Healed Cuff Repairs Impart Normal Shoulder Scores in Those 65 Years of Age and Older

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Abstract

Background It is unclear whether repaired rotator cuffs heal in older patients and whether the function in those shoulders compares with those of similarly aged patients with untreated tears.

Questions/Purpose We questioned whether, in patients 65 years of age and older, shoulders with rotator cuff repairs that remained intact would have Simple Shoulder Test (SST) scores and Constant scores similar to those of untreated individuals with intact rotator cuffs.

Methods We retrospectively reviewed 39 patients (42 shoulders) 65 years of age and older in whom 42 full-thickness rotator cuff tears were repaired with a mini open technique. All patients completed SST and Constant scores 12 to 60 months postoperatively; all patients also had ultrasound at those times to assess the status of the repair.

These findings were compared with 200 untreated similarly aged shoulders assessed in the same fashion.

Results Shoulders with healed repairs (33 of 42) had similar mean SST scores and Constant scores to those in untreated shoulders with intact rotator cuffs. Those with healed repairs also had higher SST and Constant scores than those with unhealed repairs. Finally, shoulders with healed repairs had higher SST and Constant scores than those with untreated tears.

Conclusions When rotator cuffs healed the function was comparable to that of similarly-aged patients without tears and better than that of patients with untreated tears.

Level of Evidence Level III, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

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Each author certifies that his or her institution has approved the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research.

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Introduction

Rotator cuff tear prevalence increases with advancing age [3, 13, 15]. The shoulders of older patients with intact rotator cuffs have better scores than those with full-thickness cuff tears [3]. It is important to understand whether full-thickness rotator cuff tear repair is warranted in older patients when their shoulders function well despite untreated tears [11] or even improve with nonsurgical treatment [7], especially because the incidence of retear after surgical repair is higher in these patients [1, 8]. It is currently unclear whether older patients with healed full-thickness tear repairs have similar scores as those who have intact rotator cuffs. Moreover, it is unclear whether patients with healed repairs have better scores than those who have full-thickness tears but have never undergone repair.

We therefore asked whether: (1) in patients 65 years of age and older, shoulders with rotator cuff repairs that

remained intact (“healed” would have Simple Shoulder Test (SST) scores and Constant scores similar to those of individuals with intact rotator cuffs (“no tear”); (2) shoulders with nonoperatively treated tears (“tear but no repair”) would have scores that were worse than those of shoulders: with healed repairs and without tears; (3) those with healed repairs would have scores greater than those with unhealed repairs.

Materials and Methods

We retrospectively reviewed all 51 patients (54 shoulders) treated by mini open rotator cuff repairs for chronic full-thickness tears in patients 65 years of age and older (Group I) from January 1, 2003, to January 1, 2007. Minimum followup was 1 year (mean, 2.7 years; range, 1–5 years). Data were collected after patients were invited to participate. Among the 54 rotator cuffs repaired, we studied 42 shoulders (25 isolated supraspinatus tears, one isolated subscapularis tear, 12 supraspinatus and infraspinatus tears, four three-tendon tears). We excluded 12 patients (12 shoulders). Three died of unrelated causes, three did not respond to a letter and a followup voicemail; four were doing “extremely well” and were grateful but could not participate because of (1) distance (greater than 150 miles); (2) recent lung cancer diagnosis and treatment; (3) recent heart transplant; or (4) recent “heart attack.” One was not happy and was considering additional surgery. One could not be located by phone or US mail. In all patients, the repair could be securely attached to humeral bone with the elbow at the side. For comparison, we used a previously reported group of 104 subjects (200 shoulders) in volunteers 65 years and older without previous shoulder surgery (Group II) [3]. All patients underwent a standard plain radiographic evaluation (true anteroposterior [AP] in internal rotation, true AP in external rotation, and axillary) before surgery. As well, an MRI was obtained of each, but they were obtained at multiple locations depending on referring physicians and other factors. After Internal Review Board approval, these patients (Group I) were asked to return a minimum of 12 months after repair. To be included, all patients were required to demonstrate the cognitive ability to understand and complete questionnaires.

A research coordinator and/or her assistant obtained all informed consents before the examiner spoke with the patients. They then completed the SST [9], a Constant Score [2], a health history report, and a rotator cuff ultrasound. The SST is a patient self-assessment metric, whereas the Constant requires both patient and examiner input. Constant scoring was performed on all patients by the surgeon of record (EVF) in a standardized fashion using a dynamometer.

