Patient adherence with postoperative restrictions after rotator cuff repair

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Hypothesis: This study aimed to measure self-reported patient adherence to postoperative restrictions after rotator cuff repair, to evaluate correlations between adherence and functional outcome, and to identify possible indicators of poor adherence. We believed that poor adherence would correlate with poor functional outcome.

Methods: Fifty consecutive patients undergoing repair for rotator cuff tears were included and instructed to wear an abduction brace for 6 weeks after surgery. Functional evaluations, including American Shoulder and Elbow Surgeons score, University of California–Los Angeles shoulder score, and Simple Shoulder Test, were made preoperatively and postoperatively. Patients commented on their adherence with a medical adherence measurement questionnaire.

Results: Average adherence was 88\% (range, 59.2-100). There were no significant correlations between adherence and improvement in American Shoulder and Elbow Surgeons, University of California–Los Angeles, or Simple Shoulder Test scores after rotator cuff repair ($P_{=.06245}$, $.5891$, and $.7688$). Of the patient demographics analyzed, only smoking status had a positive effect on adherence ($P_{=.00432}$; coefficient, 9.867). All other demographics, including hand dominance, mechanism of injury, repair complexity, comorbidities, living status, employment status, and age, had no significant effect on self-measured adherence to postoperative restrictions ($P_{=.7876}$, $.5889$, $.6444$, $.4190$, $.0609$, $.4171$, $.5402$).

Conclusions: Patients' self-reported adherence did not correlate with shoulder outcome as measured on any of 3 functional outcome scores.

Level of evidence: Level II, Prospective Cohort, Treatment Study.

Keywords: Adherence; rotator cuff repair; functional outcome; indicators; demographics; postoperative; restriction; physical therapy
a patient to remain in the arm sling, it is difficult to ensure that patients will be adequately movement restricted, given that the arm sling restriction occurs at home under normal constraints. Indeed, poor adherence has been identified by the World Health Organization as one of the greatest causes in the failure to recover from long-term illnesses.12 A study by Cuff and Pupello7 has demonstrated that poor adherence may be connected to poorer functional outcome but did not assess for possible indicators of poor adherence beyond workers’ compensation status. The purpose of this study was to investigate patients’ reported adherence to postoperative restrictions after rotator cuff repair and to evaluate whether patients’ reported adherence has a correlation with functional outcome. The secondary aim of this study was to identify particular indicators of patient nonadherence to postoperative restrictions after rotator cuff repair.

Materials and methods

Patient selection, demographics, and injury characteristics

From April 2007 to June 2009, 50 consecutive patients who underwent rotator cuff repair were enrolled in this study. These patients had rotator cuff tears diagnosed by a combination of physical examination and magnetic resonance imaging and subsequently underwent rotator cuff repair by a single operating surgeon at a single facility. All patients consented to be included in the study during regularly scheduled preoperative or postoperative visits. Of the initial 50 patients, 5 were lost to follow-up, resulting in a final enrollment of 45. Power analysis was performed and predicted a sensitivity to correlations of $r = .430$ and above, allowing type I error to be 5% and type II error to be set at 20%.

Patient demographics and injury characteristics were obtained by chart review and chosen on the basis of their implication as risk factors in other studies or clinical observation (Table I). Of the 45 patients, 18 received an isolated arthroscopic rotator cuff repair and 27 received rotator cuff repair with at least another additional procedure. Additional procedures are listed in Table II.

Functional preoperative and postoperative evaluations

Full functional evaluations were performed no more than 3 weeks preoperatively and between 6 and 25 months postoperatively with a mean and median follow-up of 12 months. Three separate standard and validated scores were used: the American Shoulder and Elbow Surgeons (ASES) score, the University of California–Los Angeles shoulder score (UCLA), and the Simple Shoulder Test (SST).9 These measurements were tabulated concurrently with a validated shoulder questionnaire during preoperative and postoperative visits. If a patient did not receive a questionnaire during the normal visit, answers were retrieved by telephone interview (8 and 12 patients for preoperative and postoperative questionnaires done by telephone, respectively). For the UCLA score, the questionnaires were supplemented by the results of a physical examination performed by a single senior author who was the primary orthopedic surgeon for enrolled patients, again at intervals no more than 3 weeks preoperatively and between 6 and 25 months postoperatively.

