

Clinical Correlation between Rotator Cuff Tear with Acromion Angulation on MRISaurabh Patel¹, Dishant Mehta², Nirav Rathi³, Mitul Patel⁴^{1,3,4}Assistant Professor, Department of Orthopaedics, GMERS Medical College, Sola, Ahmedabad²Orthopaedic Surgeon, Department of Orthopaedics, GMERS Medical College, Ahmedabad

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Abstract

Background and Aim: Many individuals experiencing on-going shoulder discomfort due to impingement often undergo magnetic resonance imaging (MRI) to further assess their condition. No previous studies have provided data on the downward angulation of the acromion in relation to CAL thickness, SAS narrowing and eventual RTC deterioration. In this study, we aimed to analyse the acromion angle in relation to RTC tears and establish a range of measurements for CAL thickness and SAS distance using MRI, providing valuable insights into these parameters.

Material and Methods: The study included patients between the ages of 25 and 60 who were admitted to the Department of Orthopaedics at GMERS Medical College and Hospital Sola in Ahmedabad, Gujarat over a one-year period. The data was collected from electronic records of the hospital and then inputted into a Google form before being exported to Microsoft Excel 2007. We gathered information about the demographics. We documented the side of injury, acromial shape (flat, curved, hooked, or convex inferior surface), type of RCTs (partial or complete), and the muscle injured (supraspinatus, infraspinatus, subscapularis, and teres minor), just like a health journalist would.

Results: The flat shape was the most commonly associated shape with RCTs in both male and female patients, with no significant difference between the two ($p > 0.05$). On the other hand, the hooked shape was found to be the least prevalent in men, while the convex shape was the least prevalent in women. According to the data in Table 1, the supraspinatus muscle was found to be the most frequently injured muscle, with a prevalence of 71.6% among both male and female patients. Most of these injuries occurred without any additional muscle involvement. There were 45 patients identified in partial RCTs. The supraspinatus muscle was found to be the most commonly affected by partial tears, followed by the subscapularis and infraspinatus muscles. In cases of partial tears, a flat acromial shape was most frequently identified, followed by curved, convex, and hooked shapes in relation to tears in the supraspinatus and subscapularis muscles.

Conclusion: There is no connection between acromial shape and sex, regardless of the specific muscle that is injured. There is a significant relationship between supraspinatus injury, acromial shape, and sex. It has been observed that women aged ≥ 50 years with flat acromia are more prone to right-side partial tear injuries compared to other rotator cuff tears.

Keywords: Acromial Anatomy, Magnetic Resonance Imaging, Rotator cuff tears, Supraspinatus.

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Introduction

Shoulder pain and disability can be attributed to rotator cuff disease and impingement syndrome, which are common culprits. The rotator cuff is made up of four muscles - the supraspinatus, infraspinatus, subscapularis, and teres minor. These muscles play a crucial role in ensuring the stability and strength of the shoulder joint. The supraspinatus tendon is the most frequently injured among these four muscles. [1] The development of a rotator cuff tear (RCT) involves multiple factors, with various risk factors contributing to the injury. These risk factors can be categorised as either

intrinsic or extrinsic. Some factors that can contribute to the issue are degenerative changes, hypovascularity, and abnormalities in collagen fibres. There are several factors that can contribute to this condition, including subacromial impingement, stretch overload, the shape of the acromion, and the formation of acromial spurs. [2] In 1972, Neer initially documented RTC impingement associated with the anteroinferior part of the acromion, categorising it into three stages. According to the description, the disease starts in younger patients and eventually leads to RTC tears.

