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Original Article

The acromial morphology and its implication in impingement syndrome: An anatomical study

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ABSTRACT

Introduction: Resection of acromion in case of impingement syndrome is a controversial issue. It is associated with the risk of instability of humeral head. The aim of our study was to determine the morphometry of acromion so that the decision for arthroscopic resection becomes easier in these cases. The morphometry of acromion was also correlated with other parameters of scapula.
Material and methods: The study was conducted in sixty one intact dry adult scapulae of unknown sex. Various parametric and nonparametric data from scapulae were taken.
Result: Type I (flat), Type II (curved) and Type III (hooked) were found in 24.59%, 49.18% and 26.22% scapulae respectively. The average scapular length and breadth were 135.96 ± 11.96 mm and 98.8 ± 7.56 mm respectively. Mean value of length, breath, and thickness of acromian were 41.23 mm, 22.12 mm and 7.01 mm respectively. The thickness of acromion was less than 8 mm in 86.67% of scapulae. In 13.33% cases the thickness was >8 mm. A statistically significant positive correlation was also found between the length of acromion and the length and breadth of scapula.
Discussion: Our study may suggest that in Indian population, 13.33% population is at risk of impingement syndrome according to the thickness of acromion. In addition, angles of acromion tilt and acromion slope are larger in Indian scapulae as compare to that of other countries. This knowledge would be useful for orthopaedic surgeons and radiologists.

1. Introduction

The shoulder impingement syndrome is characterized by pain in shoulder while raising arm, associated with weakness caused by catching muscle tendons in the shoulder. Involved rotator cuff tendon is a tough rubbery cord that connects the shoulder muscles to arm. In relation to it is a subacromial space which is a narrow space transferring the tendon and muscle. Pain is aggravated while raising the arm overhead. Possible causes for shoulder impingement syndrome are narrowing of subacromial space, bone spur under the bony roof at the top of subacromial space, inflammation of fluid filled space, swelling or thickening of rotator cuff tendon, calcium deposits within the tendon. Acromioplasty is a vital surgery in cases of rotator cuff surgeries. The advantages of acromioplasty is to improve subacromial space for visualization during surgery of rotator cuff repair and allow free movement of structure underneath and reduce compression of rotator cuff. Usually, large incision is necessary for rotator cuff repair.[1] As per the studies done by Blevin et al.[2] and Gartsman et al.,[3] endoscopic repair of rotator cuff along with acromioplasty leads to satisfactory improvement in pain score. Although acromioplasty leads to significant improvement in symptoms, it is done only after assessment of patients on the basis of their symptoms and radiograph of shoulder to yield best results.

Despite the various etiologies playing role in rotator cuff tear, positional morphology (linear and angular) of acromion that affect tear is still unclear. In our study, we evaluated nonparametric and parametric data of acromion and discussed their relation with the scapular parameters.

2. Material and methods

The current study was conducted on 61 dry intact adult scapulae of unknown sex and age procured from departmental collection. Institute ethical committee has exempted us for consent as samples were cadaveric scapulae. On each bone, fixed points were marked for parametric data. Nonparametric and parametric data were compiled.

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2.1. Nonparametric data

1. Shape of acromion from dorsal view (Fig. 1)
2. Type of acromion according to curve: Flat (Type I), Curved (Type II), Hooked (Type III)[4]

2.2. Parametric data

For parametric data, the following points were taken (Fig. 2)
A Highest point on acromion
B Lowest point on acromion
C Lateral most point on acromion
D Medial most point on acromion
E Point 1 cm medial to point 'C' and 1 cm below to point 'A'
F Lateral most point on the coracoid process of scapula
G Point on the dorsum of coracoid process of scapula
H Highest point on supraglenoid tubercle

Scapular length and scapular breath along with other parameters were measured with digital caliper (accurate to 0.01 mm). Two authors took measurements independently to avoid the interobserver errors. Mean of these values were final values.