Adherence

Patients were instructed to wear an abduction brace for 6 weeks postoperatively with limited time out of the sling. Specifically, they were instructed that they were allowed to come out of the sling for up to a total of 1 hour per day, to do pendulum exercises 3 times per day and to perform hygiene. To measure adherence, an augmented medical adherence measurement questionnaire13 was given to patients during their 6-week follow-up appointment in the clinic (Fig. 1). Patients who did not receive the questionnaire during the 6-week follow-up appointment (12 patients) were interviewed by telephone to complete the questionnaire. Adherence
was measured on a scale from 0% to 100% by the following equation:

\[
\text{Adherence} (\%) = \left( \frac{\text{Hours of sling use}}{24} \right) \times 0.5 + \left( \frac{\% \text{ activities performed with the sling on}}{1} \right) \times 0.25 + \left( \frac{\text{Self - ranked adherence}}{10} \right) \times 0.25 \times 100.
\]

**Statistical analysis**

Total functional improvement was calculated from preoperative and postoperative ASES, SST, and UCLA scores with use of postoperative shoulder function as a unique value, absolute gain in shoulder function, and percentage gain in shoulder function. For the percentage gain analysis of the SST, the 0- to 12-scale was changed to 1 to 13 to create real values. This analysis yielded 9 separate indices for functional improvement. Each of these 9 indices was then compared with self-reported medical adherence measurement scores by linear regression. To create binary characteristics from demographic data, repairs were considered “complex” if they involved 3 or more billable procedures. The Mann-Whitney test was used to compare self-reported medical adherence measurement scores with binary demographic data. Age, the only continuous demographic data, was compared with self-reported medical adherence measurement by linear regression.
regression. R version 2.14.2 was used for all statistical analyses, with the α level set at .05.

Results

Adherence

Average adherence was 88% with a standard deviation of 10% and a negative skew. The range of adherence was 59.2 to 100 (Fig. 2).

Functional outcome

Shoulder function distributions are as follows. By use of the ASES score, average preoperative shoulder function was 23.6 (range, 3.3-76.7) and average postoperative shoulder function was 74.6 (range, 11-95). Average absolute and percentage gain in functional score were 50.9 (range, 3-88.3) and 506% (range, 115%-2650%), respectively. By use of the UCLA score, average preoperative shoulder function was 13.7 (range, 5.2-25.8) and average postoperative shoulder function was 28.5 (range, 16.5-34.5). Functional absolute and percentage gain were 6 (range, 1-12) and 275% (range, 111%-1300%), respectively. With the SST score, average preoperative shoulder function was 2.93 (range, 0-3), and average postoperative shoulder function was 9 (range, 2-12). Functional absolute and percentage gain were 6 (range, 1-12) and 275% (range, 111%-1300%), respectively.

Functional outcome as a function of adherence

There were no statistically significant correlations between any of the 9 indices of functional shoulder improvement and patient-reported adherence (Table III). There was no significant correlation between ASES-measured improvement and patient-reported adherence (P = .765, .399, and .063 for postoperative score, absolute gain, and percentage gain, respectively). The UCLA- and SST-measured improvement indices also lacked statistically significant correlations with the patient-reported adherence. (The UCLA indices had P values of .665, .739, and .589 for postoperative score, absolute gain, and percentage gain, respectively. The SST indices had P values of .141, .927, and .769 for postoperative score, absolute gain, and percentage gain.)

Adherence as a function of demographics

There were no significant correlations between injury characteristics and patient-reported adherence (Fig. 3 and Table IV). Patients who injured the dominant arm reported an average adherence of 88.1%, whereas patients who injured the nondominant arm reported an average adherence of 89.4% (standard deviation [SD] = 11.0 and 8.2; P = .788). Patients whose injuries were degenerative reported an average adherence of 89.0%, whereas patients whose injuries were traumatic reported an average adherence of 88.2% (SD = 8.3 and 11.2; P = .589). Patients with injuries requiring complex repairs reported an average adherence of 89.4%, whereas patients with injuries requiring simple repairs reported an average adherence of 87.3% (SD = 10.3 and 9.5; P = .644).

Of the patient demographics analyzed, only smoking status had a positive correlation with patient-reported adherence. Average reported adherence for smokers was 96.4, whereas average reported adherence for nonsmokers was 86.6 (SD 1.7 and 10.2; P = .004 with a coefficient of 9.867). All other demographics had no correlation with patient-reported adherence. Patients with ≤ 2 comorbidities reported an average adherence of 88.4%, whereas patients with more than 2 comorbidities reported an average adherence of 88.7% (SD = 9.1 and 11.0; P = .419). Patients living with others reported an average adherence of 90.5%, whereas patients living alone reported an average adherence of 85.1% (SD = 9.8 and 9.6; P = .061). Patients who were employed reported an average adherence of 89.3%, whereas patients who were unemployed reported an average adherence of 88.0% (SD = 10.1 and 10.0; P = .417). Age had no correlation to reported adherence (P = .540).

Discussion

Rotator cuff repair is one of the most common procedures performed by the orthopedic surgeon. However, functional outcomes after these surgeries are variable. Many factors

![Figure 2](image-url)
contribute to optimal functional outcome, and some of them are beyond the control of the surgeon.

Many studies have focused on the use of operative techniques and novel surgical approaches to improve functional outcome, but few have addressed the influence of patient behavior on functional outcome after rotator cuff repair. Although surgeons may prescribe any mode of rehabilitation and immobilization, these prescriptions do not ensure patient behavior, which means that a large factor in functional outcome is not being addressed.

