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The Duration of Symptoms does not correlate with Rotator Cuff Tear Severity or Other Patient Related Features. A Cross Sectional Study of Patients with Atraumatic, Full Thickness Rotator Cuff Tears

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Abstract

Introduction—The purpose of this cross-sectional study is to determine if the duration of symptoms influences the features seen in patients with atraumatic full thickness rotator cuff tears. Our hypothesis is that increasing duration of symptoms will correlate with more advanced findings of rotator cuff tear severity on MRI, worse shoulder outcome scores, more pain, decreased range of motion, and less strength.

Methods—450 patients with full thickness rotator cuff tears were enrolled in a prospective cohort study to assess the effectiveness of nonoperative treatment and factors predictive of success. Duration of patient symptoms were divided into four groups: ≤3 months, 4–6 months, 7–12 months, and >12 months. Data collected at patient entry into the study included: 1.) Demographic data, 2.) History and physical exam data, 3.) Radiographic imaging data, and 4.) Validated patient reported measures of shoulder status. Statistical analysis included a univariate

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analysis with Kruskal-Wallis test and Pearson tests to identify statistically significant differences in these features for different durations of symptoms

Results—Longer duration of symptoms does not correlate with more severe rotator cuff disease. Duration of symptoms was not related to weakness; limited range of motion; tear size; fatty atrophy; or validated patient reported outcome measures.

Conclusions—There is only a weak relationship between the duration of symptoms and features associated with rotator cuff disease.

Level of Evidence—Level III, Cross Sectional Study

Keywords

Rotator Cuff Tear; Duration of Symptoms; Cross-Sectional Study

Introduction

The patient presenting with a full thickness rotator cuff tear can have a variety of complaints including pain, weakness, functional loss, and decreased range of motion[14]. The prevalence of asymptomatic rotator cuff tears is high, particularly with increasing age[24, 36]. The factors provoking symptoms in patients with rotator cuff tears remain unknown[35].

Currently, the duration of shoulder symptoms is used as an indication for the surgical treatment of full thickness rotator cuff tears[10, 21, 34]. In the setting of a known acute traumatic full thickness rotator cuff tear, repair within three weeks of injury has been suggested as optimal[2]. Repair of full thickness rotator cuff tears beyond one year of symptoms appears to have poorer results, and patients who undergo repair within three for four months of the onset of symptoms can expect a good result[10, 21, 34]; however this relationship between the duration of symptoms and poorer outcomes after surgery has not been demonstrated consistently[5, 14, 26, 34].

Anatomically, an increased duration of a full thickness rotator cuff tear may contribute to increased tear size or fatty atrophy of rotator cuff muscle[12, 30, 36]. However it is not clear how these anatomic features are related to the development of symptoms.

The purpose of this cross-sectional study is to test the hypothesis that increasing duration of symptoms in patients with atraumatic full thickness rotator cuff tears will correlate with more advanced findings of rotator cuff tear severity on MRI, worse shoulder outcome scores, more pain, decreased range of motion, and less strength on initial presentation.

Materials and Methods

Study Design

Our research group is a collaborative effort comprised of 16 surgeons and research personnel representing private and academic practices from across the United States. This group met repeatedly over two years to develop research questions and align practice behaviors, by conducting systematic reviews of the literature, performing agreement studies,

and developing consensus when no data was available[3, 4, 16, 17, 29, 34]. The first clinical study conducted by the group was a prospective cohort study evaluating physical therapy for patients with atraumatic full thickness rotator cuff tears[18]. There were a total of 452 patients enrolled in the study and 30 patients withdrew. However the baseline data was obtained in 11 of the 30 that withdrew leaving a final total of 433 for analysis in the current study.

Setting

Patients were enrolled in the offices of the surgeons in the involved research group.

Participants

Patients who presented with symptoms and atraumatic full thickness rotator cuff tears between the ages of 18–100 were invited to participate. Exclusion criteria included a history of acute injury (defined as a traumatic event that precipitated symptoms with 3 months of presentation), prior surgery to the shoulder, pain determined to be related to cervical or other disorders, glenohumeral osteoarthritis or inflammatory arthritis, adhesive capsulitis, fracture of the proximal humerus, known bilateral rotator cuff tears, and a history of dementia.

