WORC scores and confidence intervals were reported for the variables associated with our outcome.

RESULTS

Three-hundred eighty-nine patients were enrolled (200 men [51%], 189 women [49%]). Mean patient age was 62.60 ± 9.97 years (range, 31-90 years). Table 1 displays patient demographics. Tables 2 and 3 display the causes of exclusion from this study and the proportion of enrolled or nonenrolled patients based on sex. The cohort of patients who did not enroll (n = 1659) was significantly younger than those who did enroll (mean age of excluded cohort was 57.8 ± 10.9 years vs 62.7 ± 9.8 years for the included cohort; $P < .001$). Of those who did not enroll, the number of women versus men was significantly fewer ($P < .001$).

TABLE 1
Patient and Tear Demographics[a]

Sex	
Male	200 (51)
Female	189 (49)
Age, y, mean ± SD	62.60 ± 9.97
Race	
White	332 (86.2)
Nonwhite	53 (13.8)
Education status	
Graduate degree	89 (22.9)
Bachelor's degree	75 (19.3)
Some college	101 (26.0)
High school diploma	95 (24.5)
No high school diploma	28 (7.22)
Employment status	
Full-time	181 (46.7)
Part-time	37 (9.54)
Retired	128 (33.0)
Disabled	20 (5.15)
Unemployed	22 (5.67)
Smoking status	
Smoker	38 (9.84)
Nonsmoker	348 (90.2)
Duration of symptoms	
>12 months	140 (36.3)
7-12 months	56 (14.5)
4-6 months	78 (20.2)
1-3 months	82 (21.2)
<1 month	30 (7.77)
Scapulothoracic dyskinesis	
Yes	110 (28.3)
No	279 (71.7)
Tear size	
Only supraspinatus	274 (71.2)
Supraspinatus + infraspinatus	84 (21.82)
Supraspinatus + subscapularis	19 (4.94)
Supraspinatus + subscapularis + infraspinatus	6 (1.56)
Only subscapularis	2 (0.52)
Degree of tear retraction	
Minimal	185 (48.1)
Midhumeral	132 (34.3)
Glenohumeral	49 (12.7)
Medial to glenoid	19 (4.94)
Supraspinatus atrophy	
Yes	205 (53.5)
No	178 (46.5)
Infraspinatus atrophy	
Yes	89 (24.6)
No	273 (75.4)
Humeral head migration	
Yes	59 (15.7)
No	317 (84.3)

[a]Values presented as No. (%) unless otherwise indicated. Not all data points were populated by all subjects, thus categories may not total 389.

Mean ASES score was 53.94 ± 18.27 (range, 8-98). Factors that were found to significantly correlate with the ASES score are listed in Table 4. The coefficients of each parameter are the change in ASES score associated with that variable. Thus, 90° of active abduction is associated with an increased ASES score by 7.02 points (9 × 0.78 = 7.02). Not having

TABLE 2
Causes of Exclusion[a]

Causes of Patient Exclusion	%
Acute/acute-on-chronic	30.90
Unwilling/desired surgery	23.69
Previous surgery	8.69
Bilateral	6.81
Neck pain	4.88
Dislocation	2.55
Frozen shoulder	1.39
Rheumatoid arthritis	1.16
Fracture	0.76
Unable to complete form	0.18
Total % of potential cohort excluded	81.01

[a]Total potential cohort, 2048 patients (1659 excluded; 389 included).

a high school diploma is associated with a decreased ASES score by 11.32 points.

Mean WORC index score was 46.86 (range, 6-97). Factors that were found to significantly relate to the WORC index score are listed in Table 5. Female sex was associated with a 7.4-point increase in the WORC score at all degrees of active abduction ROM (Figure 2). Not having a high school diploma was associated with a 17.4-point decrease in WORC score. The presence of scapulothoracic dyskinesis was associated with a lower WORC score at higher degrees of active abduction ROM (Figure 3).

