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ORIGINAL RESEARCH

CORRELATION OF ACROMIAL MORPHOLOGY WITH IMPINGEMENT SYNDROME AND ROTATOR CUFF TEAR USING MAGNETIC RESONANCE IMAGING

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Abstract

Background: Magnetic Resonance Imaging is proven to be an important imaging modality of choice both for evaluation of shoulder pathology and characterizing acromial morphology. Evaluation of Acromial morphology in pathogenesis of impingement syndrome and rotator cuff tear is needed for better understanding of the disease of Shoulder joint, as Indications of acromioplasty are based on clinical symptoms and changes in acromion morphology on MRI.

Aims and Objectives: To identify the morphological characteristics of acromion associated with rotator cuff tear and impingement syndrome using Magnetic Resonance Imaging.

Methods: The study subjects underwent MR imaging of shoulder using 1.5T MRI machine. Coronal, sagittal oblique and axial T2W and PDFS sequences were acquired to evaluate for subacromial impingement and rotator cuff tears. Acromion morphology (Acromion type, Acromion slope, Acromion tilt, Lateral Acromial Angle and Acromion Index) were calculated and their relationship to subacromial impingement and rotator cuff tears was assessed and taken for analysis. Group 1 patients included 20 Normal controls; Group 2 included 20 patients with subacromial impingement; and Group 3 included 20 patients with rotator cuff tears.

Results: The mean ages of group 1(46y) and group 2(48y) were similar, but those of groups 1(46y) and 3(58y) and groups 2(48y) and 3(58y) were significantly different. In all the 3 groups, more than 50% of the acromia were graded as type II. Only 5% of the controls had type III acromion, in contrast to 20% of the impingement and of the cuff tear patients. The mean AS of the controls (20°) was significantly smaller than the slope of impingement (25°; $p<0.05$) and cuff tear patients (26°; $p<0.05$). There was no statistically significant difference between groups 2 and 3 (p value not<0.05).The mean AT of the control (28°) was

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significantly smaller than that of group 2(34°; p<0.05) and that of group 3 (35°; p<0.05).Groups 2 and 3 were not statistically different (p value not<0.05).The mean LAA of group 3 (76°) was significantly lower than group 1 (83°; p<0.05) and group 2(82°;p<0.05).An angle of <70° occurred only in patients with rotator cuff tears (n = 3).The mean AI of the controls (0.68) was lower than that of group 2 (0.74; p<0.05) and of group 3 (0.76; p<0.05).The difference between group 2 and 3 did not reach statistical significance.

Conclusion: Low lateral acromial angle, higher acromial index, higher acromial tilt and higher acromial slope were associated with higher prevalence of subacromial impingement and rotator cuff tears. A better defined acromial morphological criteria and reporting system should be structured, containing a scoring system from which risk of Subacromial Impingement and Rotator cuff tears can be anticipated.

Keywords: Acromion type; Acromion slope; Acromion tilt; Lateral acromial angle; Acromion index; Subacromial impingement; Rotator Cuff tears.

Introduction

Subacromial impingement and Rotator cuff tears are most common causes of shoulder pain and indications for MRI evaluation of shoulder.

The factors predisposing for the same can be classified as

1. Intrinsic factors - Supraspinatus hypertrophy and greater tuberosity abnormality
2. Extrinsic factors - Mechanical impingementby coracoacromial arc structures [1]

The role of the acromion is still ambiguous, although few studies have attempted to correlate Neer's original theory of extrinsic mechanical impingement as the main etiological factor of rotator cuff disease[1]. Accurate assessment of extrinsic factors results in better management of the patients. [2]

Studies involving the Indian population are limited to emphasize the role of Acromial morphology on Rotator Cuff tears and Subacromial Impingement.

There have been few previous studies that have attempted to correlate radiographic acromial characteristics with rotator cuff tears, but the results have not been conclusive. In order to advance our understanding of rotator cuff disease, further investigation of the radiographic characteristics of the acromion and their relationships to rotator cuff disease is needed.