Variables/Data Sources

Patients who were enrolled contributed data on demographics, comorbidities[27], and historical information regarding the intensity and severity of symptoms on a questionnaire form. In addition, patients completed the following validated measures of patient shoulder status: SF-12[32], American Shoulder and Elbow Surgeons (ASES) Score[25], Western Ontario Rotator Cuff (WORC) Index[15], Single Assessment Numeric Evaluation (SANE) Score[33], and the Shoulder Activity Scale[7]. Patients were specifically asked to define the duration of symptoms as: less than three months, between four and six months, between seven and 12 months, or greater than one year.

Physicians performed physical examinations of the patients and recorded information on areas of tenderness; active and passive range of motion measured in 10-degree increments; and strength measured using the Medical Research Council (MRC) manual muscle testing[19] grades 0–5. In addition, physicians reviewed radiographs and MRI scans for each patient then graded the severity of the rotator cuff tear based on the number of tendons involved; retraction of the rotator cuff tear in the coronal plane (minimal, mid-humeral, glenohumeral, to glenoid)[22]; and the degree of muscle atrophy[12], features found to have reasonably high inter-observer agreement in our research group[29]. MRI scans were obtained an average of 31 days prior to enrollment in the study.

Quantitative Variables

Quantitative variables included the categorical dependent variable of duration of symptoms (≤3 months, 4–6 months, 7–12 months, or > 1 year) and independent variables including: 1.) Demographics (age, gender, workers compensation claims, race, employment, marital status, patient expectations of treatment[13], and hand dominance); 2.) History information (pain level); 3.) Physical examination findings (strength using MRC grades[19], range of motion measured in 10-degree increments for various planes and rotations); 4.) Imaging findings (level of rotator cuff tear retraction, presence of superior humeral head migration, rotator

cuff muscle atrophy, acromial shape, and acromiohumeral interval); and 5.) Patient reported outcome scores as described above.

Statistical Methods

The relationships between duration of symptoms and nonparametric continuous variables were evaluated using the Kruskal-Wallis test. Pearson's chi-square test was employed to evaluate the association between duration of symptoms and categorical variables. Statistical analysis was performed with fee open source R statistical software (R Development Core Team. R: A Language and Environment for Statistical Computing. Vienna, Austria: R Foundation for Statistical Computing; 2010. Available at: http://www.R-project.org/).

Results

Of the 433 patients included in the cohort, 430 patients had complete data regarding the duration of symptoms. Demographic data and its relationship to the patient's durations of symptoms are displayed in Table 1. In the cohort 30% of patients had symptoms for ≤ 3 months, 10% had symptoms for 4–6 months, 15% had symptoms for 7–12 months, and 36% had symptom for over a year. No significant relationship exists between the duration of a patient's symptoms and gender, race, employment, marital status, worker's compensation, and patient expectation of treatment. There was a significant difference noted among groups with regard to age with a higher median age among those with symptoms of less than three months.

The severity of the rotator cuff tear, as measured by MRI showed no correlation with the duration of symptoms (Table 2). Patient reported level of pain did not correlate with the durations of symptoms (Table 3). Physical examination tests for strength (Table 3) and range of motion (Table 4) had no correlation to the patient's duration of symptoms, except forward elevation, which was ten degrees greater in patients with more than 7 months of symptoms. The duration of symptoms was not correlated with validated measures of shoulder status or general health status (Table 5).

Discussion

The results from this large cross-sectional study are surprising. If we assume that the rotator cuff tear is the source of the patient's symptoms, then it follows that longer duration of symptoms should correlate with larger rotator cuff tear size, more muscle atrophy, and poorer active motion and more weakness among physical examination findings. Our results reveal that none of these measures of rotator cuff tear severity appear to be related to a patient's duration of symptoms. We found no correlation with other features including the patient's reported severity of pain and status of the patient's shoulder as measured by validated outcome scores.

Interestingly, there are multiple lines of evidence that suggest that pain as a symptom may not be clearly associated with rotator cuff disease. Many patients will report significant pain relief with non-operative treatment of rotator cuff tears[1, 18, 20]. The severity of a patient's pain does not correlate with the severity of rotator cuff disease[8], and patients in whom a

rotator cuff repair fails will have outcome score improvement identical to patients in whom the repair heals[28]. This evidence compels an examination of the assumption that rotator cuff tears are the source of a patient's symptoms, and suggests that pain in this patient population may be originating from other sources.

