Acromial shapes and extension of rotator cuff tears: Magnetic resonance imaging evaluation

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Magnetic resonance imaging makes it possible to inspect the status of the rotator cuff and the shape of the acromion. To clarify the relationship between acromial shapes and rotator cuff tears, we evaluated magnetic resonance images obtained in 192 shoulders. We classified the acromial shapes into 3 types: type I (flat), type II (curved), and type III (hooked). Among a group of 91 shoulders with rotator cuff tears, 33 (36.3%) were type I, 22 (24.2%) type II, and 36 (39.6%) type III. The size of rotator cuff tears in type III acromions was significantly larger than in type I or II acromions. Comparison of the incidence of each acromial shape between groups of specimens with and without rotator cuff tears revealed no significant differences. We suggest that whereas acromial shapes have a bearing on the extent of rotator cuff tears, the correlation between rotator cuff tears and a type III acromion is not as strong as has been suggested in the literature. (J Shoulder Elbow Surg 2002;11:576-8.)

Bigliani et al1 classified acromial morphology into type I (flat), type II (curved), and type III (hooked). They reported that type III acromion was most often found in cases of rotator cuff tears (RCTs) and that type III tended to cause impingement, an important factor in the development of RCT. However, Gohlke et al3 found no hooked acromion in cadavers with RCT. Ozaki et al9 suggested that acromial morphology was acquired as a result of RCT. As few comparison studies have been performed between the age-matched individuals with and without RCT,5 a causative relationship between acromial shape and RCT remains unclear.

With only a plain radiograph of the acromion in the supraspinatus outlet view,7 it is sometimes difficult to distinguish the hooked acromion from the non-hooked acromion with anterior spurs. Taking advantage of the ability of magnetic resonance imaging (MRI) to visualize both the acromial shape and the status of the rotator cuff, we attempted to elucidate the relationship between acromial shapes and RCT.

MATERIALS AND METHODS

Study 1

There were 91 patients with complete RCT (mean age, 62.5 years; range, 26-92 years). The diagnosis of RCT was based on the results of surgery, arthrography, or MRI studies. All cases were studied at 0.5 T (Gyroscan T5H; Philips medical systems, Best, The Netherlands). To determine the size of the RCT in 91 shoulders, we measured its largest extent in the coronal plane along the long-axis of the supraspinatus tendon and in the sagittal oblique plane on T2-weighted images (TR 2400 ms, TE 85 ms). In our previous diagnostic study of complete RCT by MRI, sensitivity was 100%, specificity was 76.9%, and accuracy was 89.2%.4

The acromial shape was evaluated from the sagittal oblique plane with the use of T2-weighted images (TR 2400 ms, TE 85 ms) and a 5-mm slice thickness. This sagittal oblique plane was parallel to the glenoid surface (Figure 1, A). The images obtained just lateral to the acromioclavicular joint were selected. The classification of acromial shapes previously described by Bigliani et al1 was performed blindly by 2 observers, into 3 types. The criteria of classification by MRI were made as follows. In type I the undersurface of the acromion was straight. When the vertex of the curve at the undersurface of the acromion lay in the middle third of the acromion, the specimen was defined as type II. When the vertex lay in the anterior third, it was defined as type III (Figure 1, B). The size of the RCT was compared between types of acromial shape.

Study 2

To investigate the incidence of each acromial shape, we compared the age-matched complete RCT group (n = 79; mean age, 60.5 years; range, 40-78 years) with the non-RCT group (n = 72; mean age, 59.6 years; range, 42-77 years). Of the latter group, 40 had periarthritis, 19 had a dislocation or fracture, and 13 were asymptomatic. The majority of the study 2 subjects were between the fifth and seventh decades of life, and there was no significant age difference between the groups.

The Mann-Whitney U test was used to determine the significance of differences in RCT size. χ² for independent testing (m × n contingency table) was used to determine the significance of the incidence of each acromial shape in both non-RCT and RCT groups. P < .05 was considered to be significant.

