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## ORIGINAL ARTICLE

# Patient self-assessed shoulder comfort and function and active motion are not closely related to surgically documented rotator cuff tear integrity

Jason E. Hsu, MD, Anna Tang, BS, Frederick A. Matsen III, MD\*

*Department of Orthopaedics and Sports Medicine, University of Washington, Seattle, WA, USA*

**Background:** The rationale for rotator cuff repair surgery is that better integrity of the cuff should be associated with better comfort and function. However, in patients with cuff disease, there is not good evidence that the degree of rotator cuff integrity is closely associated with the shoulder's comfort, function, or active motion. The goal of this study was to explore these relationships in shoulders with surgically documented cuff disease.

**Methods:** In 55 shoulders having surgery for cuff-related symptoms, we correlated the preoperative Simple Shoulder Test score with the objectively measured preoperative active shoulder motion and with the integrity of the cuff observed at surgery.

**Results:** The 16 shoulders with tendinosis or partial-thickness tears had an average Simple Shoulder Test score of  $3.7 \pm 3.3$ , active abduction of  $111^\circ \pm 38^\circ$ , and active flexion of  $115^\circ \pm 36^\circ$ . The corresponding values were  $3.6 \pm 2.8$ ,  $94^\circ \pm 47^\circ$ , and  $94^\circ \pm 52^\circ$  for the 22 full-thickness supraspinatus tears and  $3.9 \pm 2.7$ ,  $89^\circ \pm 39^\circ$ , and  $100^\circ \pm 39^\circ$  for the 17 supraspinatus and infraspinatus tears.

**Conclusion:** In this study, surgically observed cuff integrity was not strongly associated with the shoulder's comfort or function. Whereas surgeons often seek to improve the integrity of the rotator cuff, the management of patients with rotator cuff disorders needs to be informed by a better understanding of the factors other than cuff integrity that influence the comfort and functioning of shoulders with cuff disease.

**Level of evidence:** Level III; Case Series; Prognosis Study

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**Keywords:** Rotator cuff; cuff integrity; Simple Shoulder Test; active abduction; active flexion; patient-reported outcome

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\*Reprint requests: Frederick A. Matsen III, MD, Department of Orthopaedics and Sports Medicine, University of Washington Medical Center, 1959 NE Pacific Street, Box 356500, Seattle, WA 98195-6500, USA.

E-mail address: [matsen@uw.edu](mailto:matsen@uw.edu) (F.A. Matsen III).

Although conditions of the rotator cuff are the most commonly surgically treated shoulder diagnoses, the relationships of patient self-assessed function and active motion to the extent of rotator cuff tendon deficiency are not well understood. Shoulders with substantial rotator cuff disease may be asymptomatic, whereas shoulders with similar or lesser disease

may be associated with substantial loss of shoulder comfort, motion, and function.<sup>19-21,24,25</sup> Clinical improvement is often observed after attempted cuff repair, even though the procedure fails in its attempt to durably reattach the tendon to the tuberosity from which it was torn. As pointed out in a recent systematic review, “Patient-reported outcomes were generally improved whether or not the repair restored the integrity of the rotator cuff.”<sup>18</sup>

These observations create uncertainty in the guidelines for the management of rotator cuff disease. The most recent Cochrane review on rotator cuff disease concluded that “surgery may not lead to any difference in pain compared with different exercise programs.”<sup>10</sup> In the recent American Academy of Orthopaedic Surgeons report, “Optimizing the Management of Rotator Cuff Problems,” most of the recommendations were classified as “inconclusive because of the absence of definitive evidence.”<sup>22</sup> A recent prospective multicenter study by the Multicenter Orthopaedic Outcomes Network group concluded that “patient symptoms and anatomic features of the chronic rotator cuff tear may not be the best features to use when deciding on surgical intervention.”<sup>6</sup>