AB Maximum length of acromion
CD Maximum width of acromion
E Maximum Thickness of acromion
AF Distance from acromion tip to coracoid tip
AG Distance from acromion tip to dorsum of coracoid

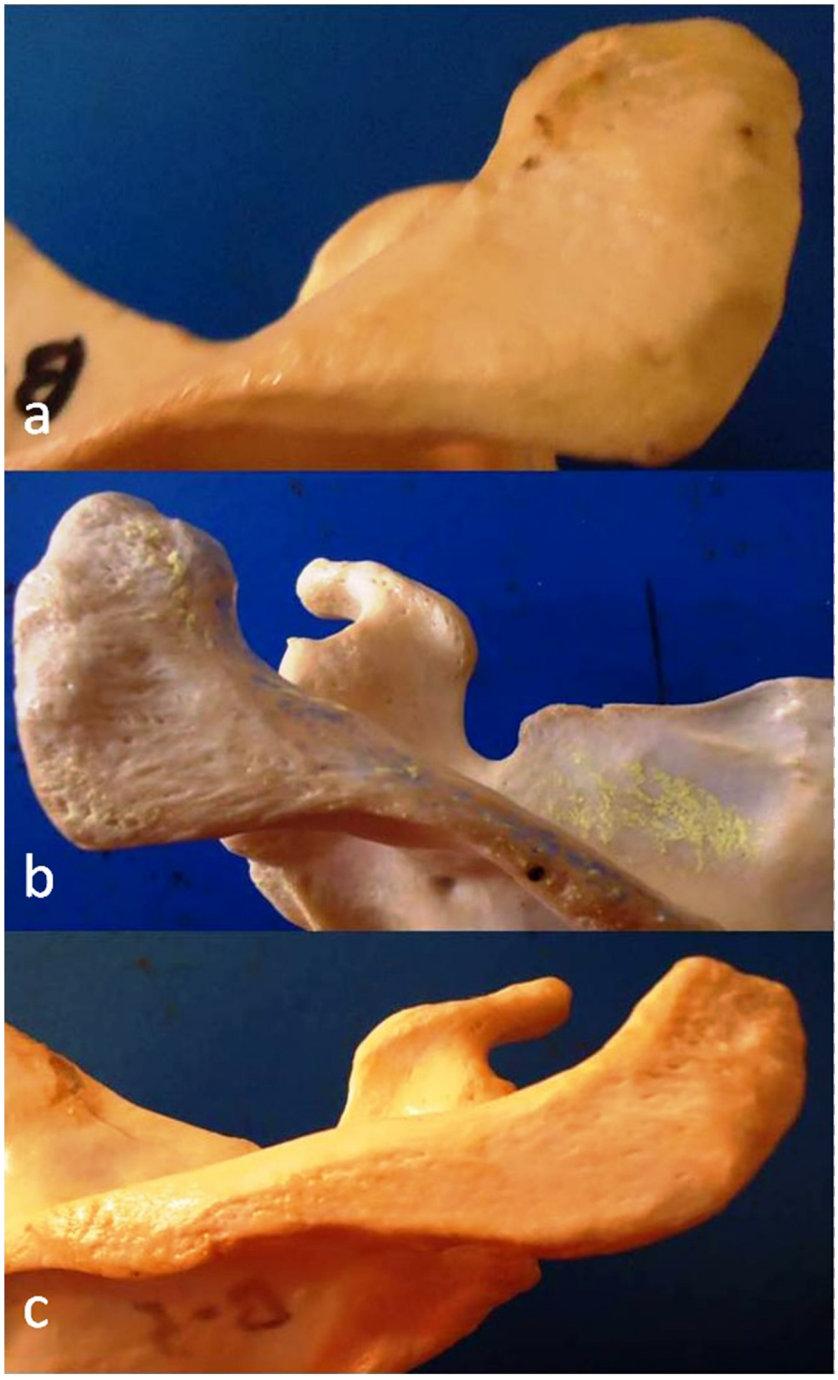

Fig. 1. Shape of acromion according to dorsal view: a) quadrangular, b) triangular, c) tubular.

