Recurrence rotator cuff tear: is ultrasound imaging reliable?

Ron Gilat, MDa,1, Ehud Atoun, MDb,1,*, Ornit Cohen, BEng, MScb, Oren Tsvieli, MDb, Ehud Rath, MDb, Dror Lakstein, MDb, Ofer Levy, MD, MCh(Orth), FRCSf

aDepartment of Orthopedic Surgery, Assaf Harofeh Medical Center, Zerifin, Israel
bFaculty of Health Sciences, Ben-Gurion University of the Negev, Barzilai Medical Center Campus, Ashkelon, Israel
cMayanei Hayeshua Medical Center, Bnei Brak, Israel
dDepartment of Orthopedic Surgery, Tel Aviv Medical Center (Affiliated With Sackler Faculty of Medicine and Tel Aviv University), Tel Aviv, Israel
eOrthopedic Department, E. Wolfson Medical Center (Affiliated With Sackler Faculty of Medicine and Tel Aviv University), Tel Aviv, Israel
fReading Shoulder Unit, Royal Berkshire Hospital, Reading, UK

Background and hypothesis: The diagnostic workup of the painful shoulder after rotator cuff repair (RCR) can be quite challenging. The aim of this study was to assess the reliability of ultrasonography (US) for the detection of recurrent rotator cuff tears in patients with shoulder pain after RCR. We hypothesized that US for the diagnosis of recurrent rotator cuff tear after RCR would not prove to be reliable when compared with surgical arthroscopic confirmation (gold standard).

Methods: In this cohort study (diagnosis), we retrospectively analyzed the data of 39 patients with shoulder pain after arthroscopic RCR who had subsequently undergone US, followed by revision arthroscopy. The rotator cuff was evaluated first using US for the presence of retears. Thereafter, revision arthroscopy was performed, and the diagnosis was either established or disproved. The sensitivity and specificity of US were assessed in reference to revision arthroscopy (gold standard).

Results: A rotator cuff retear was indicated by US in 21 patients (54%) and by revision arthroscopy in 26 patients (67%). US showed a sensitivity of 80.8% and specificity of 100% in the diagnosis of rotator cuff retears. Omission of partial rotator cuff retears resulted in a spike in sensitivity to 94.7%, with 100% specificity remaining.

Conclusion: US imaging is a highly sensitive and specific test for the detection of recurrent rotator cuff tears, as confirmed by revision arthroscopy, in patients with a painful shoulder after primary RCR.

Level of evidence: Level III; Diagnostic Study

© 2017 Journal of Shoulder and Elbow Surgery Board of Trustees. All rights reserved.

Keywords: Rotator cuff tear; painful shoulder; rotator cuff repair; retear; revision; ultrasound

This research was approved by the Institutional Review Board (Helsinki Committee), Royal Berkshire Hospital, Reading, UK (No. N4442).

*These authors contributed equally to this article and share first authorship.

Reprint requests: Ehud Atoun, MD, Barzilai Medical Center, Ha-Histadrut St 2, Ashkelon, 7830604, Israel.
E-mail address: dratoun@gmail.com (E. Atoun).

1058-2746/ - see front matter © 2017 Journal of Shoulder and Elbow Surgery Board of Trustees. All rights reserved.
https://doi.org/10.1016/j.jse.2017.12.017

Recurrent rotator cuff tears after rotator cuff repair (RCR) are common and found to be a major cause of postoperative pain. Retear rates are approximated at 7% to 17% for small tears and up to 41% to 94% for large and massive tears.
Retears most commonly occur up to 6 months after the operation.\textsuperscript{8}

The postoperative diagnosis of a recurrent rotator cuff tear can be quite challenging. There are a few factors that may preclude the correct diagnosis of a retear, for instance, different healing processes (inflammation, hematoma, edema, fibrosis, and so on), surgical implants (e.g., suture anchors), and the presence of other postoperative complications (e.g., stiffness, deep infection, implant failure, and chondrolysis) (Figs. 1–4).

Although magnetic resonance imaging (MRI) was found to be relatively accurate in detecting full-thickness tears after repair, it was found to be prone to producing artifacts when implants were present.\textsuperscript{7} Previous studies also reported that MRI is less efficient in the detection of partial cuff tears, which can be indistinguishable from repaired tendons.\textsuperscript{7,12} Moreover, MRI and magnetic resonance arthrography are relatively expensive, are not always available, and are contraindicated in some patients.\textsuperscript{2}

Ultrasonography (US) is inexpensive and readily accessible, and it allows for dynamic testing. Studies have demonstrated that US imaging is a reliable method for the diagnosis of rotator cuff retears.\textsuperscript{6,14} However, these studies included a significant number of patients who underwent operations other than RCR, such as subacromial decompression, acromioplasty, or other procedures without RCR.

