



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



The MOON Shoulder Group: Kenneth P. Unruh, MD^a, John E. Kuhn, MD, MS^{a,*}, Rosemary Sanders, BA^a, Qi An, MS^a, Keith M. Baumgarten, MD^b, Julie Y. Bishop, MD^c, Robert H. Brophy, MD^d, James L. Carey, MD, MPH^e, Brian G. Holloway, MD^f, Grant L. Jones, MD^c, Benjamin C. Ma, MD^g, Robert G. Marx, MD, MPH^h, Eric C. McCarty, MDⁱ, Souray K. Poddar, MDⁱ, Matthew V. Smith, MD^d, Edwin E. Spencer, MD^f, Armando F. Vidal, MDⁱ, Brian R. Wolf, MD^j, Rick W. Wright, MD^d, Warren R. Dunn, MD, MPH^k

^aDivision of Sports Medicine, Department of Orthopaedics and Rehabilitation, Vanderbilt University Medical School, Nashville, TN, USA

^bOrthopaedic Institute, Sioux Falls, SD, USA

^cDepartment of Orthopaedics, The Ohio State University, Columbus, OH, USA

^dDivision of Sports Medicine, Department of Orthopedics, Washington University, St. Louis, MO, USA

^eDivision of Sports Medicine, Department of Orthopaedics, University of Pennsylvania, Philadelphia, PA, USA

^fKnoxville Orthopedic Clinic, Knoxville, TN, USA

^gDivision of Sports Medicine, Department of Orthopaedic Surgery, University of California, San Francisco, CA, USA

^hHospital for Special Surgery, New York, NY, USA

ⁱDivision of Sports Medicine, University of Colorado, Denver, CO, USA

^jDivision of Sports Medicine, University of Iowa, Iowa City, IA, USA

^kDivision of Sports Medicine, University of Wisconsin, Madison, WI, USA

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

Institutional review board approval was obtained at Vanderbilt University (No. 060109), University of Colorado (No. 06-0421), University of Iowa (No. 200605752), The Ohio State University (No. 200605752), Washington University in St. Louis (No. 06-0634), Hospital for Special Surgery (No. 27008), University of California, San Francisco (No. H48075-29336-05),

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*Reprint requests: John E. Kuhn, MD, MS, Vanderbilt Sports Medicine, 3200 MCE South Tower, 1215 21st Ave S, Nashville, TN 37232, USA.

E-mail address: j.kuhn@vanderbilt.edu (J.E. Kuhn).

Methods: We enrolled 450 patients with full-thickness rotator cuff tears in a prospective cohort study to assess the effectiveness of nonoperative treatment and factors predictive of success. The duration of patient symptoms was divided into 4 groups: 3 months or less, 4 to 6 months, 7 to 12 months, and greater than 12 months. Data collected at patient entry into the study included (1) demographic data, (2) history and physical examination data, (3) radiographic imaging data, and (4) validated patient-reported measures of shoulder status. Statistical analysis included a univariate analysis with the Kruskal-Wallis test and Pearson test to identify statistically significant differences in these features for different durations of symptoms.

Results: A longer duration of symptoms does not correlate with more severe rotator cuff disease. The 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, Epidemiology Study.

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Keywords: Rotator cuff tear; duration of symptoms; cross-sectional study

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 3 weeks of injury has been suggested as optimal.² Repair of full-thickness rotator cuff tears beyond 1 year of symptoms appears to have poorer results, and patients who undergo repair within 3 to 4 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 shown 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 the 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 an 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 magnetic resonance imaging (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 composed of 16 surgeons and research personnel representing private and academic practices from across the United States. This group met repeatedly over a period of 2 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 were 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, baseline data were obtained in 11 of the 30 patients who withdrew, leaving a final total of 433 patients for analysis in this study.

Setting and participants

Patients were enrolled in the offices of the surgeons in the involved research group. Patients who presented with symptoms and atraumatic, full-thickness rotator cuff tears aged between 18 and 100 years were invited to participate. Exclusion criteria included a history of acute injury (defined as a traumatic event that precipitated symptoms within 3 months of presentation), prior surgery on the shoulder, pain determined to be related to cervical or other disorders, glenohumeral osteoarthritis or inflammatory arthritis, adhesive capsulitis, fractures of the proximal humerus, known bilateral rotator cuff tears, and a history of dementia.

Variables and data sources

Patients who were enrolled contributed data on demographic characteristics, 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: Short Form 12,³² American Shoulder and Elbow Surgeons score,²⁵ Western Ontario Rotator Cuff index,¹⁵ Single Assessment Numeric Evaluation score,³³ and Shoulder Activity Scale.⁷ Patients were specifically asked to define the duration of symptoms as follows: 3 months or less, 4 to 6 months, 7 to 12 months, or greater than 1 year.