Some authors have recommended using duration of symptoms as a guide to recommend surgical repair of rotator cuff tears[2, 6, 10, 21, 23, 34]. The goals of rotator cuff repair are to reduce pain and improve function, however the indications for operative treatment of a full thickness rotator cuff tear are not clearly defined[21, 34], which may explain why there is little agreement in the approach to patients[9], and the existence of geographic variation in rotator cuff repair rates[31]. The results of this study would suggest that the duration of symptoms might not be the best historical feature to use when deciding a treatment approach for patients with atraumatic full thickness rotator cuff tears.

The strengths of this study include the large population from across the United States in both academic and private practice environments-features that allow generalization of the results, and the use of assessments that have been found to be reliable and valid. Limitations include the fact that this study population did not include patients with a history of injury and the findings would not apply to patient with traumatic rotator cuff tears. In fact, with regard to acute traumatic rotator cuff tears, the duration of symptoms has been related to muscular atrophy, tendon retraction, tear size and operative outcomes[2, 10–12, 14, 30, 34]. In addition, in this population without a history of injury, collecting data on the duration of a patient's symptoms may introduce the potential for recall bias. Without an exact date of injury, patients may over- or under-represent the duration of their symptoms. Patients may have reported the duration of symptoms incorrectly or may have been unable to recall an injury. Furthermore, while time is a continuous variable, the duration of symptoms in the questionnaire was treated as a categorical variable to assist with comparisons between groups of patients, which will reduce the statistical power of this variable.

Conclusions

Despite these limitations, this cross sectional study of a large population of patients with symptomatic atraumatic full thickness rotator cuff tears failed to demonstrate a correlation between the duration of symptoms and the anatomic severity of rotator cuff disease, physical examination findings, or validated patient reported measures of shoulder status. There appears to be only a weak relationship between the duration of symptoms and features associated with rotator cuff tears.

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Table 1

Duration of Symptoms Related to Demographics.

Duration of Symptoms (Months)	**≤3**	**6–6**	**7–12**	**>12**	***p-value***
Age in Years: Median with lower and upper quartiles[1]	**58 (63) 72**	57 (60) 66	57 (62) 69	55 (60) 69	***0.03***
Gender (% Female)[1]	48	54	60	44	*0.17*
Worker's Compensation (% Yes)[1]	6	11	12	11	*0.52*
Race (%)[2]					*0.59*
Other	5	7	2	5	
Black	13	7	8	8	
White	82	85	90	87	
Employment (%) [2]					*0.68*
Full-time	48	46	47	46	
Part-time	10	11	7	8	
Retired	36	31	33	34	
Homemaker	0	4	8	4	
Not Working	6	8	5	8	
Marital Status (%)[2]					*0.43*
Other	2	10	5	4	
Divorced	15	12	22	13	
Married	61	65	62	66	
Single	7	6	5	6	

Duration of Symptoms (Months)	**≤3**	**6–6**	**7–12**	**>12**	***p-value***
Widowed	15	7	7	9	
Patient Expectations	3.8 (4.1)	3.7 (4.2)	3.8 (4.5)	3.5 (4.0)	*0.30*
Mean with lower and upper quartiles Mean with lower and upper quartiles[2]	5.0	4.8	5.0	4.7	
Dominant Side (% Yes)[2]	74	59	67	72	*0.12*

[1]Kruskal-Wallis Test;

[2]Pearson Test.

A(B)C – A=lower quartile, B= median. C=upper quartile. The only statistically significant finding was a slightly older age in patients with symptoms less than 3 months.

Table 2

Duration of Symptoms Related to Radiographic Imaging.

Duration of Symptoms (Months)	**≤3**	**4–6**	**7–12**	**>12**	***p-value***
Rotator Cuff Tendon Retraction (%)[2]					*0.63*
Minimal	53	51	53	44	
Mid-humeral	28	34	28	37	
Glenohumeral	13	12	17	13	
Glenoid	5	2	2	6	
Superior Humeral Head Migration (% present)[2]	14	14	15	16	*0.96*
Number of Tendons Torn (%)[2]					*0.63*
One	77	78	70	72	
Two or More	23	22	30	28	
Supraspinatus Atrophy (%)[2]					*0.75*
Normal	47	56	53	43	
25 Percent	29	18	23	30	
50 Percent	15	19	18	17	
75 Percent	8	6	3	8	
100 Percent	1	1	2	2	
Infraspinatus Atrophy (%)[2]					*0.96*
Normal	76	82	79	75	
25 Percent	15	13	11	13	
50 Percent	7	3	6	7	
75 Percent	2	1	2	3	
100 Percent	0	1	2	1	
Teres Minor Atrophy (%)[2]					*0.78*
Normal	98	97	100	99	
25 Percent	1	1	0	1	
50 Percent	1	1	0	0	