We recruited Group II with poster recruitment at our medical center. Our goal with this group was to determine the prevalence of full-thickness rotator cuff tears in patients 65 years of age and older and correlate the findings with shoulder comfort, function, and patient comorbidities. A secondary goal was to provide baseline shoulder functional status of patients 65 years of age and older with and without full-thickness rotator cuff tears. Like with those in Group I, patients were required to demonstrate the cognitive ability to understand and complete questionnaires. All were studied with the same questionnaires and shoulder scores as those in Group I. For Group II, 104 subjects 65 years of age or older were recruited to obtain 200 shoulders because eight volunteers had undergone shoulder surgery in one shoulder; thus, the majority were bilateral examinations. Full-thickness rotator cuff tear prevalence was 22% (44 of 200) with a 95% confidence interval (15.5%–28.5%). Nine patients had bilateral tears. The other 26 tears were in patients who had a unilateral tear.

We compared the shoulders with healed repairs (33 of 42) of Group I with the subset of Group II shoulders that did not have tears (“no tear”; 156 of 200). We also compared those with healed repairs with the subset of Group II shoulders that had tears but were not repaired (“tear but no repair”; 44 of 200). The groups had similar gender and race composition (Table 1). The “no tear” group was younger ($p = 0.04$) than the “healed” group and younger ($p = 0.0001$) than the “tear but no repair” group.

All surgery was performed by one surgeon (EVF). No shoulder underwent arthroscopic evaluation. Concomitant acromioplasties, distal clavicle surgery, and labral surgery were not performed as described by others [6, 12]. Eleven shoulders had concomitant long head of the biceps tenodeses to soft tissue surrounding the intertubercular groove and the pectoralis major tendon for concomitant long head of the biceps splitting, tearing, and/or instability. Simple

Table 1. Group I demographic information

Demographic	Healed (N = 33)	Not healed (N = 9)	p Value (test)
Gender: number male (%)	19 (57.6%)	8 (88.9%)	0.12 (Fisher’s exact test)
Race: number white (%)	32 (97.0%)	9 (100%)	1.0 (Fisher’s exact test)
Age: mean (SD)	72.7 (5.1)	72.4 (5.2)	0.90 (two-sample t test)

Number 2 braided polyester sutures, bony troughs, and bone tunnels were used for repairs. A half-inch osteotome was used to make troughs. Sutures were placed as tags through the tendon tissue with Number 5 Mayo needles, and these sutures were subsequently routed into the bony troughs and out through the lateral humeral cortex with Number 3 Mayo needles without power equipment. Sutures were tied over lateral humeral cortical bridges. Side-to-side sutures were added depending on tear configuration and shape. All repairs were performed under general anesthesia with a concomitant regional interscalene anesthetic.

Postoperatively, all patients were kept overnight in an extended-stay unit for care and physical therapy. Passive supine forward elevation to 140° and external rotation with the elbow at the side to 40° was begun the day of surgery and continued for 6 weeks at which time active-assisted and then active elevation were begun. External rotation was limited to 20° in those with subscapularis repairs. Progressive active use was also allowed at 6 weeks with one-tendon tears; however, full activity progression was disallowed until 12 weeks with any tear involving more than one tendon. Formal strengthening was not initiated with any patient. All but five performed the exercise programs on their own at home after initial instruction in the hospital by a physical therapist; these five required additional outpatient physical therapy during the postoperative course. All were asked to immobilize their respective upper extremity in a sling for comfort only during the first 10 to 14 days, but they were not required to do so if they could avoid active use of the arm.

Shoulders in Groups I and II were examined 12 to 60 months postoperatively with ultrasound to assess their rotator cuff status as described by Mack et al. [10]. As such, shoulders were placed in extension and internal rotation to allow visualization of the rotator cuffs in longitudinal and transverse planes. Defects were noted as the absence of the normal tissue echoes and failure of the tissue to move appropriately with defined humeral movements. We used a GE Healthcare Logiqbook (Milwaukee, WI)

with a 4- to 10-MHz linear probe for ultrasonography. Teefey et al. suggested ultrasound was "...less sensitive for partial thickness tears..." [16]. Thus, we did not attempt to quantify partial-thickness tears. Full-thickness tears were measured from anterior to posterior at their footprint. The surgeon who performed the repairs in Group I also performed all testing and ultrasounds of all patients. His training includes instruction by a radiology expert in rotator cuff ultrasound followed by 3 years of ultrasound examinations before this study.