Involvement of the supraspinatus, infraspinatus, and subscapularis tendons was associated with a decreased ASES score by 28.8 points (P = .004) (via tear location on MRI). The following factors did not relate to the ASES or WORC index scores or were removed from the regression model because of their interaction with other variables: tear size (number of tendons involved, except for tears involving the supraspinatus, infraspinatus, and subscapularis), degree of tear retraction, presence of superior humeral head migration, patient age, duration of symptoms, race, smoking status, supraspinatus strength, and external rotation strength.

DISCUSSION

This study has identified modifiable factors that could be addressed nonoperatively to improve or possibly eliminate symptoms in patients willing to undergo an initial trial of physical therapy for an atraumatic, full-thickness rotator cuff tear. These factors include scapulothoracic dyskinesis, range of motion in active abduction and forward elevation, and strength in abduction and forward elevation, all of which contribute significantly to pain or loss of function.

Patient age, duration of symptoms, race, tear size, degree of tear retraction, presence of superior humeral head migration, smoking status, supraspinatus strength, and strength in external rotation did not relate to patient pain or symptoms. These factors, many of which are not modifiable, have been shown to negatively affect outcomes following surgery. Patients with modifiable risk factors for symptoms before surgery and nonmodifiable risk factors for poor outcomes after surgery may be particularly amenable to nonoperative management of symptomatic, atraumatic rotator cuff tears.

TABLE 3
Proportion of Enrolled or Nonenrolled Patients (in Percentages) Based on Sex

Sex	Excluded	Included	Total
Male	37	50	39
Female	63	50	61

Unfortunately, there is a lack of higher methodological quality prospective studies in the literature that report the effectiveness of nonoperative management of rotator cuff tears with physical therapy. However, an increase in strength of rotator cuff musculature alone (via a physical therapy program) may logically improve the anatomic function and action of the still-intact cuff muscles. Stable humeral head compression in the glenoid with motion reduces superior humeral head migration and clearance of the cuff musculotendinous units within the subacromial space.[5] The presence of a rotator cuff tear influences force couple vectors about the shoulder, altering upper extremity biomechanics with arm elevation and lowering (ie, dynamic instability). Although the success of physical therapy for dynamic instability is only approximately 80% to 83%,[3] it is certainly also a modifiable factor that can improve patients' pain and limitation of function. Scapulothoracic dyskinesis may ensue due to the actual biomechanical impairment or the pain caused by the tear.[18] Our study's model has shown that the presence of scapulothoracic dyskinesis is associated with a decrease in the WORC index and ASES scores of 6.85 and 4.07 points, respectively. Therefore, correcting this issue alone may not be enough to be perceived as a clinically important difference by the patient (according to the MCID of the ASES and WORC), but it is more than half of that required. Although a positive scapulothoracic assist test may indicate that scapulothoracic dyskinesis is directly involved in the patient's symptoms and may be predictive of which patients can correct their dyskinesia,[18] it was not evaluated in our study. Another limitation of the applicability of scapulothoracic dyskinesis to its influence on clinical outcome in rotator cuff tears is that other underlying confounders, such as supraspinatus and infraspinatus muscle atrophy, may play a distinct role. Furthermore, the bias associated with multiple examiners making a clinical diagnosis of scapulothoracic dyskinesis was minimized via the use of a simple yes/no method with good sensitivity and positive predictive value.[32]

Physical therapy for treatment of scapulothoracic dyskinesis can also address issues of strength and motion. Our study has illustrated that active abduction motion, active forward elevation motion, strength of forward elevation, and strength in abduction all correlate with a patient's pain and loss of function. These modifiable factors can improve both WORC index and ASES scores. Our model

TABLE 4
Model Predictive of ASES Score Based on Parameters Analyzed[a]