Physicians performed physical examinations of the patients and recorded information on areas of tenderness, active and passive range of motion measured in 10° increments, and strength measured with the Medical Research Council manual muscle testing¹⁹ (grades 0-5). In addition, physicians reviewed radiographs and MRI scans for each patient and then graded the

Table I Duration of symptoms related to demographic data

	Symptom Duration				P value
	≤3 mo	4-6 mo	7-12 mo	>12 mo	
Age [lower quartile–upper quartile (median)] (y)*	58-72 (63) [‡]	57-66 (60)	57-69 (62)	55-69 (60)	.03 [‡]
Gender (% female)*	48	54	60	44	.17
Worker's compensation (% yes)*	6	11	12	11	.52
Race (%) [†]					.59
Other	5	7	2	5	
Black	13	7	8	8	
White	82	85	90	87	
Employment (%) [†]					.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 (%) [†]					.43
Other	2	10	5	4	
Divorced	15	12	22	13	
Married	61	65	62	66	
Single	7	6	5	6	
Widowed	15	7	7	9	
Patient expectations [lower quartile–upper quartile (median)] [†]	3.8-5.0 (4.1)	3.7-4.8 (4.2)	3.8-5.0 (4.5)	3.5-4.7 (4.0)	.30
Dominant side (% yes) [†]	74	59	67	72	.12

* Kruskal-Wallis test.

† Pearson test.

‡ The only statistically significant finding was a slightly older age in patients with symptoms for 3 months or less.

severity of the rotator cuff tear based on the number of tendons involved; retraction of the rotator cuff tear in the coronal plane (minimal retraction, mid-humeral retraction, glenohumeral retraction, or retraction to glenoid)²²; and the degree of muscle atrophy¹²—features found to have reasonably high interobserver agreement by our research group.²⁹ MRI scans were obtained at a mean of 31 days before 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) demographic data (age, gender, worker's 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 the Medical Research Council grades¹⁹ and range of motion measured in 10° 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 earlier.

Statistical methods

The relationships between the duration of symptoms and nonparametric continuous variables were evaluated with the

Kruskal-Wallis test. The Pearson χ^2 test was used to evaluate the association between the duration of symptoms and categorical variables. Statistical analysis was performed with free open-source R statistical software (R Foundation for Statistical Computing, Vienna, Austria).

Results

Of the 433 patients included in the cohort, 430 had complete data regarding the duration of symptoms. Demographic data and their relationship to the patients' durations of symptoms are shown in [Table I](#). In the cohort, 30% of patients had symptoms for 3 months or less, 10% had symptoms for 4 to 6 months, 15% had symptoms for 7 to 12 months, and 36% had symptoms for more than 1 year. No significant relationship existed between the duration of a patient's symptoms and gender, race, employment, marital status, worker's compensation status, and patient's expectation of treatment. There was a significant difference noted among groups with regard to age, with a higher median age among those with symptoms for 3 months or less.

The severity of the rotator cuff tear, as measured by MRI, showed no correlation with the duration of symptoms ([Table II](#)). The patient-reported level of pain did not correlate with the duration of symptoms ([Table III](#)). Physical examination tests for strength ([Table III](#)) and range of

Table II Duration of symptoms related to radiographic imaging

	Symptom Duration				P value
	≤3 mo	4-6 mo	7-12 mo	>12 mo	
Rotator cuff tendon retraction (%) [*]					.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) [*]	14	14	15	16	.96
No. of tendons torn (%) [*]					.63
1	77	78	70	72	
≥2	23	22	30	28	
Supraspinatus atrophy (%) [*]					.75
Normal	47	56	53	43	
25%	29	18	23	30	
50%	15	19	18	17	
75%	8	6	3	8	
100%	1	1	2	2	
Infraspinatus atrophy (%) [*]					.96
Normal	76	82	79	75	
25%	15	13	11	13	
50%	7	3	6	7	
75%	2	1	2	3	
100%	0	1	2	1	
Teres minor atrophy (%) [*]					.78
Normal	98	97	100	99	
25%	1	1	0	1	
50%	1	1	0	0	
Subscapularis atrophy (%) [*]					.66
Normal	88	95	90	93	
25%	6	5	6	5	
50%	5	0	4	1	
75%	1	0	0	1	
Acromial shape [*]					.07
Type 1	8	8	17	12	
Type 2	81	64	68	69	
Type 3	11	28	15	19	
Acromiohumeral interval [lower quartile–upper quartile (median)] (mm) [†]	8-11 (10)	9-11 (10)	8-11 (10)	8-11 (10)	.36

^{*} Pearson test.