We used descriptive statistics to summarize the demographic and clinical characteristics of the study subjects. Fisher's exact test was used to assess the bivariate association between categorical variables (race and gender composition between groups; Tables 1, 2). We used the Wilcoxon rank sum test to compare SST score and Constant score between the no repair group and healed group (Table 2 footnotes) and between healed and not healed groups (Table 3). Two-sample t-tests were used to compare age between groups (Table 1). Kruskal-Wallis tests were used to compare SST score and Constant score among the three groups (healed, tear but no repair, and no tear; Table 2) and one-way analysis of variance to assess age among groups (Table 2). Multiple linear regression was used to adjust for potential confounders when comparing shoulder functions among groups (SST score or Constant score as dependent variable; age, gender, race, and group as independent variables; Tables 4, 5). Model assumptions were assessed for all parametric approaches used. Parametric tests were used only

Table 3. SST scores and Constant scores of Group I

Score	Healed (N = 33)	Not healed (N = 9)	p value (test)
SST score: median (range)	12 (7, 12)	6 (1, 12)	0.01 (Wilcoxon rank sum test)
Constant Score: median (range)	85 (66, 98)	58 (38, 87)	0.001 (Wilcoxon rank sum test)

SST = Simple Shoulder Test.

Table 2. Demographics and shoulder scores for shoulders of different tear status from Groups I and II

Demographic	Healed (N = 33)	Tear, no repair (N = 44)	No tear (N = 156)	p value (test)
Gender: number male (%)	19 (57.6%)	23 (52.3%)	80 (51.3%)	0.85 (Fisher's exact test)
Race: number white (%)	32 (97.0%)	43 (97.7%)	155 (99.4%)	0.25 (Fisher's exact test)
Age: mean (SD)	72.7 (5.1)	74.1 (6.0)	70.6 (5.0)*	0.0003 (one-way analysis of variance)
SST score: median (range)	12 (7, 12)	9.5 (0, 12) [†]	12 (2, 12)	< 0.0001 (Kruskal-Wallis test)
Constant Score: median (range)	85 (66, 98)	71.5 (24, 98) [‡]	84 (24, 100)	< 0.0001 (Kruskal-Wallis test)

* No tear group is significantly younger than healed group ($p = 0.04$) and tear, no repair group ($p = 0.0001$) using one-way analysis of variance;

[†]tear, no repair group has significantly lower SST score than healed group ($p = 0.0002$) and no tear group ($p < 0.0001$) using Wilcoxon rank sum test; [‡]tear, no repair group has significantly lower Constant score than healed group ($p < 0.0001$) and no tear group ($p < 0.0001$) using Wilcoxon rank sum test; SST = Simple Shoulder Test.

Table 4. Estimated effects of covariates on Simple Shoulder Test scores (multiple linear regression)

Variable	Estimated effect	Standard error	p Value
Age	−0.015	0.029	0.60
Gender (female versus male)	−0.59	0.30	0.05
Race (nonwhite versus white)	1.73	1.34	0.20
No tear versus tear no repair	1.75	0.40	< 0.0001
Healed versus tear no repair	2.24	0.53	< 0.0001

Table 5. Estimated effects of covariates on Constant-Murley scores (multiple linear regression)

Variable	Estimated effect	Standard error	p Value
Age	−0.22	0.19	0.26
Gender (female versus male)	−8.1	2.0	< 0.0001
Race (nonwhite versus white)	4.0	8.8	0.65
No tear versus tear no repair	11.6	2.7	< 0.0001
Healed versus tear no repair	15.5	3.5	< 0.0001

when the model assumptions were satisfied. Analyses were carried out in SAS 9.1 (Cary, NC).

Results

The “no tear” and “healed” groups had similar SST and Constant scores. The “tear but no repair” group had lower SST score and Constant scores than the “healed” group ($p = 0.0002$ and $p < 0.0001$, respectively) and the “no tear” group ($p < 0.0001$ and $p < 0.0001$, respectively) (Table 2). The same relationships for shoulder scores held after adjusting for potential confounders age, gender, and race (Tables 3, 4). Nine rotator cuffs (from nine patients) had not healed. Although the sample size is small, the two Group I subgroups (healed or unhealed) were similar in age, gender, and race (results not shown). Those with healed repairs had higher SST ($p = 0.01$) and Constant ($p = 0.001$) scores than those with unhealed repairs (Table 5).