Several other studies have used US to diagnose complications in patients with shoulder pain after RCR. However, surgical confirmation of the diagnosis was either incomplete or missing.\textsuperscript{6,8,11} The aim of this study was to assess the diagnostic reliability of US for the detection of rotator cuff tears in patients with shoulder pain after RCR with the use of shoulder arthroscopy as the gold standard.
Materials and methods

Patient population

We retrospectively searched our database for patients who underwent shoulder arthroscopy in our institute between January 1, 2006, and December 31, 2011, to locate those with shoulder pain after arthroscopic RCR who had subsequently undergone US, followed by revision arthroscopy. The inclusion criteria comprised patients with a painful shoulder, previous arthroscopic RCR, US of the rotator cuff after RCR, and revision arthroscopy. The exclusion criteria were patients who underwent surgery other than RCR on the index shoulder, previous proximal humeral fracture, and inflammatory arthropathy of the index shoulder.

Operative technique

Shoulder arthroscopy was performed with the patient in the lateral decubitus position. All revision arthroscopies began with a primary survey of the shoulder, followed by assessment of rotator cuff integrity and investigation for other possible pathologies. The surgeon noted the presence or absence of a rotator cuff tear. Rotator cuff tears were delineated into full-thickness, partial bursal-side, and partial joint-side tears. Arthroscopic images of all tears and other pathologies were recorded by the surgeon. All revision arthroscopies were performed by a single surgeon.

US imaging technique

All patients underwent diagnostic US of the painful shoulder with a US scanner (Sonosite 180; Sonosite, Bothell, WA, USA). By use of a linear 3- to 11-MHz transducer, the US depth was adjusted to accommodate for differences in soft-tissue mass among the patients with ranges between 3 and 5 cm. All sonographic examinations were performed by a single experienced shoulder surgeon, who performed an average of 30 shoulder US examinations per week for more than 20 years.

The examination was performed with the patient lying supine on the examination table. A standard systematic sonographic examination of the shoulder was performed, assessing the supraspinatus, infraspinatus, and subscapularis tendons in both the longitudinal and transverse planes.

US criteria

A continuous complete rotator cuff was considered to be intact in the absence of a focal defect or sign of retraction or avulsion. A full-thickness rotator cuff tear was diagnosed in the presence of a defect that extended from the bursal side of the tendon to the articular margin. A finding of a partial-thickness tear was recorded when a focal defect was present either on the articular surface or on the bursal surface of the rotator cuff.

Statistical analysis

We assessed the diagnostic sensitivity and specificity of US for the detection of rotator cuff tears (either complete or incomplete) compared with revision arthroscopy as the gold standard. We also performed a second sensitivity and specificity analysis omitting patients with partial rotator cuff tears. We used the \( \chi^2 \) test to assess the correlation between rotator cuff integrity as indicated by US and revision arthroscopy findings as viewed by the surgeon. Finally, we used the Spearman rank correlation coefficient to analyze the correlation between rotator cuff tear size as quantified by US and revision arthroscopy findings (intact rotator cuff, partial bursal-side tear, partial joint-side tear, or full-thickness tear). Analysis was performed using SPSS Statistics for Windows (version 22.0 [2013 release]; IBM, Armonk, NY, USA).

Results

Demographic characteristics

Thirty-nine consecutive patients with an average age of 66 years (range, 39-81 years) met our inclusion and exclusion criteria and were included in the study. A rotator cuff retear was revealed by US in 21 patients (54%). An intact rotator cuff was indicated by US in 18 patients (46%).

Arthroscopic surgery revealed 26 rotator cuff retears (67%). Of these, 19 were full-thickness tears (73%), 5 were joint-side tears (19%), and 2 were bursal-side tears (8%). An intact rotator cuff was demonstrated via arthroscopy in 13 patients (33%).

US reliability

US showed a sensitivity of 80.8% and specificity of 100% in the diagnosis of rotator cuff retears (Table I). The likelihood ratio was 0.192. When we omitted partial rotator cuff retears, the sensitivity spiked to 94.7%, with 100% specificity (Table II). The correlation between rotator cuff integrity as indicated by US and revision arthroscopy findings as viewed by the surgeon was statistically significant with \( P = .001 \) by use of the \( \chi^2 \) test.