Magnetic Resonance Imaginghas proven to be an important imaging modality of choice both for characterizing acromial morphology and for evaluating rotator cuff tears. [2]

In this study we evaluated five commonly used parameters of Acromion morphology (Acromion type, Acromion slope, Acromion tilt, Lateral Acromial angle and Acromion index) and their relationship to Subacromial Impingement and Rotator cuff tears.

Aims & objectives

To identify the morphological characteristics of acromion associated with rotator cuff tear and impingement syndrome usingMagnetic Resonance Imaging.

Materials & methods

- **Source of data**

Patients with shoulder pathology referred to the Department of Radio-diagnosis, MMCRI, Mysore

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- **Study design**

A correlative study.

- **Study period**

December 2021 - July 2022

- **Sample size**

20 patients with rotator cuff tears (Partial or Complete), 20 patients with subacromial impingement and 20 controls without subacromial pathology were included in the study.

A. Inclusion Criteria Of The Cases:

- Above 18 years of age and willing to give informed consent.
- All patients undergoing MRI shoulder.

B. Exclusion Criteria For Cases And Controls:

- Patients with previous shoulder surgery, fractures, infections or tumours.
- Claustrophobic patients

The study subjects underwent MR imaging of shoulder using 1.5T MRI machine.

Coronal, sagittal oblique and axial T2W and PDFS sequences were acquired to evaluate for subacromial impingement and rotator cuff tears.

Acromion morphology (Acromion type, Acromion slope, Acromion tilt, lateral acromial angle and acromion index) were calculated and their relationship to subacromial impingement and rotator cuff tears was assessed.

Group 1 patients included 20 Normal controls ; Group 2 included 20 patients with subacromial impingement; and Group 3 included 20 patients with rotator cuff tears (Partial or Complete)

1. Acromial type

The acromial type was classified according to Bigliani et al. [3]

- Type I – Flat
- Type II – Curved
- Type III – Anteriorly hooked

Figure 1 : Types of Acromian. A – Flat. B – Type II – Curved and C – Type III –

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Anteriorly hooked

2. Acromial Slope

One line was drawn connecting the most anterior point of the inferior acromion and midway point on the inferior acromion. Another line was drawn connecting the most posterior point of the inferior acromion with the same midway point.

Figure 2: Sagittal MRI of Shoulder showing measurement of Acromial Slope

3. Acromion tilt

One line was drawn connecting the most posterior point of the inferior acromion to the most anterior point of the inferior acromion. Another line was drawn connecting the same most posterior point of the acromion to the inferior tip of the coracoid process. The resulting angle represented AT.

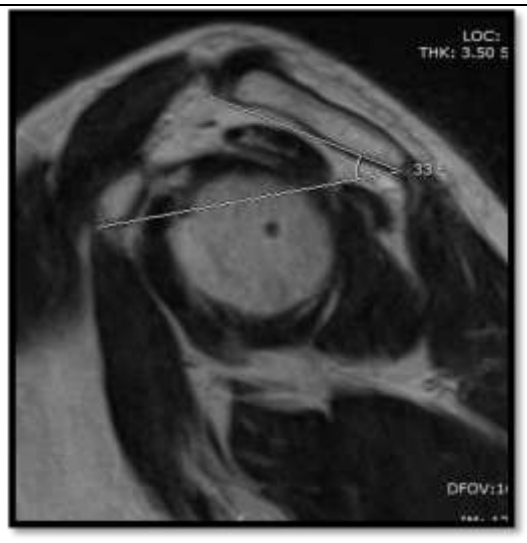

Figure 3: Sagittal MRI of Shoulder showing measurement of Acromial tilt

4. Lateral acromial angle

One line was drawn along the superior and inferior most lateral points of the glenoid. Another line was drawn parallel to the acromion undersurface. The angle between these two lines represented the LAA.