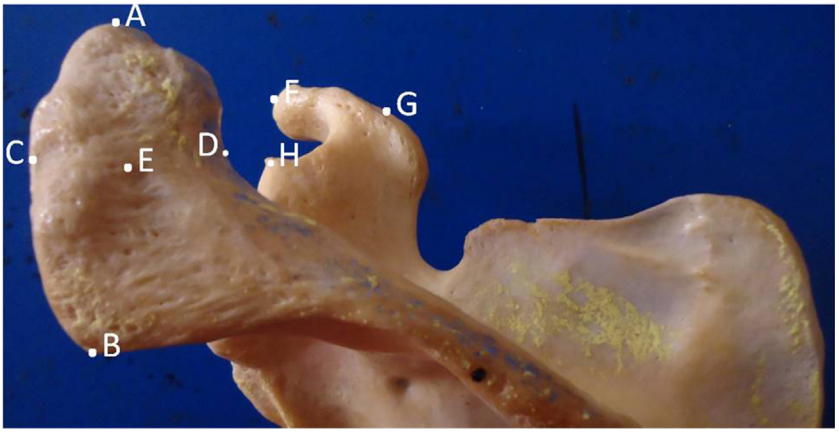

Fig. 2. Various points for measurements on acromion.

AH Distance from acromion tip to supraglenoid tubercle (acromioglenoid distance)

X° Acromion slope: a line between anterior point on inferior surface of acromion and mid point on inferior surface and other line on posterior point on inferior surface of acromion and mid point on inferior surface (extending this line upward), angle between these two lines is acromion slope (Fig. 3)

Y° Acromion tilt: a line between inferior point on tip of coracoid to posterior point on inferior surface of acromion and then to anterior point on inferior surface of acromion (Fig. 3)

Mean, SD and range of parameters calculated with the help of SPSS 15. Angular measurements were done with angle measuring tool in Corel DRAW X3 version 13 after clicking the photograph (Fig. 3). Pearsons' correlation coefficient was obtained to see any correlation between various parameters. Correlation was graded as excellent (0.81–1.00), good (0.61–0.80), moderate (0.41–0.60) and fair (0.40–0.20).

3. Results

The results of nonparametric and parametric data measured in this study are mentioned in Tables 1–3. The variables measured were found normally distributed. The acromion thickness was categorized as less than or more than 8 mm thick as the people with acromion thickness more than 8 mm are more vulnerable to impingement syndrome.[5] It was less than 8 mm in 86.67% and more than 8 mm in13.33% cases.

Pearson's correlation was applied to correlate acromion length, breadth with the scapular length and breadth. We found that the acromion length had good correlation with the length (0.62) and breadth of scapulae (0.69) whereas the acromion breadth had moderate correlation with the scapular length (0.49) and fair correlation with the scapular breadth (0.39).

The mean values of the acromion tilt and the acromion slope found were 43.13° and 31.39° respectively [Table 2]. The acromial slope was 29°, 29° and 38° in type I, II and III respectively. While the average/mean acromion tilt for acromial type I was 42°, for type II 43°, and for type III 45° (Table 3). The differences didn't reach the statistical significance.

4. Discussion

4.1. Nonparametric data

In our study, shapes of acromion, according to classification by Bigliani et al,[4] were as follows: Type I (flat)-24.59%, Type II