<table>
<thead>
<tr>
<th>Table I</th>
<th>Sensitivity and specificity of US in diagnosis of rotator cuff retear</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surgery</td>
</tr>
<tr>
<td></td>
<td>Positive</td>
</tr>
<tr>
<td>US</td>
<td></td>
</tr>
<tr>
<td>Positive Count</td>
<td>21</td>
</tr>
<tr>
<td>%</td>
<td>80.8%</td>
</tr>
<tr>
<td>Negative Count</td>
<td>5</td>
</tr>
<tr>
<td>%</td>
<td>19.2%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

US, ultrasonography.
Table II  Sensitivity and specificity of US in diagnosis of rotator cuff retear after omission of partial tears

<table>
<thead>
<tr>
<th>Surgery</th>
<th>Positive</th>
<th>Negative</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>18</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>%</td>
<td>94.7%</td>
<td>0.0%</td>
<td>56.25%</td>
</tr>
<tr>
<td>Negative</td>
<td>1</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>%</td>
<td>5.3%</td>
<td>100.0%</td>
<td>43.75%</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>13</td>
<td>32</td>
</tr>
<tr>
<td>%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

US, ultrasonography.

Discussion

Treating patients with shoulder pain after RCR can pose a challenge to the orthopedic surgeon. There is limited evidence to support which diagnostic workup should be offered to these patients. We are not aware of any study assessing the reliability of US in these complex patients, with surgical confirmation. Our study shows that US is highly sensitive and specific in diagnosing rotator cuff retears in this group of patients.

Earlier studies have reported on the use of US for the diagnosis of rotator cuff retears. Mack et al. studied 53 patients (60 shoulders) who underwent acromioplasty with or without RCR. Of the patients who underwent RCR (43 patients [50 shoulders]), only 27 had undergone surgical confirmation for rotator cuff retears. US accurately diagnosed 26 of the 27 rotator cuff retears. The authors concluded that US was effective in diagnosing recurrent rotator cuff tears. Prickett et al. studied the accuracy of US imaging of the rotator cuff in patients with postoperative shoulder pain. They studied 44 patients, 34 of whom underwent RCR and 10 of whom underwent decompression, débridement, or an instability procedure. They found US to have an accuracy of 89%. However, interpretation of the results of these studies might be misleading as they have reported on heterogeneous groups of patients and surgical confirmation was lacking.

Previous studies have also evaluated the efficacy of MRI in the diagnosis of rotator cuff retears. Magee et al. reported that MRI had an 84% sensitivity and 87% specificity in detecting recurrent rotator cuff tears. The study included patients who underwent arthroscopic RCR, as well as patients who underwent open repair, cuff débridement, and acromioplasty. They also reported that MRI had a positive predictive value of 56% in the detection of partial supraspinatus tears. Motamed et al. studied 37 patients and assessed recurrent rotator cuff tear presence and size as determined by MRI. They reported that MRI had a 91% sensitivity and 25% specificity in detecting recurrent rotator cuff tears. They found MRI to have a tendency toward overdiagnosing retears in the postsurgical patients. It is our notion that this high false-positive rate attributed to MRI could clearly result in wrongly indicated and redundant reoperations.

As described earlier, previous studies have evaluated the use of postoperative US of the shoulder. However, these studies included a heterogeneous group of operations (RCR, acromioplasty, and more). Moreover, surgical confirmation of these results was only partial in most studies. Last, in most cases, it was unspecified whether the evaluation of patients in the studies was because of postoperative shoulder pain or, alternatively, routine follow-up.

Our study evaluates the reliability of postoperative US after RCR in the patient with shoulder pain. We have found US to be highly reliable in the detection of rotator cuff retears, as confirmed by arthroscopy. We find US in these cases to be highly useful as it is reliable, it is inexpensive, it allows for a dynamic evaluation, and it is readily accessible.

Our study is not without limitations. We describe a retrospective evaluation of a relatively small group of patients. Another limitation is the lack of comparison with MRI in this group of patients; MRI is not routinely performed in our practice before revision cases, while US is performed by the attending physician during every clinic visit. There is no gold standard for the detection of a partial intratendinous tear; none of the patients in our cohort had sonographic signs of a partial intratendinous rotator cuff tear. A possible explanation might be the location of cuff failure after RCR as compared with a primary rotator cuff tear, in which the tear originates in the midsubstance in a significant percentage of the cases. We could not find previous studies that discussed this issue. In 2 cases in which an intratendinous tear was suspected, saline solution was injected into the area but yielded a negative “bubble sign” finding. In addition, we could not include patients with negative or positive sonographic findings who did not consent to undergo revision surgery because of the inability to obtain the gold-standard arthroscopic findings. Nevertheless, our study group contained a very homogeneous group of patients, who were treated in 1 facility by a single surgeon.

Conclusion

US is a useful tool for the diagnosis of rotator cuff retears in patients presenting with shoulder pain after RCR. Caution should be taken when a partial rotator cuff is suspected and US imaging findings are negative. In these cases, physicians should be advised to consider a repeat US examination, MRI, and/or diagnostic arthroscopy.

Disclaimer

The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.
References