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Figure 4 : Coronal MRI of Shoulder showing measurement of Lateral Acromial Angle

5. Acromion Index

The distance from the glenoid plane to the acromion (GA) was divided by the distance from the glenoid plane to the lateral aspect of the humeral head (GH).

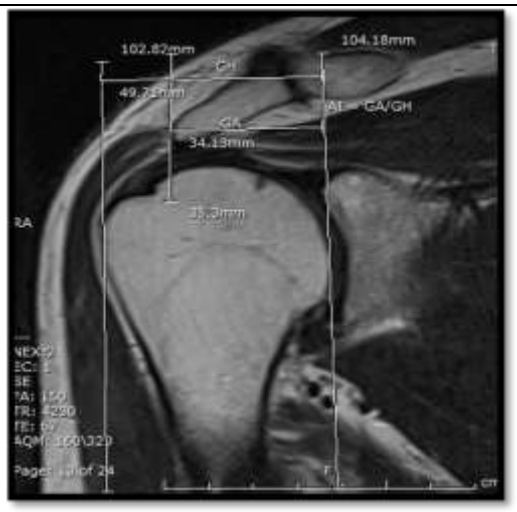

Figure 5 : Coronal MRI of Shoulder showing measurement of Acromial Index

Statistical Analysis

Data were entered and managed in the Microsoft Excel 2010 spreadsheet. Variables were tabulated into means for continuous variables and percentages for categorical variables

Independent t test was used to determine the significance of differences between categorical variables and to compare means, all using a 5% significance level.

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Results

The mean ages of group 1(46y) and group 2(48y) were similar, but those of groups 1(46y) and 3(58y) and groups 2(48y) and 3(58y) were significantly different.

Groups	Mean(Yrs)	Range	SD
1 Control	46	30-85	14
2 Impingement	48	32-80	9
3 Cuff tear	58	37-79	9

Table 1 : Table showing distribution of mean age among the three groups

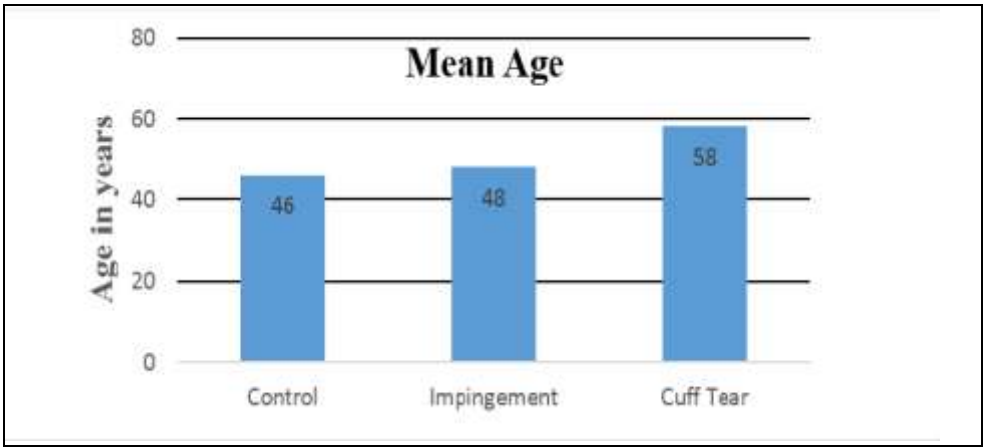

Figure 5 : Graph showing distribution of mean age among the three groups

6. Acromial type

In all the 3 groups, more than 50% of the acromia were graded as type II. Only 5% of the controls had type III acromion, in contrast to 20% of the impingement and of the cuff tear patients.

