

**Original article:**

## Morphometric parameters of the acromion process in adult human scapulae

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### ABSTRACT

**Introduction:** In scapula, the acromion process projects forwards almost at right angles from the lateral end of the spine. The coraco-acromian ligament spans between tip of acromian and coracoid process thus it forms coraco-acromial arch. The space below the arch gives passage to the tendons of muscles forming musculo-rotator cuff. As morphometry of the acromion process of the scapula is an important factor implicated in impingement syndrome of the shoulder joint.

**Methodology:** Present study carried out on the 129 dry scapulae of unknown age and sex, 67 were from the right side, and 62 were from the left. Measurements were taken using a sliding vernier calliper and recorded in millimeters

**Result:** The mean values of scapular height and width were observed 145.1 mm and 105.5 mm in total number of scapulae respectively. The mean values of acromian length, acromian width and thickness were observed as 46.1 mm, 23.2 mm and 6.60 mm respectively. The distance taken from the Tip of Acromian process to the Tip of coracoid process was found 37.5 mm in total sample. The three types of acromion were observed as type-I flat was seen in 22.5%, type II curved in 38.8% and type III hooked in 38.8% respectively.

**Conclusion:** Knowledge of the morphometric values of scapula and acromian process is important for clinicians in understanding and curing shoulder joint ailments.

**Key words:** Scapula, Acromian process, Morphometry.

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### INTRODUCTION

The Scapula is a large, flat, triangular bone which lies on the postero-lateral aspect of the chest wall covering parts of the 2<sup>nd</sup> to 7<sup>th</sup> ribs. It has three processes Spine, its continuation the Acromion and the Coracoid process. The acromion projects forwards almost at right angles from the lateral end of the spine. Medial aspect of the tip of the acromion gives attachment to lateral end of coraco-acromial ligament. The coraco-acromial arch lies above the gleno-humeral joint and is composed of the coracoid and anterior acromion, which are spanned by the coraco-acromial ligament. The rotator cuff tendons, the subacromial bursa, the biceps tendon, and proximal humerus all pass beneath this arch. Any process acquired or congenital, that narrows the space available for these structures can cause mechanical impingement.

Acromial morphology has been implicated as contributing to impingement. Bigliani, Morrison and April described 3 types of acromion morphology and noted an increase in rotator cuff tears with type - III or hooked acromion. Since this time the Bigliani morphological classification has been the dominant diagnostic tool for the impingement syndrome and rotatorcuff tears.<sup>1</sup> Patients with less slope to their acromion have propensity towards impingement because of subacromial stenosis.<sup>2</sup> The Variations seen in acromial morphologic condition are not acquired from age-related changes and spur formation and thus contribute to impingement disease independent of and in addition to age-related processes.<sup>3</sup>

Natsis et al. claimed that enthesophytes were significantly more common ( $p < 0.05$ ) in the type III acromion, and that combination was particularly associated with subacromial impingement syndrome and rotator cuff tears. At any rate either as the cause or as the result, the enthesophytes are an important factor for subacromial impingement syndrome and rotator cuff tears.<sup>4</sup> MakoHirano, reported the type III acromion was the most common in patients with rotator cuff tears. They found that in the type III (hooked) acromion, the rotator cuff tears size was significantly larger than in type I or II acromion. Their study suggested that acromial shape influences rotator cuff tears size.<sup>5</sup> Other investigators have suggested that acromial morphology was much required in rotator cuff tears.<sup>6,7</sup> Edelson and Taitz concluded that the slope and length of the acromion and the height of the arch were most closely associated with degenerative changes. Increased degenerative changes of both types were associated with increased length of the acromion and length was in turn related to the shape of the acromion. There was also considerable variation in the thickness and width of the acromion .they further stated that the parameters studied by them however not appeared to correlate with degenerative changes.<sup>8</sup>The different shapes of acromion play important role in impingement syndrome. The variations of acromion process should be kept in mind during surgery around the shoulder joint. It helps Anthropologists during their study on evolution of acromian.<sup>9</sup> The aim of this study was to record the morphometric values of the acromion process of scapula in a North-Indian population sample. Not many studies have been done on morphology of acromion in Indian population so this study becomes essential. The morphometric parameters of acromian process would be helpful in the surgical intervention of the shoulder joint and coraco-acromial arch.

#### **MATERIALS AND METHODS**

The study was performed at the Department of Anatomy, S.P. Medical College, Bikaner, Raja-sthan, Between January to march 2013. A total of dry 129 unpaired scapula bones were randomly selected at the anatomy laboratory of our department. Of the 129 scapulas, 67 were from the right side, and 62 were from the left. The bones belonged to mature specimens, but the exact ages and gender of the specimens were not known. The bones were isolated and inspected macroscopically. Damaged scapulae bones were excluded from this study. Scapulas were grouped according to the morphology of the acromial type.

Measurements were taken using a sliding vernier calliper (accurate to 0.1 mm) and recorded in millimeters. Each of the measurement was taken twice and then average was taken to reduce the bias errors. Data was analyzed using SPSS version 13.0 and mean values presented in tables. Descriptive statistics like percentage mean and standard deviation were used to analyze the data obtained.

Following measurements were taken.

1. Maximum scapular length :-Measured from the superior angle to the inferior angle of scapula
2. Maximum scapular width :-The maximum transverse diameter between the medial border of the scapula, where the spine meets the body of the scapula, and the anterior lip of the glenoid
3. Maximum thickness of the crest of the spine of scapula close to the deltoid tubercle
4. Maximum thickness of the lateral border measured at midpoint
5. The maximum length of the acromion along longitudinal axis
6. The maximum breadth of acromion :-The distance between the lateral and medial borders at the midpoint of the acromion process.
7. The thickness of the acromion :-1 cm posterior to the anterior border and 1 cm medially to the lateral border.

