Arthroscopic repair of large rotator cuff tears using the double-row technique: an analysis of surgeon experience on efficiency and outcomes

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\textbf{Background:} Arthroscopic rotator cuff repair is one of the most commonly performed procedures in the orthopaedic specialty. The goal of this study was to evaluate the effect(s) of surgical experience on efficiency and patient outcomes after double-row rotator cuff repair.

\textbf{Methods:} A retrospective review of 69 consecutive patients with large rotator cuff tears who underwent double-row arthroscopic rotator cuff repair by 1 surgeon from the start of practice was conducted. We divided the patients into 2 cohorts: group 1, early (first 18 months of study period) (n = 35), and group 2, recent (final 12 months of study period) (n = 34). Outcome measures including American Shoulder and Elbow Surgeons score, Penn Shoulder Score, and range of motion were assessed preoperatively and at final follow-up. In addition, we compared the operative times between the groups.

\textbf{Results:} At a mean follow-up of 13.25 months, both cohorts showed significant improvement (P < .001) in American Shoulder and Elbow Surgeons scores (from 47.9 to 76.5 and from 43.6 to 79.4 in groups 1 and 2, respectively) and Penn Shoulder Scores (from 45.8 to 80 and from 38.7 to 79.6 in groups 1 and 2, respectively) postoperatively. The magnitude of change and final scores were similar between the groups. Similar improvements in range of motion were noted in both groups. Patients in group 1 had a statistically significantly longer mean operative time than those in group 2 (116 minutes vs 99.7 minutes, P = .036).

\textbf{Conclusion:} Double-row rotator cuff repair provides predictable improvement in pain and function. It can be performed effectively early in a surgeon’s career. However, with experience, efficiency is improved.

\textbf{Level of evidence:} Level III, Retrospective Case-Control Design, Treatment Study.

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\textbf{Keywords:} Rotator cuff repair; arthroscopy; outcomes; learning curve

Rotator cuff repair has been associated with a high degree of functional improvement and patient satisfaction.\textsuperscript{11,22,26,28} The impact of factors such as age, obesity, chronicity, type of repair, tendon quality, gender, biceps tendinopathy, and concomitant acromioclavicular pathology has been assessed and reported.\textsuperscript{5,8,14,22,26,28} However,
literature on the impact of surgeon-specific variables—specifically, surgeon experience—on rotator repair outcomes is lacking. To our knowledge, only Guttmann et al9 have attempted to evaluate this issue. In their series of the first 100 patients who underwent rotator cuff repair in a single surgeon’s practice, they evaluated operative time as a measure of learning curve and noted a decrease in time to perform rotator cuff repair after the first 10 performed. However, functional outcomes as a result of the learning curve were not discussed. This remains to be fully elucidated as we attempt to further understand factors that affect rotator cuff repair outcomes.

The purpose of our study was to evaluate a group of patients with similar rotator cuff tear patterns (large) treated using a standardized arthroscopic double-row technique (1) to evaluate the change in operative time as one gains more experience and (2) to study the change in functional variables—specifically, American Shoulder and Elbow Surgeons (ASES) score, Penn Shoulder Score (PSS), and range of motion (ROM)—with increased experience. Our hypothesis was that with more experience, surgeries would be performed more efficiently with decreased operative times and superior functional outcomes.

Methods

We performed a retrospective review of the rotator cuff repairs performed by a single shoulder and elbow fellowship-trained surgeon, starting with his first repair. These data spanned 30 months, from November 1, 2005 to May 1, 2008.

Inclusion criteria included (1) age of 18 years or older; (2) full-thickness, large tears (3-5 cm)4; and (3) complete medical record including preoperative and postoperative data. Exclusion criteria included patients with (1) less than 6 months’ follow-up, (2) history of prior shoulder surgery, (3) significant fatty atrophy (Goutallier grade 3 or greater) as evidenced on magnetic resonance imaging (MRI), and (4) simultaneous concomitant procedures other than rotator cuff repair and subacromial decompression/acroplasty.