Groups	Type I	Type II	Type III
1 Control	5(25%)	14(70%)	1(5%)
2 Impingement	6(30%)	10(50%)	4(20%)
3 Cuff tear	5(25%)	11(55%)	4(20%)

Table 2 : Table showing distribution of Acromial type among the three groups

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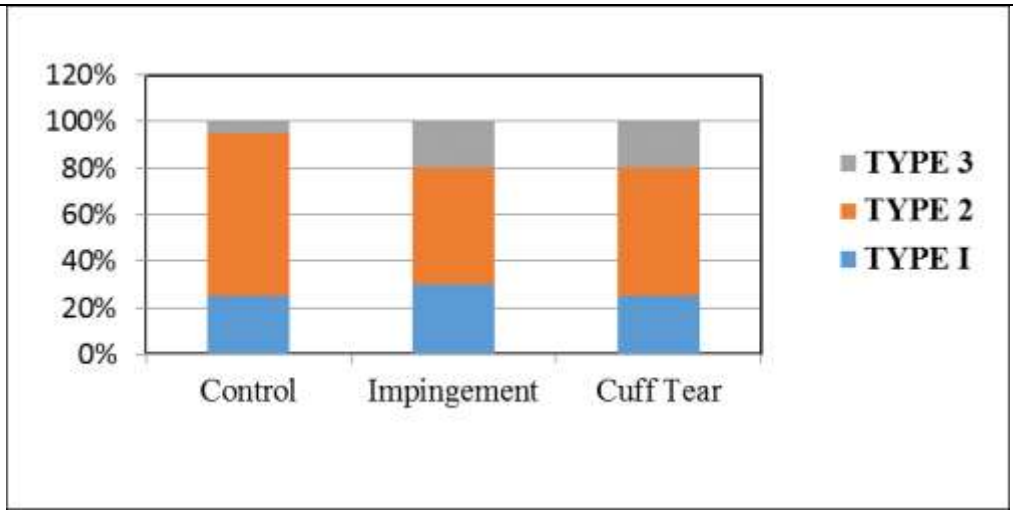

Figure 6 : Graph showing distribution of Acromial type among the three groups

7. Acromial Slope

The mean AS of the controls (20°) was significantly smaller than the slope of impingement (25°; $p<0.05$) and cuff tear patients (26°; $p<0.05$). There was no statistically significant difference between groups 2 and 3 (p value not<0.05)

Groups	Mean AS	Range	SD
1 Control	20°	1-40°	8°
2 Impingement	25°	1-41°	11°
3 Cuff tear	26°	1-50°	12°

Table 3 : Table showing distribution of Acromial slope among the three groups

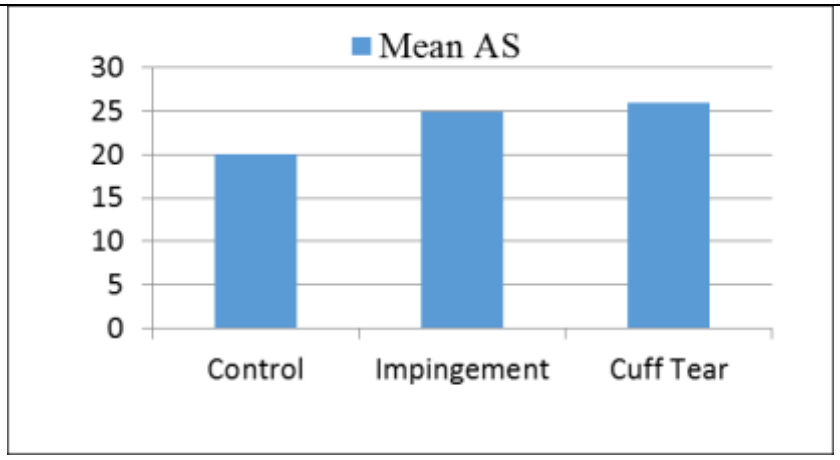

Figure 7 : Graph showing distribution of Acromial slope among the three groups

8. Acromion tilt

The mean AT of the control (28°) was significantly smaller than that of group 2(34°; $p<0.05$) and that of group 3 (35°; $p<0.05$).Groups 2 and 3 were not statistically different (p value not<0.05).