Parameter	Coefficient	Standard Error	*P* Value	95% Confidence Interval
Female	5.10	1.74	.004	1.68 to 8.52
Bachelor's degree	−0.69	2.66	.794	−5.92 to 4.53
Some college	−5.82	2.46	.019	−10.66 to –0.98
High school diploma	−4.99	2.58	.054	−10.06 to 0.08
No diploma	−11.32	3.76	.003	−18.71 to –3.92
Active abduction ROM (10°)	0.78	0.34	.021	0.12 to 1.43
Active forward elevation ROM (10°)	0.85	0.38	.025	0.11 to 1.60
Passive external rotation ROM (10°)	1.40	0.62	.024	0.18 to 2.62
Humeral head migration	6.40	2.55	.012	1.39 to 11.41
Scapulothoracic dyskinesis	−4.07	2.04	.047	−8.08 to –0.06

[a]ASES, American Shoulder and Elbow Surgeons; ROM, range of motion.

TABLE 5
Model Predictive of WORC Index Score Based on Parameters Analyzed[a]

Parameter	Coefficient	Standard Error	*P* Value	95% Confidence Interval
Bachelor's degree	−2.79	2.79	.32	−8.27 to 2.69
Some college	−9.59	2.60	<.01	−14.70 to –4.48
High school diploma	−11.61	2.67	<.01	−16.87 to –6.35
No diploma	−17.42	4.06	<.01	−25.40 to –9.44
Female	7.40	1.83	<.01	3.81 to 10.99
Scapulothoracic dyskinesis	−6.85	2.10	<.01	−10.98 to –2.73
Active abduction ROM (1°)	0.11	0.02	<.01	0.07 to 0.16
Strength in forward elevation (5/5)	18.39		.002	
Strength in abduction (5/5)	13.79		.007	
Supraspinatus atrophy	−4.21		.04	
Infraspinatus atrophy	−7.37		.003	

[a]ROM, range of motion; WORC, Western Ontario Rotator Cuff.

has shown that for every 10° increase in motion in active abduction and forward elevation, there is an associated increase in the ASES score of 0.78 and 0.85 points, respectively (eg, an increase of 50° of abduction and an increase of 50° of forward elevation is associated with an increase in ASES score of 3.9 and 4.3 points, respectively). Also, full muscle strength against resistance in forward elevation and abduction is associated with a clinically important increase in WORC index scores (18.39 and 13.79 points, respectively).

It is unclear whether targeting the modifiable factors identified in this study will improve patient pain and symptoms or if such an intervention can convert a symptomatic rotator cuff tear to an asymptomatic rotator cuff tear. Outcome studies of the current cohort and future investigations should evaluate whether this is possible.

Another important finding is the nonmodifiable factors that did not appear to correlate with patient pain and symptoms in this cohort. Increasing patient age has been shown to negatively influence tendon healing after repair.[2,7,12,30] Furthermore, the functional outcome is less improved if the tendon fails to heal.[2,7,12,31] Up to 43% of tendons fail to heal following repair in patients older than age 65 years.[2] Despite these facts, older patients do tend to have significant improvements in clinical outcome scores after repair and, in some situations, to a significantly greater degree than younger patients.[1,11,24,33] This may be skewed by the fact that younger patients place greater demand on the shoulder and have greater expectations with operative intervention. Our cohort of patients, at the commencement of an initially nonoperative treatment program, did not demonstrate an association between WORC index and ASES scores and patient age. Another nonmodifiable factor is patient sex. Although the literature is mixed on the effect of sex on outcomes following repair,[4,6,27] females had significantly greater WORC index (7.40 points) and ASES (5.10 points) scores in our cohort (Figure 2).

Following open rotator cuff repair, a cohort of preoperative smokers had significantly less improvement in UCLA score and significantly greater pain than patients who did not smoke preoperatively.[20] Our study has shown that pretreatment smoking status did not influence the WORC index or ASES score for this cohort, although only 10% of the patients in our cohort were smokers. Because smoker status has been shown to negatively affect outcomes following surgical repair where soft tissue healing is paramount, if no repair has occurred, then the effect of smoking may be relegated to a lesser role.