[3,4] Further studies delve into the details of acromion shape, angulation, and configuration in relation to RTC pathology. The relationship between acromion angulation, the coracoacromial ligament (CAL), and the subacromial space (SAS) is a complex interplay that contributes to subacromial impingement. [5-7] in previous studies, researchers have discussed various aspects of the acromion, such as its type and configuration, by analysing radiographic images and anatomical specimens. In addition, differences in the structure and shape of the CAL are linked to different levels of degeneration in anatomical samples. [8,9] It seems that the biomechanics are connected to the steep acromion angle, which may lead to friction of the CAL along the bursal fibres of the supraspinatus (SST) and infraspinatus tendons (IST). Increased tension in the undersurface fibres can lead to tears in the articular surface of the SST and IST. [10]

Many individuals experiencing on-going shoulder discomfort due to impingement often undergo magnetic resonance imaging (MRI) to further assess their condition. The relationship between the downward angulation of the acromion, CAL thickness, SAS narrowing, and RTC deterioration has not been previously documented. There have been limitations in studying the correlation between MRI findings of acromial shape and RTC pathology. These limitations arise from variations in positioning, slice selection, and interobserver variability. [11-13]

In this study, we aimed to analyse the acromion angle in relation to RTC tears and establish a range of measurements for CAL thickness and SAS distance using MRI.

Material and Methods

The study included patients between the ages of 25 and 60 who were admitted to the Department of Orthopaedics at the GMERS Medical College and Hospital Sola in Ahmedabad, Gujarat over a one-year period. We conducted a thorough analysis of the presence of RCTs by retrospectively reviewing MRI data.

Here are the exclusion criteria: Shoulder pain can arise from various causes, including fractures, shoulder surgery, osteoarthritis, inflammatory arthritis, congenital deformities, unstable or frozen shoulder, septic shoulder, bone tumours, and calcified tendinitis.

The data was collected from electronic records of the hospital and then inputted into a Google form before being exported to Microsoft Excel 2007. We gathered demographic information such as sex, age, and medical record number, ensuring the privacy of patients by not collecting any names. We documented the side of injury (right or left),

acromial shape (flat, curved, hooked, or convex inferior surface), type of RCTs (partial or complete), and the muscle injured (supraspinatus, infraspinatus, subscapularis, and teres minor).

Statistical Analysis

The recorded data was organised and inputted into a spread sheet computer programme (Microsoft Excel 2007) before being transferred to the data editor page of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA). Quantitative variables were reported using either means and standard deviations or median and interquartile range, depending on their distribution. The data on qualitative variables were presented in the form of counts and percentages. Confidence level and level of significance were set at 95% and 5% respectively for all tests.

Results

A total of 480 patients received shoulder MRI scans for pain. We enrolled 60 patients with randomised controlled trials (RCTs) for this study. Several individuals experienced multiple muscle injuries. The average age was 50.59 years. Based on the MRI results, we were able to identify all four types of acromia. Male patients tended to experience more injuries to their left shoulder, whereas women were more likely to be affected on the right side.

In both male and female patients, the flat shape was found to be the most common shape associated with RCTs, while the hooked shape was less prevalent in men and the convex shape was less prevalent in women ($p > 0.05$). The supraspinatus muscle was found to be the most frequently injured, with a prevalence of 71.6% among both male (55.5%) and female (44.4%) patients, as shown in Table 1.

A significant number of these injuries occurred without any additional muscle involvement, as indicated by the statistical analysis ($p = 0.01$) (Table 2). On the other hand, injuries to the subscapularis and infraspinatus muscles were more frequently observed in conjunction with other rotator cuff tears, rather than occurring on their own ($p > 0.05$ and 0.04 , respectively).

There were 45 patients who were identified in partial RCTs. The supraspinatus muscle was most frequently affected by partial tears, followed by the subscapularis and infraspinatus muscles. In cases of partial tears, the acromial shape most commonly identified was flat, followed by curved, convex, and hooked for supraspinatus and subscapularis tears. No cases of partial tears of the infraspinatus muscle showed any signs of hooked acromia.

The most commonly observed shape in complete RCTs was the flat acromial shape, followed by

curved and hooked shapes. No convex acromion was found in conjunction with a complete rotator cuff tear. Partial tears were found to be more prevalent than complete RCTs in both male and female patients, regardless of the side (right or left). Flat acromial shape was found to be predominant among female patients with partial or complete RCTs on either side. Partial tears were found to be more prevalent than complete tears in women with left-sided RCTs, and a flat acromial shape was the most common.