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Groups	Mean AT	Range	SD
1 Control	28°	17-42°	5°
2 Impingement	34°	22-40°	11°
3 Cuff tear	35°	18-58°	7°

Table 4 : Table showing distribution of Acromial tilt among the three groups

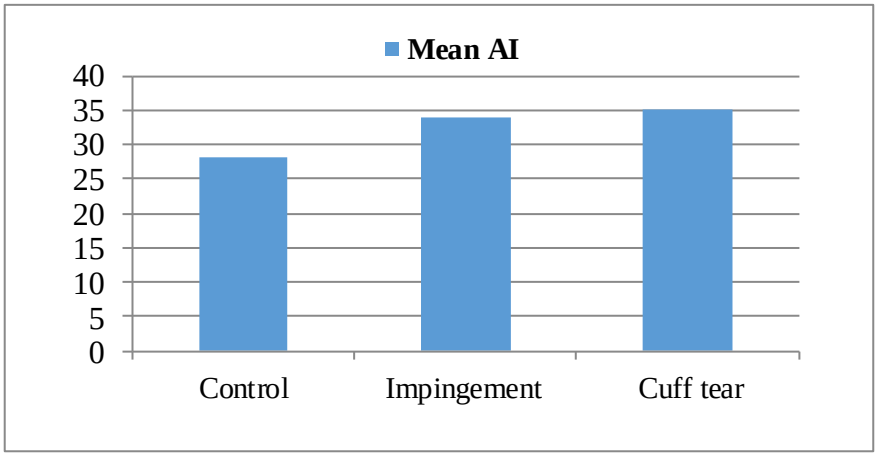

Figure 8 : Graph showing distribution of Acromial tilt among the three groups

9. Lateral acromial angle

The mean LAA of group 3 (76°) was significantly lower than group 1 (83°; $p<0.05$) and group 2(82°; $p<0.05$). An angle of <70° occurred only in patients with rotator cuff tears (n = 3

Groups	Mean LAA	Range	SD
1 Control	83°	73° - 93°	6°
2 Impingement	82°	72° - 92°	6°
3 Cuff tear	76°	63° - 90°	8°

Table 5 : Table showing distribution of Lateral acromial angle among the three groups

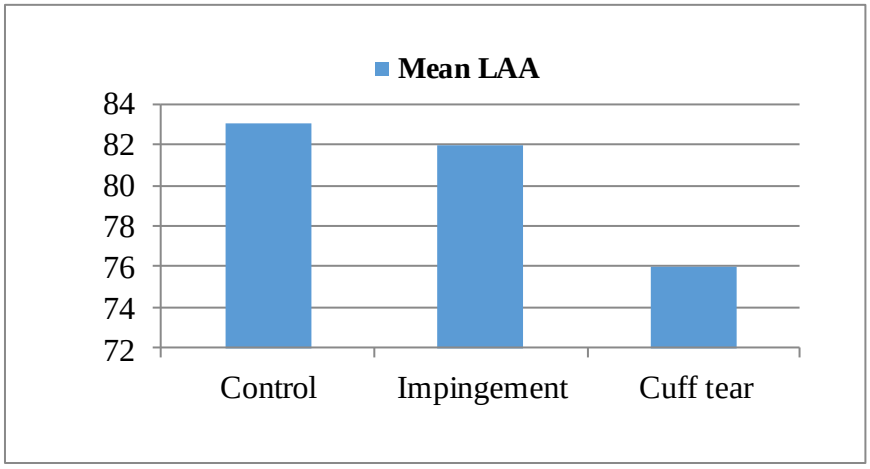

Figure 9: Graph showing distribution of Lateral acromial angle among three groups

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10. Acromion Index

The mean AI of the controls (0.68) was lower than that of group 2 (0.74; $p<0.05$) and of group 3 (0.76; $p<0.05$).The difference between group 2 and 3 did not reach statistical significance.