[†] Kruskal-Wallis test.

motion (Table IV) showed no correlation with the patient's duration of symptoms, except for forward elevation, which was 10° greater in patients with symptoms for 7 months or more. The duration of symptoms was not correlated with validated measures of shoulder status or general health status (Table V).

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 a longer

duration of symptoms should correlate with a larger rotator cuff tear size, more muscle atrophy, and poorer active motion and more weakness among physical examination findings. Our results show 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 nonoperative treatment of

Table III Duration of symptoms related to pain and strength

	Symptom Duration				P value
	≤3 mo	4-6 mo	7-12 mo	>12 mo	
Pain [lower quartile–upper quartile (median)]	3.1-6.4 (4.6)	2.4-6.4 (4.4)	2.6-6.6 (4.3)	2.6-6.4 (4.3)	.74
Supraspinatus strength (%)					.49
3	12	7	17	13	
4	63	62	53	54	
5	25	31	30	34	
External rotation strength (%)					.10
3	12	7	12	9	
4	32	43	23	44	
5	56	49	65	47	
Flexion strength (%)					.26
3	10	5	8	8	
4	54	45	42	40	
5	36	50	50	52	
Abduction strength (%)					.41
3	10	10	8	10	
4	59	44	43	47	
5	32	46	48	44	
Internal rotation strength (%)					.16
3	3	1	2	2	
4	9	5	0	11	
5	88	94	98	87	

The Pearson test was used for all comparisons. Strength was measured by use of the following Medical Research Council grades¹⁹: 3, the joint can be moved only against gravity with the examiner's resistance completely removed; 4, strength is reduced, but contraction can still move the joint against resistance; and 5, the muscle contracts against full resistance.

Table IV Duration of symptoms related to range of motion

	Symptom Duration				P value
	≤3 mo	4-6 mo	7-12 mo	>12 mo	
Elevation (°)	115-180 (160)	140-180 (160)	130-180 (170)*	142-180 (170)*	.032*
Extension (°)	30-50 (30)	30-60 (40)	30-40 (30)	30-50 (40)	.26
Abduction (°)	60-90 (80)	70-90 (80)	70-90 (80)	70-90 (80)	.22
Adduction (°)	30-50 (30)	30-60 (40)	30-60 (40)	30-60 (30)	.095
External rotation in adduction (°)	40-60 (60)	40-60 (60)	42-60 (60)	40-60 (60)	.24
Internal rotation in adduction (°)	60-60 (60)	60-60 (60)	60-60 (60)	60-60 (60)	.13
External rotation in abduction (°)	60-90 (80)	70-90 (80)	70-90 (80)	70-90 (90)	.76
Internal rotation in abduction (°)	20-60 (50)	20-68 (40)	30-60 (50)	30-60 (30)	.79

Data are presented as lower quartile to upper quartile (median). The Kruskal-Wallis test was used for all comparisons. Rotation was measured with the arm at the side (adduction) or at 90° of abduction.

* The only statistically significant finding occurred in patients who had symptoms for 7 months or more, who had 10° more forward elevation.

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 those 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 the 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 as well as the existence of geographic variation in rotator cuff repair rates.³¹ The results of this study suggest that the duration of symptoms might not be the best historical feature to use when one is 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, as well as the use of assessments that have

Table V Duration of symptoms related to patient-reported outcome scores

	Symptom Duration				P value
	≤3 mo	4-6 mo	7-12 mo	>12 mo	
Shoulder Activity Scale score*	5-13 (9)	8-14 (11)	8-13 (11)	7-13 (10)	.73
ASES score*	39-65 (55)	41-74 (54)	43-68 (52)	41-71 (57)	.62
SANE score*	30-60 (50)	30-65 (50)	25-60 (40)	30-65 (50)	.43
WORC index†	34-62 (46)	33-62 (44)	34-58 (46)	32-62 (45)	.95
SF-12V2 mental component†	37-44 (41)	37-44 (40)	39-44 (42)	36-44 (42)	.31
SF-12V2 physical component†	34-36 (35)	35-36 (36)	35-36 (36)	34-36 (35)	.95

Data are presented as lower quartile to upper quartile (median).

ASES, American Shoulder and Elbow Surgeons; SANE, Single Assessment Numeric Evaluation; SF-12V2, Short Form 12 (version 2); WORC, Western Ontario Rotator Cuff.

* Kruskal-Wallis test.

† Pearson test.

been found to be reliable and valid. Limitations include the fact that this study population did not include patients with a history of injury; moreover, the findings would not apply to patients 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, whereas time is a continuous variable, the duration of symptoms on the questionnaire was treated as a categorical variable to assist with comparisons between groups of patients, which reduces the statistical power of this variable.

Conclusion

Despite the aforementioned limitations, this cross-sectional study of a large population of patients with symptomatic, atraumatic, full-thickness rotator cuff tears failed to show 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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