All patients had preoperative and postoperative functional assessment with the ASES score and PSS.13 Similarly, glenohumeral ROM was measured preoperatively and postoperatively (active abduction, forward flexion, and external rotation with elbow at neutral) by the senior author. In this study, strength was not formally assessed.

Large rotator cuff tears were initially noted on MRI and confirmed on arthroscopic examination. All patients underwent arthroscopic rotator cuff repair in the beach-chair position. Repairs were performed with double-row-equivalent arthroscopic repair techniques with concomitant subacromial decompression and acroplasty that were consistent and unchanged in the surgeon’s practice throughout the period of this study. All patients underwent the same postoperative rehabilitation protocol with clinical follow-up visits at 1 week, 6 weeks, 3 months, 6 months, and 1 year and then yearly thereafter or sooner if indicated. If the patient had regained satisfactory improvement at 6 months, he or she was given the option to return at 1 year or undergo follow-up as needed. At each time point, the previously listed data were prospectively gathered. The most recent data were used for this study. In addition, operative time logs were recorded.

Patient selection

Two hundred thirty-six full-thickness rotator cuff repairs were performed during our study period (Fig. 1). All small- and medium-sized tears were repaired with a single-row technique, whereas a double-row technique was used for large and massive tears. On the basis of our power analysis, we determined that 64 patients were needed for this study. Eighty double-row repairs for large, full-thickness tears were identified. Of these patients, 6 had less than 5 months’ follow-up, 3 had prior shoulder surgery, and 3 underwent a concomitant procedure other than rotator cuff repair and subacromial decompression with acroplasty. These 11 patients were excluded. Therefore, 69 patients meeting our criteria were included in our study. We therefore divided our patient cohort into an early group (group 1, operated on during the first 18 months of the study period, from November 2005 to April 2007) and late group (group 2, operated on during the final 12 months of the study period, from May 2007 to May 2008), amounting to 35 and 34 consecutive patients in groups 1 and 2, respectively.

Operative technique

After appropriate anesthesia was obtained (general anesthesia with interscalene block), the patient was placed in the seated beach-chair position. A standard posterior-superior arthroscopic portal and an anterior-superior instrumentation portal were established. Systematic examination of the glenohumeral joint was conducted. The arthroscope was removed from the glenohumeral joint and placed into the subacromial space. Subacromial bursectomy was performed outlining the confines of the acromion. The coracoacromial ligament was released but not resected. A posterior cutting block acroplasty was performed, converting the acromion to a type I configuration.23

Attention was then turned to the rotator cuff. The margin of the rotator cuff was debrided back to a healthy tendon stump. The mobility of the rotator cuff was assessed. The footprint of the greater tuberosity was lightly decorticated. Arthrex (Naples, FL, USA) bioabsorbable fully threaded 5.5-mm suture anchors were placed along the footprint of the greater tuberosity. Sutures were shuttled through the rotator cuff in standard fashion, from posterior to anterior. Sutures were retrieved out of a working cannula and sequentially tied, reapproximating the rotator cuff.

We then performed a modified double-row suture bridge technique using Arthrex bioabsorbable 4.75-mm PushLock anchors. We used PushLock anchors approximately 2.5 cm lateral to our medial row. We shuttled sutures through the eyelet of the anchor(s) and impacted them into bone in standard fashion. This reapproximated the footprint.

Statistical analysis

Statistical analysis included repeated analysis of variance to assess for the significance of between-group differences in change in outcome scores, operative times, and ROM over the follow-up period. To compare improvements from preoperatively to
postoperatively, we found that to detect a difference, we would need 64 patients to obtain 80% power and a type I error rate of .05.