Tear size has been demonstrated to significantly predict both patient-reported and physician-evaluated outcomes

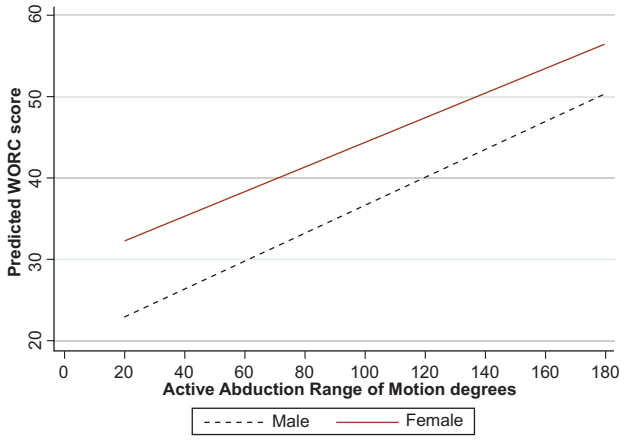

Figure 2. Predicted Western Ontario Rotator Cuff (WORC) index score based on sex. Across all degrees of active abduction range of motion (ROM), women had a significantly higher WORC index score.

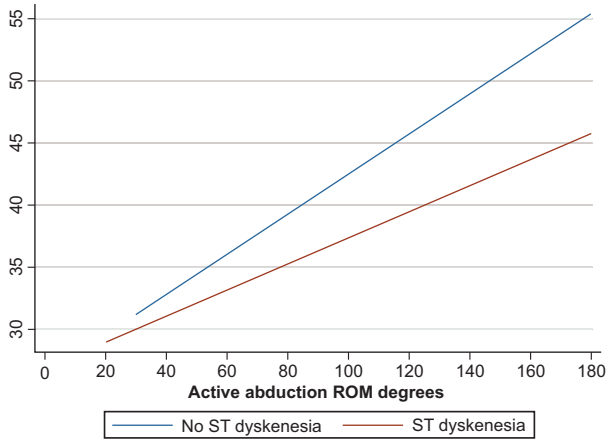

Figure 3. Predicted Western Ontario Rotator Cuff (WORC) index score based on presence or absence of scapulothoracic dyskinesis. At low active abduction range of motion (ROM), the presence or absence of scapulothoracic (ST) dyskinesis has an imperceptible effect on WORC index score. However, at higher degrees of ROM, the presence of ST leads to a lower WORC index score.

after repair. At short-term,[6,14] midterm,[12,27] and long-term[4] follow-up after repair, large and massive tear sizes have been associated with significantly less improvement in subjective patient satisfaction and objective active motion and muscle strength.[4,6,14,27] However, in our cohort, this nonmodifiable factor did not correlate with the WORC index or ASES score. These findings reflect the factors correlating with pain and function in those patients willing to attempt a nonoperative physical therapy program, not those following surgical repair. This may account for the discrepancy in this study's results versus those studies of patients undergoing operative treatment.

Analysis of each question posed to the patient by the ASES score and WORC index questionnaire shows that strength in external rotation may not be a significant requirement that would influence scores. Few questions on the ASES activities of daily living section and WORC index sections of "Lifestyle," "Work," and "Sports" mandate strength in external rotation.

Rotator cuff muscle atrophy with fatty degeneration in the context of rotator cuff tear has been shown to likely be an irreversible phenomenon after repair,[8,9] essentially a nonmodifiable factor. Furthermore, muscle fatty degeneration predisposes patients to a higher risk of recurrent tear following repair,[10,31] which in turn is associated with worse clinical outcome.[10,31] Our study has shown that atrophy of the supraspinatus and infraspinatus muscles is associated with a lower WORC index score by 4.21 and 7.37 points, respectively.