Although it has been noted in the past that “anatomic features defining the severity of atraumatic rotator cuff tears are not associated with the pain level,”<sup>5</sup> to our knowledge there has been no prior study that explored the relationships among surgically verified cuff integrity, objectively measured preoperative active motion, and preoperative patient self-assessed shoulder comfort and function. Thus, to enhance our understanding of the effects of cuff integrity and active shoulder motion on the shoulder’s comfort and function as perceived by the patient, we tested 3 hypotheses in a group of patients with surgically documented cuff disease:

1. Preoperative patient self-assessed comfort and function as documented by the Simple Shoulder Test (SST) are significantly associated with the degree of cuff integrity observed at surgery.
2. Preoperative objectively measured active abduction and flexion are significantly associated with the degree of cuff integrity observed at surgery.
3. The preoperative SST score is significantly associated with preoperative objectively measured active abduction and flexion.

## Methods

Between January 21, 2015, and November 14, 2016, patients having cuff surgery were invited to participate in this study. During this period, 55 patients had preoperative assessment of their shoulder with the SST, preoperative measurement of their active abduction and flexion using the observer-independent Kinect motion capture system,<sup>16,17</sup> and documentation of their cuff status by direct observation at surgery. In these patients, the indications for surgery were pain, stiffness, and loss of function in a shoulder with clinical evidence of cuff disease that was refractory to at least 6 weeks of nonoperative management, including physical therapy, activity mod-

ification, and nonsteroidal anti-inflammatory medication. Rather than relying on preoperative imaging—which was not consistently available—the integrity of the cuff was determined by direct visualization at the time of surgery. The cuff tendon integrity was characterized as (1) tendinosis or partial-thickness tear, (2) full-thickness supraspinatus tear, or (3) full-thickness supraspinatus and infraspinatus tear. Whereas each of these shoulders received surgical treatment of the cuff disease, the type of treatment and the treatment outcomes are not relevant to the testing of the hypotheses of this investigation.

## Statistical analysis

Means and standard deviations were determined for the SST scores and active motions for shoulders in each of the 3 cuff integrity groups. Unpaired *t*-tests were used to compare these means among the 3 groups. Assigning a cuff integrity score of 0 for the tendinosis/partial tear group, 1 for the supraspinatus tear group, and 2 for the supraspinatus and infraspinatus group, correlation coefficients were determined for the relationship between cuff integrity and active motion, between SST score and cuff integrity, and between SST score and active motion.

## Results

Of the 55 included patients, 16 had tendinosis/partial-thickness tears (age  $57.8 \pm 8.2$  years, 62.5% male), 22 had full-thickness supraspinatus tears (age  $60.6 \pm 8.5$  years, 59.1% male), and 17 had supraspinatus and infraspinatus full-thickness tears (age  $64.7 \pm 9.5$  years, 41.2% male). The ages of the tendinosis/partial-thickness tear group and the ages of the supraspinatus and infraspinatus tear group were statistically significantly different ( $P = .033$ ). The other pairs of ages were not significantly different.

*Hypothesis 1 Patient self-assessed comfort and function documented by the SST are significantly associated with the degree of cuff integrity observed at surgery.*

The preoperative SST scores were essentially the same for the 3 groups:  $3.7 \pm 3.3$  for the shoulders with tendinosis and partial-thickness tears,  $3.6 \pm 2.8$  for the shoulders with supraspinatus tears, and  $3.9 \pm 2.7$  for the shoulders with supraspinatus and infraspinatus tears (Fig. 1). The SST values were not significantly different between the tendinosis/partial tear group and the supraspinatus tear group ( $P = .92$ ), between the tendinosis/partial tear group and the supraspinatus and infraspinatus tear group ( $P = .81$ ), or between the supraspinatus tear group and the supraspinatus and infraspinatus tear group ( $P = .70$ ). Sample size calculations, assuming an  $\alpha$  of .05 and a power of 80%, indicated that >34,000 cases would be necessary to show a significant difference in average SST score between the tendinosis/partial-thickness tear group and the supraspinatus tear group, >8500 cases would be necessary to show a significant difference between the tendinosis/partial-thickness tear group and the supraspinatus/infraspinatus tear group, and >2500 cases would be necessary to show a significant difference between the supraspinatus and the

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