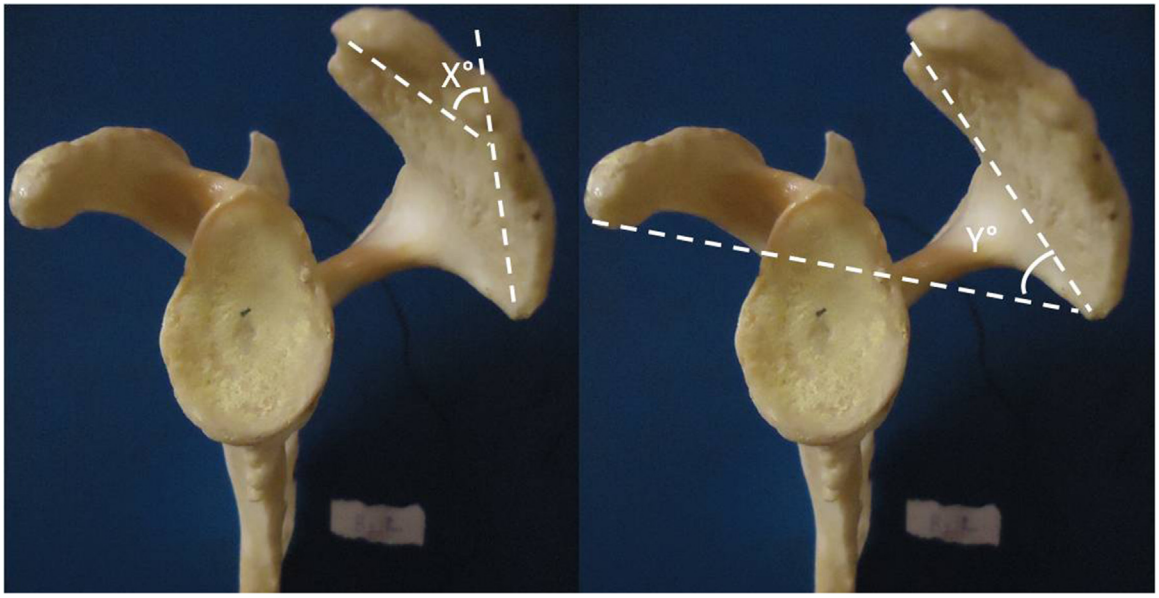

Fig. 3. Angles in scapula: X. acromion Slope Y. acromion tilt.

Table 1
Percentage distribution of different types of acromion.

SN	Shape of Acromion		Percentage of distribution
1	Dorsal view	Triangular	19 (31.14%)
2		Quadrangular	34 (55.73%)
3		Tubular	8 (13.11%)
4	Side view (According to Bigliani classification	Flat (Type I)	15 (24.59%)
5		Curved(Type II)	30 (49.18%)
6		Hooked (Type III)	16 (26.22%)

Table 2
Parameters of acromion along with scapula.

SN	Parameters	Range (N = 61)	Mean ± SD
1	Scapular length	114.0–161.0mm	135.96 ± 11.96 mm
2	Scapular width	85.0 –123.0 mm	98.8 ± 7.56 mm
3	Length of acromion	31.13–52.6 mm	41.23 ± 4.62 mm
4	Breadth of acromion	17.46–29.2 mm	22.12 ± 2.61 mm
6	Thickness of acromion	4.56–10.01 mm	7.01 ± 1.19 mm
7	Acromio-coracoid distance (Distance from acromion tip to coracoid tip)	26.36–51.31 mm	35.94 ± 5.58 mm
8	Acromio- coracoid distance (Distance from acromion tip to dorsum of coracoid)	27.76–59.29 mm	40.93 ± 6.47 mm
9	Acromio- glenoid distance (distance from tip of acromion to supraglenoid tubercle)	21.33–37.11 mm	28.28 ± 3.84 mm
10	Acromial Slope	14°–62°	31.39°±8.98°
11	Acromial Tilt	27°–55°	43.78°±6.32°

Table 3
Different angles in different types of acromion.

Type of Acromion	Acromion Slope	Acromion Tilt
Flat (n = 15)	29°±6.25	42.13°±8.35
Type I	(16–40)	(27°–55°)
Curved(n = 30)	29°±7.78	43.63°±5.24
Type II	(14°–46°)	(34°–52°)
Hooked (n = 16)	38.12°±10.19	45.62°±5.92
Type III	(22°–62°)	(34°–53°)

(curved)- 49.18% and Type III (hooked)- 26.22% (Table 1). The commonest type was Type II (curved) as also described by others.[4,6] In our study, the frequency was Type II > Type III > Type I which is similar to other studies.[4,7–11] In some other studies, the frequency was as follows: Type II > Type I > Type III.[12–14] Type III, known for impingement syndrome was found in 26.22% which is higher than that found by Mansure et al,[6] Vijay and Sheela[12] and Balke et al[15] and lower than that found by Bigliani et al[4] This may be acquired and rare type. In sex-wise distribution of shape of acromion, type I in female and type III in male were the commonest type.[9]