When other studies have evaluated adherence related to postsurgical outcome, they have generally found that adherence is positively related to better outcomes. Poole demonstrated that patient compliance with postoperative instructions was positively correlated to weight gain and postoperative complications in patients after bariatric surgery. Cuff’s study demonstrating that patients with workers’ compensation tend to have a lower compliance rate and a poorer functional outcome after rotator cuff repairs is even more pertinent.

Our study has not replicated these findings. Although adherence is identified by the World Health Organization as a major contributing factor in the failure to recover from long-term illnesses, it is difficult to measure. Self-reported adherence is usually validated with patient surveillance or secondary sources. Because of these difficulties, our study measured adherence by use of patient questionnaires, a method that was previously validated in pediatric renal transplant patients. Recent data have demonstrated, however, that reported adherence is frequently higher than real adherence and may have little statistical value. Given the tight distribution of the reported adherence and the negative skew found in this study, it is likely that our measured reported adherence was similarly affected and has contributed to clouding any possible correlation between adherence and outcome.

<table>
<thead>
<tr>
<th>Table IV</th>
<th>Demographic indicators of reported adherence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variable</strong></td>
<td><strong>Reported adherence (standard deviation)</strong></td>
</tr>
<tr>
<td>Injury location</td>
<td></td>
</tr>
<tr>
<td>Dominant arm</td>
<td>88.1% (11.0)</td>
</tr>
<tr>
<td>Nondominant arm</td>
<td>89.4% (8.2)</td>
</tr>
<tr>
<td>Nature of injury</td>
<td></td>
</tr>
<tr>
<td>Degenerative</td>
<td>89.0% (8.3)</td>
</tr>
<tr>
<td>Traumatic</td>
<td>88.2% (11.2)</td>
</tr>
<tr>
<td>Repair complexity</td>
<td></td>
</tr>
<tr>
<td>Complex</td>
<td>89.4% (10.3)</td>
</tr>
<tr>
<td>Simple</td>
<td>87.3% (9.5)</td>
</tr>
<tr>
<td>Comorbidities</td>
<td></td>
</tr>
<tr>
<td>≤2</td>
<td>88.4% (9.1)</td>
</tr>
<tr>
<td>&gt;2</td>
<td>88.7% (11.0)</td>
</tr>
<tr>
<td>Smoking status</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>96.4% (1.7)</td>
</tr>
<tr>
<td>No</td>
<td>86.6% (10.2)</td>
</tr>
<tr>
<td>Living status</td>
<td></td>
</tr>
<tr>
<td>With friends or family</td>
<td>90.5% (9.8)</td>
</tr>
<tr>
<td>Independent</td>
<td>85.1% (9.6)</td>
</tr>
<tr>
<td>Employment status</td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>89.3% (10.1)</td>
</tr>
<tr>
<td>Unemployed or retired</td>
<td>88.0% (10.0)</td>
</tr>
</tbody>
</table>
Overall this study covers an important topic that is difficult to measure. Limitations in this study include the attrition rate of 10% and the relatively small sample size, which makes it difficult to translate general recommendations into clinical practice. Also, the surgeon was involved in recording the postoperative evaluations, and therefore the outcomes may have been potentially biased.

In searching for possible indicators of poor compliance, other studies have found that workers’ compensation, unemployment, smoking, and poor organizational skills were positively correlated with nonadherence. In our study, we found no indicators of poor adherence. Interestingly, we found that smoking contributed to improved adherence, contrary to Khdour’s findings in a chronic obstructive pulmonary disease population. These findings may demonstrate that it is not possible to find a “medical adherence” number that can describe a patient’s general adherence to all medical advice. A patient who is very adherent in postsurgical situations may not take his or her medication daily. Furthermore, there may be illness-specific risk factors for poor adherence. Interestingly, Clohisy et al found that a young age was predictive of higher adherence to appointment follow-up after total joint replacement, whereas Wheeler et al demonstrated that a young age was predictive of a lower adherence to appointment follow-up after bariatric surgery.

Given the interesting data published by other adherence researchers and the little known about postsurgical adherence, the questions left by this study are worth pursuing. Is adherence positively correlated to better outcomes, as other studies have demonstrated, or is it not? Given that the most rigorous method of observing postoperative adherence after rotator cuff repair has been intermittent scheduled visits to observe whether the patient is wearing a brace, there is certainly room for improvement in how we measure adherence. Adherence researchers evaluating thoracic-lumbar-sacral orthoses have used compliance monitors to analyze motion, which is a promising approach. Furthermore, to evaluate each possible contributor to adherence fully, a study should have more patients and more surgeons to appropriately eliminate any confounders in the patient-surgeon relationship.

Conclusions

Patient-reported postoperative adherence was not found to have a correlation with improved patient outcomes after rotator cuff repair surgery. No significant correlations between patient demographics and adherence were found with the exception of smoking, which was found to be an indicator of improved adherence \( P = .004 \). However, the study was not powered to stratify patients on the basis of smoking status, and this result merits further study.

Disclaimer

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References