Results

This study included 69 patients, 35 in the early group and 34 in the late group. The mean ages of patients were similar between the groups: 63.1 years and 65.3 years in groups 1 and 2, respectively. Patients in groups 1 and 2 were followed up for a mean of 12.9 months (range, 6-34 months; SD, 8.5 months) and 13.6 months (range, 6-28 months; SD, 5.5 months), respectively. Both groups were noted to be similar in terms of demographics (Table I).

Operative time and function

A significantly shorter operative time was noted in group 2 (99.7 minutes vs 116 minutes, \( P = .036 \)) (Table II). In terms of clinical function and scoring, both groups showed significant improvement \( (P < .001) \) in ASES score (from 47.9 to 76.5, and from 43.6 to 79.4 in groups 1 and 2, respectively) and PSS (from 45.8 to 80, and from 38.7 to 79.6 in groups 1 and 2, respectively) postoperatively (Fig. 2). However, the early and late cohorts had equivalent increases in final ASES score \( (P = .5) \) and PSS \( (P = .9) \).

Range of motion

Both groups had similar ROM preoperatively. A statistically significant but similar improvement in abduction (from 78.7° to 91.8° \( [P < .001] \) in group 1 and from 73° to 88.6° \( [P < .001] \) in group 2) and forward flexion (from 131.9° to 147.5° \( [P = .008] \) in group 1 and from 116° to 140.8° \( [P = .002] \) in group 2) after surgery was noted in both groups. In terms of external rotation, improvement that did not reach statistical significance was noted in both groups. The change in abduction \( (P = .25) \), forward flexion \( (P = .86) \), and external rotation \( (P = .67) \) was similar between the groups (Table II).

Of the 69 patients, 4 noted recurrence of their symptoms and, on repeat MRI, were shown to have recurrent tears. Of these patients, 2 (5.7%) (tear noted at a mean of 9 months after surgery) were in group 1 and 2 (5.9%) (tear noted at a mean of 11 months after surgery) were in group 2. Both patients in group 1 and 1 patient in group 2 underwent revision surgery. No complications were noted.

Discussion

Rotator cuff repair has become one of the most commonly performed orthopaedic surgical procedures with relatively

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Table I  Patient demographic data

<table>
<thead>
<tr>
<th>Demographic variables</th>
<th>Group 1 (early)</th>
<th>Group 2 (late)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>35</td>
<td>34</td>
</tr>
<tr>
<td>Age (yr)</td>
<td>63.1 ± 8.7</td>
<td>65.3 ± 9.8</td>
</tr>
<tr>
<td>Male</td>
<td>18 (51%)</td>
<td>17 (49%)</td>
</tr>
<tr>
<td>Female</td>
<td>16 (47%)</td>
<td>18 (53%)</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>29.4 ± 5.2</td>
<td>30.3 ± 6.0</td>
</tr>
<tr>
<td>Tobacco use</td>
<td>3 (9%)</td>
<td>4 (12%)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>9 (12%)</td>
<td>10 (13%)</td>
</tr>
<tr>
<td>Injury variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acute tear</td>
<td>11 (31%)</td>
<td>11 (32%)</td>
</tr>
<tr>
<td>Chronic tear</td>
<td>24 (69%)</td>
<td>23 (68%)</td>
</tr>
</tbody>
</table>
consistent good clinical results reported.\textsuperscript{18,21,22} The techniques used to approach rotator cuff surgery have evolved over the years from open to arthroscopic. Correspondingly, recent reports have failed to show significant advantages of the open and mini-open approaches compared with the arthroscopic approach in terms of clinical and functional outcomes.\textsuperscript{12,20,24,25}

Despite satisfactory results with arthroscopic repair, the impact of the learning curve on results has not been formally addressed. In the study of Guttmann et al.\textsuperscript{9} an increase in surgical proficiency in terms of operative time was noted with repetition. However, no attempt was made to study the potential effects of experience on final clinical outcomes. The impact of experience on patient outcomes is important because it allows us to better inform our patients and provide a metric for what a surgeon may expect when starting his or her practice or a new technique.