Duration of Symptoms (Months)	**≤3**	**4–6**	**7–12**	**>12**	***p-value***
Subscapularis Atrophy (%)[2]					*0.66*
Normal	88	95	90	93	
25 Percent	6	5	6	5	
50 Percent	5	0	4	1	
75 Percent	1	0	0	1	
Acromial Shape[2]					*0.07*
Type I	8	8	17	12	
Type II	81	64	68	69	
Type III	11	28	15	19	
Acromiohumeral Interval (mm)[1]	8(10)11	9(10)11	8(10)11	8(10)11	*0.36*

[1]Kruskal-Wallis Test;

[2]Pearson Test.

A(B)C – A=lower quartile, B= median. C=upper quartile.

Table 3

Durations of Symptoms Related to Pain and Strength.

Duration of Symptoms (Months)	**≤3**	**4–6**	**7–12**	**>12**	***p-value***
Pain[2]	3.1(4.6)6.4	2.4(4.4)6.4	2.6(4.3)6.6	2.6(4.3)6.4	*0.74*
Supraspinatus Strength (%)[2]					*0.49*
3	12	7	17	13	
4	63	62	53	54	
5	25	31	30	34	
External Rotation Strength (%)[2]					*0.10*
3	12	7	12	9	
4	32	43	23	44	
5	56	49	65	47	
Flexion Strength (%)[2]					*0.26*
3	10	5	8	8	
4	54	45	42	40	
5	36	50	50	52	
Abduction Strength (%)[2]				*0.41*	
3	10	10	8	10	
4	59	44	43	47	
5	32	46	48	44	
Internal Rotation Strength (%)[2]					*0.16*
3	3	1	2	2	
4	9	5	0	11	
5	88	94	98	87	

[1] Kruskal-Wallis Test;

[2] Pearson Test.

A(B)C – A=lower quartile, B= median. C=upper quartile. Strength was measured using MRC grades[19], where 3= joint can be moved only against gravity with examiner's resistance completely removed, 4= strength reduced, but contraction can still move joint against resistance, 5=muscle contracts against full resistance

Table 4

Durations of Symptoms Related to Range of Motion

Kruskal-Wallis Test used.

Duration of Symptoms (Months)	≤3	4–6	7–12	>12	*p-value*
Elevation	115(160)180	140(160)180	**130(170)180**	**142(170)180**	***0.032***
Extension	30(30)50	30(40)60	30(30)40	30(40)50	*0.26*
Abduction	60(80)90	70(80)90	70(80)90	70(80)90	*0.22*
Adduction	30(30)50	30(40)60	30(40)60	30(30)60	*0.095*
External Rotation in Adduction	40(60)60	40(60)60	42(60)60	40(60)60	*0.24*
Internal Rotation in Adduction	60(60)60	60(60)60	60(60)60	60(60)60	*0.13*
External Rotation in Abduction	60(80)90	70(80)90	70(80)90	70(90)90	*0.76*
Internal Rotation in Abduction	20(50)60	20(40)68	30(50)60	30(30)60	*0.79*

A(B)C – A=lower quartile, B= median. C=upper quartile. Rotations were measured with arm at side (adduction) or at 90 degrees of abduction (abduction). The only statistically significant finding was found to affect those who had symptoms for 7 months or more, who had 10 degrees more forward elevation.

Table 5

Duration of Symptoms Related to Patient Reported Outcome Scores.

Duration of Symptoms (Months)	**≤3**	**4–6**	**7–12**	**>12**	***p-value***
Shoulder Activity Score[1]	5(9)13	8(11)14	8(11)13	7(10)13	*0.73*
ASES Score[1]	39(55)65	41(54)74	43(52)68	41(57)71	*0.62*
SANE Score[1]	30(50)60	30(50)65	25(40)60	30(50)65	*0.43*
WORC Index[2]	34(46)62	33(44)62	34(46)58	32(45)62	*0.95*
SF-12V2 Mental Component[2]	37(41)44	37(40)44	39(42)44	36(42)44	*0.31*
SF-12V2 Physical Component[2]	34(35)36	35(36)36	35(36)36	34(35)36	*0.95*

[1]Kruskal-Wallis Test;

[2]Pearson Test.

A(B)C – A=lower quartile, B= median. C=upper quartile.