No recent studies have investigated the association between sex and the affected shoulder side, so we were unable to find any significant findings in this regard. In our study, we discovered that there was no notable connection between gender and the shape of the acromion. However, we did observe that the most prevalent acromial shape among patients with rotator cuff tears was flat, regardless of gender.

Discussion

In 1970, Weiner and Macnab [14] discussed the correlation between a decrease in acromiohumeral distance and the occurrence of rotator cuff tears. According to a study using arthrography, it was found that the acromiohumeral distance in intact shoulders averaged at 10.5 mm. However, this distance decreased to 8.2 mm in the presence of a rotator cuff tendon tear. [15] A measurement of acromiohumeral distance ≤ 7 mm indicated a complete tear of the rotator cuff.

Thus, a cut-off value of ≤ 7 mm indicates an abnormal acromiohumeral distance. The shoulder is a fascinating area of study, as it involves the intricate interplay between bones, ligaments, and the tendons of the rotator cuff. [16]

There can be different ways that the anatomy is arranged, which can cause the rotator cuff tendons to be affected and not function properly. Previous studies have indicated that differences in the structure and alignment of the acromion, as well as the presence of osteoarthritis, may contribute to a higher likelihood of developing RTC pathology and tears. [10-12] there are various imaging techniques available to evaluate rotator cuff injuries.

Acromiohumeral distance is measured by shoulder surgeons on conventional radiographs to assess the effectiveness of a rotator cuff repair. A acromiohumeral distance less than 7 mm is considered unfavourable for rotator cuff repair. [17] Patients with a small acromiohumeral distance may experience an unfavourable outcome due to the correlation between a short distance and the presence of a large rotator cuff tear and fatty degeneration in the infraspinatus and supraspinatus muscles. [18] Both large rotator cuff tears and fatty muscle degeneration can significantly impact the

outcome following rotator repair. In a study by Pfahler et al. [19], they found that patients with a cuff defect smaller than 2×3 cm had a positive outcome after rotator cuff reconstruction. In a study conducted by Goutallier et al [20], it was discovered that the presence of fatty degeneration in both the supraspinatus and infraspinatus muscles can lead to unfavourable outcomes in terms of structure and function following surgical repair. It is advisable to consider operating on the rotator cuff before irreversible muscular damage occurs, particularly in the case of the infraspinatus muscle, as suggested by the authors. The most common type of acromion found among all patients with RCTs was the flat acromion. Our findings align with a previous study, indicating that there is no significant correlation between acromial shape and sex. In contrast, a study conducted by Paraskevas et al. found a strong association between the flat acromial shape and female sex. [21] We found a noteworthy connection between supraspinatus injury, acromial shape, and sex ($p \leq 0.05$).

There was no significant correlation found between acromial shape, muscle injury, and sex for the infraspinatus and subscapularis muscles. According to a study conducted by Balke et al., our findings are in line with theirs, as they also concluded that there is no notable connection between acromial shape, RCT, and sex. [6] Interestingly, a study conducted with 100 patients found no statistically significant correlation between acromial shape and RCT. Fourteen According to a study conducted by Morelli et al., individuals with a Type III (hooked) acromion have a threefold higher risk of experiencing RCTs compared to those with Type I or Type II acromia. [22]

It has been demonstrated in the latest study that the acromiohumeral distance can be accurately measured using both conventional radiographs and MR images in clinical practice. No notable differences were found between the raters or methods. The interrater reliability remained consistently high across all methods, despite the significant difference in experience levels between two reviewers. On MR images, the acromiohumeral distance consistently showed smaller measurements compared to conventional radiographs. One drawback of the study was the absence of a correlation between rotator cuff tears and surgery, despite the high accuracy of MR arthrography studies in detecting such tears.

Conclusion

There is no connection between acromial shape and sex, regardless of the specific muscle that is injured. There is a significant relationship between supraspinatus injury, acromial shape, and sex. It has been observed that women aged ≥ 50 years with flat acromia are more prone to right-side

partial tear injuries compared to other rotator cuff tears.

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