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RESULTS

Study 1

Three distinct acromial shapes were identified by this study as shown in Figure 2. These images demonstrated the real acromial shape as high-signal intensity without subacromial spurs. We demonstrated that, in 91 shoulders with complete RCT, the acromial shapes of 33 shoulders were type I (36.3%), 22 type II (24.2%), and 36 type III (39.5%). As shown in Table I, the RCT size of type III acromions was significantly larger than that of type I or II acromions (P < .05).

Table I Sizes of RCTs of each acromial shape on T2-weighted MRI

<table>
<thead>
<tr>
<th>Acromial shape</th>
<th>Diameter in coronal oblique plane (cm)</th>
<th>Diameter in sagittal oblique plane (cm)</th>
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<tbody>
<tr>
<td>Type I (n = 33, 36.3%)</td>
<td>1.9 ± 1.4</td>
<td>1.8 ± 1.2</td>
</tr>
<tr>
<td>Type II (n = 22, 24.2%)</td>
<td>2.0 ± 1.4</td>
<td>1.7 ± 1.2</td>
</tr>
<tr>
<td>Type III (n = 36, 39.5%)</td>
<td>2.7 ± 1.4*</td>
<td>2.4 ± 1.3*</td>
</tr>
</tbody>
</table>

*P < .05 type III vs type I or type II.

Study 2

In 72 shoulders in the non-RCT group, type I acromion appeared in 34 cases, type II in 14 cases, and type III in 24 cases. In 79 shoulders in the RCT group, type I acromion appeared in 31 cases, type II in 16 cases, and type III in 32 cases. When age-matched
RCT and non-RCT groups were compared, there was no statistically significant difference in the incidence of each acromial shape ($P = .5791$; Figure 3).

**DISCUSSION**

Our goal was to clarify the relationship between acromial shape and RCT. Therefore, we selected T2-weighted MRI to classify the shapes, which were evaluated from the sagittal oblique plane. These images demonstrated the real acromial shape as high-signal intensity without subacromial spurs. As the images obtained just lateral to the acromioclavicular joint consistently demonstrated the longest dimension of the acromion, these were selected to define the acromial shape.

Bigliani et al showed a relationship between acromial shape and RCT and devised a subjective acromial classification that is commonly used. This classification system is based on the anterior slope of the acromion taken from a supraspinatus outlet radiograph in the sagittal plane only. Outlet views are often technician-dependent and difficult to interpret in terms of acromial shape. We define an objective acromial classification with the use of MRI.

In our study, as in series reported by other authors,1,5,6,8,10 the type III acromion was the most common in patients with RCT. We found that in the type III (hooked) acromion, the RCT size was significantly larger than in type I or II acromion. Our study suggests that acromial shape influences RCT size. Shoulder surgeons often encounter a damaged bursal-side rotator cuff in patients with a hooked acromion, an observation that supports our suggestion.

However, when age-matched patients with and without RCT were compared, the occurrence rate of type III acromial shape in the RCT group was not significantly high. This suggests that the type III acromion does not always correlate with the occurrence of RCT. Some other morphological factors may contribute to irritation of rotator cuff tendons mechanically. Further study to elucidate this problem is necessary in the future.

The etiology and pathogenesis of RCT continue to be debated. According to Neer,7 the majority of RCTs are the result of subacromial impingement, and acromioplasty is based on that concept. On the other hand, Ozaki et al suggested that acromial morphology was acquired as a result of RCT. Nicholson et al reported that acromial shape was independent of age and a primary anatomic characteristic, that anterior acromial spur formation was an age-dependent process, and that it was possible that acromial changes may be a result rather than a cause of RCT. Our study did not investigate the cause-and-effect relationship between acromial shapes and RCT.

The non-RCT group in our study included not only asymptomatic but also symptomatic shoulders, and this may have influenced our results. Farley et al reported that a thickened coracoacromial ligament and anterior acromial spurs were significantly related to supraspinous tendon tears. We did not analyze the coracoacromial ligament or anterior acromial spurs.

In this series the RCT size with a type III acromion was significantly larger than that of type I or II, suggesting that acromial shapes affected RCT size. Our results suggest that the correlation between RCT and type III acromion is not as strong as has been described in the literature, whereas acromial shapes have a bearing on the extent of the RCT.

**REFERENCES**