Limitations of the present study include those associated with selection, performance, transfer, and detection bias. Although this multicenter, time-zero study had a large number of patients, it is still subject to the selection of patients and subsequent enrollment by several different physicians. Not all the patients presenting to the participating surgeons' offices were enrolled in the study—more symptomatic patients may have opted for surgery. In fact, only 19% of patients who presented to our offices with full-thickness rotator cuff tears were enrolled in the prospective cohort. The inclusion/exclusion criteria of the study were explicit and defined a priori to intentionally select and analyze the following group of patients: symptomatic rotator cuff tears not secondary to a traumatic event, those who simply desired surgery or were unwilling to participate in the study, and those with prior shoulder surgery, bilateral tears, concomitant neck pain or glenohumeral dislocation, adhesive capsulitis, rheumatoid arthritis, or fracture. Given that more symptomatic patients may have initially opted for surgery, this is acknowledged as a selection bias. However, given that all of our other exclusion criteria properly and intentionally eliminated other causes, risk factors, or confounders, the true proportion of enrollment for the group of patients we intended to analyze was 45% (389 enrolled; 485 either desired surgery or were unwilling to participate in the study *and* lacked any other exclusion criterion; 389/(389 + 485) = 45%).

The patient age demographic, under the assumption of a normal distribution, should encompass ages 43 to 83 years (95% interval of 2 standard deviations from the mean). Nevertheless, age ranged from 31 to 90 years, implicating a potential effect of outliers on the association of age and outcome. Although duration of symptoms prior to enrollment defined the acute versus chronic nature of the tear in this study, this arbitrary choice introduces bias. Asymptomatic rotator cuff tears have been well documented in the literature. Thus, the onset of symptoms may not coincide with the simultaneous appearance of a tear. Thus, this is a recognized and acknowledged limitation given that patients with symptoms <3 months were excluded and only those with symptoms >3 months were included. In addition to rotator cuff tear, other confounding

intra- and extra-articular diagnoses, although most were exclusion criteria, can be sources of shoulder pain. Another potential source of bias includes lack of stratifying results based on Goutallier stage of muscle atrophy (MRI). However, this classification has been evaluated for interobserver agreement by Spencer et al.[29] The latter study showed that shoulder-fellowship or sports medicine–fellowship trained orthopaedic surgeons have an interobserver agreement of 0.36 (fair) with a κ value of 0.1 to identify the correct Goutallier stage of atrophy. Of 19 parameters assessed on shoulder MRIs in this latter study, muscle atrophy had the lowest interobserver agreement of all 19 parameters. Furthermore, the κ value was 0.1, indicating that the results were nearly due to random chance alone (0.0). This may mean that it is unnecessary to quantify the degree of atrophy. Although many surgeons may treat severe atrophy differently than mild or no atrophy (based on MRI), the ability to correctly identify severe atrophy versus mild atrophy is perhaps compromised given the results of the latter study.

The time-zero nature of this study, by definition, precludes follow-up. Nevertheless, only sufficient follow-up of nonoperative management, as well as attention to these modifiable factors deemed significant in this study, will determine the effect that these factors have on ultimate clinical outcome. Furthermore, a combination of these significant factors may exceed the MCID of both the WORC index and ASES scores, but not one alone would be perceived as clinically important by the patient.

Future planned investigations of this prospective study cohort include clinical and radiographic (MRI) follow-up at 2 and 5 years to assess the effect of these risk factors on long-term outcome. Modifiable risk factors will be evaluated to determine if physical therapy is successful in controlling symptoms and preventing the need for surgical treatment of patients with symptomatic, full-thickness rotator cuff tears. Furthermore, if patients do eventually require surgery, then these outcomes would be followed as well to see if surgery actually improved their results.

CONCLUSION

Nonsurgically modifiable factors, such as scapulothoracic dyskinesia, active abduction, strength in forward elevation, and abduction, were identified that could be addressed nonoperatively with therapy and correlate with functional scores. Therefore, physical therapy for patients with symptomatic rotator cuff tears should target these modifiable factors associated with pain and loss of function.

CONTRIBUTING AUTHORS

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