Two patients had complications: one an infection for which the patient underwent irrigation and débridement (his repair had failed but his shoulder was included) and one with a deep venous thrombosis and nonfatal pulmonary embolus.

Discussion

Few absolutes exist with rotator cuff disease. However, one that is appropriate is that rotator cuff tear prevalence

increases with increasing age [3, 13, 15]. Moreover, rotator cuff retears or failures to heal after repair may be more likely in aged patients [1, 8]. Given that shoulders of older patients with intact rotator cuffs have better scores than those with full-thickness cuff tears [3], it is important to understand whether full-thickness rotator cuff tear repair is warranted in older patients when their shoulders function well despite untreated tears [11] or even improve with nonsurgical treatment [7]. To date, it is unclear whether older patients with healed full-thickness tear repairs have similar scores as those who have intact rotator cuffs. Moreover, it is unclear whether patients with healed repairs have better scores than those who have full-thickness tears but have never undergone repair. We therefore asked whether in patients 65 years of age and older, shoulders with rotator cuff repairs that remained intact would have SST and Constant scores similar to those of individuals with intact rotator cuffs.

Our study has several important limitations. First, it is retrospective because our questions were asked after repairs had been performed. Yet, our goal was simply to look at shoulders with and without healed repairs and compare them with a group of their peers with and without tears. Second, the surgeon who performed all examinations, including the ultrasounds, was also the one who performed the repairs. Although potential for surgeon bias exists, our goal was not to determine cuff integrity rates after repair; rather, we wanted to study healed and unhealed tendons and compare those with shoulders of their peers. This bias could have influenced the ultrasound examination as to whether a cuff was healed or unhealed, which would influence our findings. Third, Group II may not have represented a true cross-section of the 65-year or older population. Yet, it was a valid attempt to study this group without examiner bias. Fourth, we did not attempt to quantify muscle atrophy, fatty infiltration, and retraction on MRI scans as a result of many variables, including multiple scanners. Yet, these measures involve many variables that would weaken the study. Fifth, acromioplasties were not performed in any shoulder. Based on the studies suggesting excellent clinical outcomes without acromioplasty at the time of repair [5, 6, 12], we elected not to perform them. Sixth, there is a difference between chronologic age and physiological age as Potter reminds us [14]. Some patients who are 65 years of age and older are in excellent health and have tissues that are worthy of repair. Chronologic age is clearly not the only variable to consider in the treatment of rotator cuff disease. Finally, as a result of the lack of pilot data and relevant published literature, particularly for this age group, we did not do a power calculation before the study. Therefore, the negative results we observed may be false-negatives as a result of lack of power. In addition, we did not adjust for multiple comparisons because we

considered our study to be hypothesis-generating. Although we do not believe this reduces the importance of our findings, these limitations may diminish the value of this attempt to determine whether the shoulders of patients 65 years of age and older with healed rotator cuff repairs score better than those of their peers with and without previous surgical treatment.

We found no difference in SST or Constant scores between the “healed” group and the “no tear” or essentially “normal” group. Moreover, the “tear but no repair” group had lower SST and Constant scores than the “healed” group and the “no tear” group. The same relationships for shoulder scores held after adjusting for potential confounders age, gender, and race. Although the sample size is small, the two Group I subgroups (healed or unhealed) were similar. Harryman et al. [8] were the first to use ultrasound to study rotator cuff integrity after repairs and reported 80% of their repairs were intact when the tear was confined to the supraspinatus at a minimum of 2 years after repair. However, isolated supraspinatus tears were also in patients who were younger. The average age of the patients with recurrent tears was older than that of those with a healed repair. Shoulders with healed repairs were more functional than in those that had not healed [8], a finding we also noted in our study. Galatz et al. [4] also successfully studied shoulders with ultrasound after repair, measuring tears in the transverse dimension. However, their average patient age at the time of surgery was 61 years [4]. Boileau et al. [1] reported complete healing in 71% of 67 isolated supraspinatus tears repaired based on either MRI or CT arthrography. However, they noted, on average, patients with a healed tendon were 10 years younger than those in whom the tendon did not heal [1].

In patients 65 years of age and older, we found comparable SST and Constant scores in shoulders with healed rotator cuff repairs and in untreated shoulders with intact rotator cuffs.

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