Patients with large rotator cuff tears repaired with a double-row technique were isolated and evaluated. We believed that investigating this group, as opposed to those with smaller tears treated with single-row repair, would allow us to better identify the possible effect(s) of the learning curve. Consequently, we noted quicker operative times with more experience. In keeping with published reports, we noted satisfactory results with improvement in ROM, ASES score, and PSS after rotator cuff repair in both groups. These changes were similar among patients in both groups. This finding serves not only as a testament to current results with arthroscopic rotator cuff repair but may also indicate that with a meticulous and principle-based approach, one can note good results in the early stages of one’s career.

Our study has several limitations. It is a retrospective study and subject to the limitations of such; however, data used for this study were obtained from a continuously updated prospective database on all patients operated on. Our study was limited to patients with over 6 months’ follow-up, and our mean follow-up was 12.9 months and 13.6 months in groups 1 and 2, respectively. Patients were seen until satisfactory improvement was noted according to our typical rotator cuff repair protocol. It is possible that our results may be different with longer follow-up. Our results are also based on the results of 1 shoulder and elbow fellowship-trained surgeon. Although this provides the advantage of a monolithic surgical approach across both patient groups, the results may differ depending on type of surgical training, skill, and approach used. In addition, results may change with the inclusion of different rotator

\begin{table}
\centering
\begin{tabular}{|l|l|l|}
\hline
 & Group 1 (early) & Group 2 (late) & \textit{P} value \\
\hline
Operative time (min) & 116 ± 41 & 99.68 ± 17.7 & .036 \\
ROM (°) & & & \\
Preoperatively & & & \\
Forward flexion & 131.9 ± 33.1 (range, 120-143) & 116 ± 46 (range, 100-132) & .10 \\
Abduction & 78.7 ± 16.4 (range, 73-84) & 73 ± 26 (range, 60-82) & .28 \\
External rotation & 33.3 ± 8.8 (range, 30-36) & 33.8 ± 15.3 (range, 29-39) & .87 \\
Postoperatively & & & \\
Forward flexion & 147.5 ± 13.5 (\textit{P} = .008\textsuperscript{*}) & 140.8 ± 18.2 (\textit{P} = .002\textsuperscript{*}) & .86\textsuperscript{1} \\
Abduction & 91.8 ± 9.4 (\textit{P} < .001\textsuperscript{*}) & 88.6 ± 12.7 (\textit{P} < .001\textsuperscript{*}) & .25\textsuperscript{1} \\
External rotation & 38.8 ± 4.5 (\textit{P} = .061\textsuperscript{*}) & 37.8 ± 10.3 (\textit{P} = .79\textsuperscript{*}) & .67\textsuperscript{1} \\
\hline
\end{tabular}
\caption{Operative variables and ROM between cohorts of patients}
\end{table}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure2.png}
\caption{Change in ASES score (A) and PSS (B) in both groups from preoperatively (Pre-op) to postoperatively (Post-op).}
\end{figure}
cuff tear patterns. Finally, we did not evaluate the difference in healing between the groups. In keeping with the literature, it is possible that despite satisfactory improvement in the ASES score and PSS, the rate of healing and possible retears may not be consistent. In addition, studies documenting better outcomes or fewer adverse events among fellows treating pediatric supracondylar fractures in an academic setting suggested attending supervision in the first 15 cases performed by the fellows. A recent study evaluating the learning curve among fellows treating pediatric supracondylar fractures in an academic setting suggested attending supervision in the first 15 cases performed by the fellows. We noted improved efficiency but similar improvement in function. Further studies looking at in vivo structural integrity of rotator cuff repair with increasing experience may more clearly define its role.

Conclusion

This study provides insight as to the effects of surgical experience on outcomes. In 2 patient cohorts, we noted that satisfactory results after rotator cuff repair are attainable early in one’s practice albeit with possibly longer operative times. Further research is required to better elucidate training-specific factors that better prepare surgeons entering practice.

Disclaimer

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References