The shape of acromion from dorsal view was quadrangular in 55.73% cases, triangular in 31.14% cases and tubular in 13.11% cases (Fig. 1). We too found quadrangular type as the most frequent type as also found by Mansure et al.[6]

4.2. Linear parameters

In the current study, the length of acromion was 41.23 mm which was comparable to Napalese scapulae[6] (46.46 mm on right and 45.57 mm on left side), less than Egyptian scapulae (52.81 mm)[12] and Chilean scapulae (69.12 mm).[7] Breadth of acromion was 22.12 mm (range: 17.46–29.2 mm) in our scapulae which was comparable to Napalese scapulae[6] (26.63 mm) however, it was slightly less than Chilean[7] (25.12 mm) and Egyptian[13] scapulae (Table 2).

In the current study, thickness of acromion ranged from 4.56 to 10.01 mm. In 13.33% cases the thickness was >8 mm. According to Rockwood acromioplasty, in the first step a portion of anterior acromion which projects beyond the clavicle is removed and in the second step, there is a need to smoothen the undersurface of acromion in order to convert it to <8 mm thickness[1,16] as people with acromion thickness >8 mm are more prone to impingement syndrome. Mohammed et al found acromion thickness 7.5 mm in control and 8.6 mm in patients with rotator cuff tear using magnetic resonance imaging (MRI).[14] Various authors also found thickness ranging from 8.2 to 8.8 mm in case of rotator cuff tear.[5,6] In other Indian studies, our findings related to acromion are in line with that of the Vijay and Sheela[12] and Saha et al.[17]

The lesser the subacromion space the greater the chance of impingement syndrome.[10] Subacromion space is related to acromioglenoid, coracoacromion, and coracoglenoid distances. Acromioglenoid distance in the current study was 28.28 mm which was 31 mm in Napalese scapulae,[6] 28.43 mm in Chilean scapulae[7] and 27.39 mm in Egyptian scapulae.[13] When acromion parameters were correlated with scapular length and scapular width, acromion length showed good correlation with both while acromion breadth had moderate correlation with scapular length. Acromion thickness also had moderate correlation with scapular width.

Acromiocoracoid distance signifies coracoacromion ligament length and resection of coracoacromion ligament without acromioplasty provides significant relief in pain of a patient with impingement. Some, however, advocate that coracoacromion ligament excision gives rise to instability of humerus.[18] Distance of coracoid from the tip of acromion was 35.94 mm and from the dorsum of acromion was 40.93 mm in the current study. These distances were comparable in Napalese scapulae[6] (26.63 mm and 39.39 mm) and Chilean scapulae (39.76 mm, 39.55 mm).[7] However, in Egyptian[13] and Greek scapulae[10] it was relatively lower.

4.3. Angular parameter

Acromial slope defines relationship of different segments of acromion with one another. Acromion slope was 31.39° in current study (Table 2). Acromion slope in control group was 21° in German population.[14] Acromial tilt defines the relationship of

acromion with coracoid. The angle may be the predictor of subacromian space compression. The lower the angle the higher would be the impingement. We found 43.78° acromion tilt with range from 27°–55° (Table 2). In current study there were no statistically significant difference between the three types. It might suggest that these scapulae would not have impingement syndrome during lifetime. Zukerman et al[19] found 33.5° acromial tilt in a cadaveric study.[19] Balke et al found 29° acromial tilt in control group, 33° in impingement cases and 34° in rotator cuff tear cases.[15] They were unable to explain bigger angle in impingement cases as compared to control. Bigger angle in current study may be attributed to the measurements done on bare bone and different racial population.

5. Conclusion

The present study provides helpful data regarding the dimensions of acromion as it is applicable to resection of acromion in cases of impingement syndrome. It was also observed that there is considerable racial variation in the dimensions of scapula and acromion. Limitation of the study is small sample size. 13.33% of the population is at risk of impingement syndrome according to thickness of acromion found in current study. Furthermore, angles of acromion tilt and acromion slope are larger in Indian scapulae. We believe that the data obtained through our study will be of crucial help to the orthopaedic surgeons who are need to know the relevant morphometry of the acromion of the local population to plan surgery related to acromion.

Conflict of interest

The authors declare that they have no conflict of interest.

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