Groups	Mean AI	Range	SD
1 Control	0.68	0.51- 0.85	0.1
2 Impingement	0.74	0.54 -0.95	0.1
3 Cuff tear	0.76	0.55-0.94	0.1

Table 6 : Table showing distribution of Acromial Index among the three groups

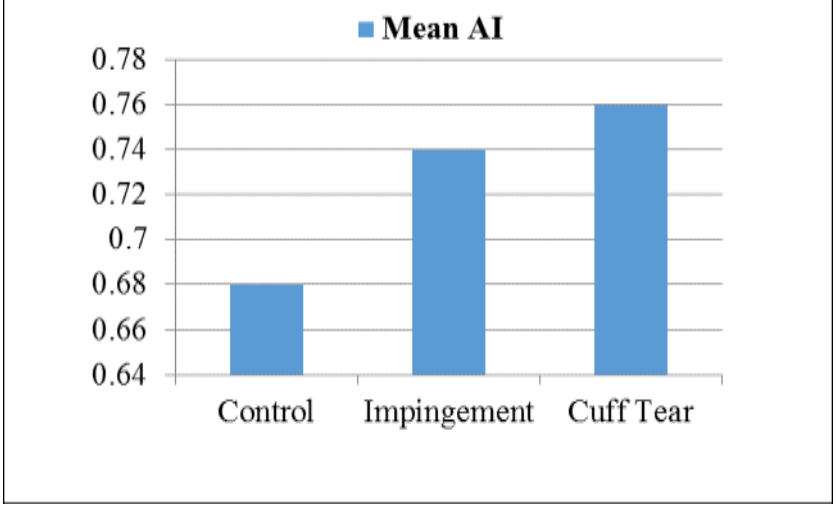

Figure 10: Graph showing distribution of Acromial Index among the three groups.

Discussion

In our study, we assessed and compared the various acromion morphology in controls and rotator cuff tear patients. Identifying the presence of subacromial impingement may aid in a better understanding of predispositions to rotator cuff pathology. The factors affecting subacromial space are the types of acromion, which was classified by Bigliani as three types. They include type 1 – flat, type II – curved, and type III – hooked acromion morphology [3]. In our study the acromial type according to Bigliani was not associated with any particular cuff lesion.

Controls had significantly smaller Acromial slope in comparison to impingement and cuff tear patients. Acromial tilt of the controls was significantly smaller than that of impingement. and cuff tear patients.

A good correlation was found between acromial type and acromial slope.

Acromial index of controls was significantly lower than that of impingement and cuff tear patients. Many studies, which reported no difference in the acromial index of patients who had Impingement and rotator cuff tears hence questioned the biomechanical theory proposed by Nyffeler et al. regarding the association between large acromial index and rotator cuff disease as well as between small acromial index and osteoarthritis [4,5,6]. In contrast, this study supported the theory proposed by Nyffeler et al. because a high AI index was seen in

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patients with rotator cuff tear [4]. In the study by Kaur R et.al it was noted that higher acromial index was noted in patients with rotator cuff tear. Torrens et al. also reported similar findings where patients with rotator cuff tears had a significantly larger acromial index of 0.72 compared with 0.68 in patients without cuff pathology [7]. It was observed that a higher acromial index could be one of the associated factors for predisposition and progression of rotator cuff tears.

Another important parameter in our study was the lateral acromial angle on coronalplane images. In our study, Lateral acromial angle of patients with rotator cuff tear and Subacromial impingment was significantly lower that of controls. Studies by Kaur R et.al [2] and Banas et al., [8] also found that a low LAA occurs in patients with rotator cuff tears.

Limitations of the study

Suboptimal MR imaging of the shoulder may influence the different measurements.Small sample size.

Conclusion

Low lateral acromial angle, higher acromial index, higher acromial tilt and higher acromial slope were associated with higher prevalence of subacromial impingement and rotator cuff tears. A better defined acromial morphological criteria and reporting system should be structured, containing a scoring system from which risk of Subacromial Impingement and Rotator cuff tears can be anticipated.

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