8. Acromio coracoid distance-I (AC-I) :-Between tip of coracoid process to the tip of the acromion process.
9. Acromio coracoid distance-II (AC-II) :-From the dorsum of the base of coracoid process to the tip of the acromion process
10. Acromio glenoid distance:-Between Supraglenoid tubercle and the tip of the acromion process.
11. Types of acromion according to its slope:-a) Bigliani type I (flat), b) Type II (curved), and c) Type III (hooked).
12. Types of inferior surface of acromion process :-According to appearance Rough type and Smooth type

## RESULTS

In the present study we found the mean value of scapular height was 145.1mm in total samples of scapulae while it was 145.7 mm in left side and 144.6 mm in right side scapulae. A summary of measurements regarding the scapula and acromion were shown in table-I & II. The mean values of the scapular width were 105.5 mm in total number of samples, where as 106.5 mm in left side and 104.6 mm right side. The mean values of the maximum thickness of the crest of spine observed in total samples as 10.3 mm, 9.8 mm in left side and 10.8 mm in right side. Coming to the mean values of the lateral border maximum thickness were found in total samples 8.9 mm, 8.7 mm in left side and 9.2 mm in right side.

The mean values of acromion length were found 46.1 mm in total samples, 45.8 mm in left side and 46.4 mm in right side. The acromion width mean values were found as 23.2 mm in total sample, 23.0 mm in left side and 23.4 mm right side. The acromion thickness was 6.60 mm in total and right side and 6.70 mm in left side. The distances between acromion and coracoid processes were measured at two points. The distance taken from tip of the acromion process to tip of the coracoid process was found 37.5 mm in total sample, in right side 37.1 mm and 37.9 mm in left side. The distance taken at the base of the coracoid to the tip of the acromion process mean value was 28.5 mm in total, 29.2 mm left side and 27.9 mm in right side. The acromio-glenoid distance observed 27.0 mm in total, 27.6 mm in left side and 26.6 mm in right side

We examined the three types of acromion. Type-I flat was seen in 29 (22.5%), type II curved in 50 (38.8%) and type III hooked in 50(38.8%) of the total samples and also it was found the inferior surface of the acromion smooth in 72 (55.8%) and rough in 57 (44.2%) samples.

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**Table 1: The mean values of scapular parameters**

Measurements	Total Mean(mm)	Right Mean(mm)	Left Mean(mm)
Scapular.Height	14.51±1.17	14.46±1.22	14.57±1.13
Scapular.Width	10.55±0.76	10.46±0.77	10.65±0.75
Mid Crest Max.Thickness	1.03±0.28	1.08±0.27	0.98±0.28
Mid Lat.Border Thickness	0.89±0.15	0.92±0.16	0.87±0.13

**Table 2: The mean values of the dimensions of acromian process**

Measurements	Total Mean(mm)	Right Mean(mm)	Left Mean(mm)
Acromian.Length	4.61±0.52	4.64±0.52	4.58±0.53
Acromian.Width	2.32±0.26	2.34±0.27	2.30±0.24
AcromianThickness	0.66±0.10	0.66±0.11	0.67±0.08
Acromio-coracoid Distance-I (AC-I)	3.75±0.53	3.71±0.55	3.79±0.52
Acromio-coracoid Distance-II (AC-II)	2.85±0.43	2.79±0.44	2.92±0.40
Acromo-glenoid Distance	2.70±0.40	2.66±0.44	2.76±0.36

## DISCUSSION

We found the mean value of scapular height as 145.1 mm in total sample where as Coskun et al has reported this mean as 9.88 cm,<sup>10</sup> in another study Sitha et al found this as 131.1 mm which is less than the value we found in our study that may be due to population variation. The mean value of scapular width has found 105.5 mm in total samples and according to the Sitha et al it was reported to be 95.70 mm<sup>11</sup>. The mean value of Acromian length, Acromian width and Acromian thickness found to be as 46.10 mm, 23.2 mm and 0.66mm in total samples respectively. Anetzberger and Putz observed acromial length as 47.00 mm.<sup>12</sup> In an another study Mallon et al took his measurements from x-rays films, recorded the Acromian length of 42.0 mm.<sup>13</sup> Similar studies done by Coskun et al had reported

the acromion length 44.7 mm width 32.0 mm. Sitha et al observed the same parameters as acromion length 40.0 mm width 23.9 mm thickness.<sup>10,11</sup> These values were very near to the values we found in our study.

Mansur et al has observed that the length of the acromion process of right scapulae mean value 46.46 mm and left side mean was 45.57 mm. They had observed that the right acromion process was longer than the left by 0.89 mm.<sup>9</sup> In our study we found that the length of the acromion process of right scapulae mean value 46.4 mm and left side mean was 45.8 mm. Right acromion process was longer than the left by .80 mm which was also found to be insignificant. The breadth of acromion process of right scapulae mean value 26.63 mm and left scapulae mean value 27.23 mm was reported in the study of Mansur et al. They reported that the right acromion process was wider than the left by 0.60 mm. In our study we found same results as the right acromion was slightly wider (0.4mm) than the left side, with the difference being insignificant. The mean values of the right and left side were found by us as 23.4mm and 23.0 mm respectively.

The distance taken from the tip of acromion to the tip of the coracoid process mean value found 37.5mm in total sample and 37.1 mm right side as well as 37.9 mm in left side. The distance taken at the base of the coracoid to the tip of the acromion process mean value was 28.5 mm in total. The mean value of the acromio-glenoid distance 27.0 mm in total samples and 26.6 mm right side, 27.6 mm of left side samples respectively. Mansur et al have observed mean values of acromio-coracoid distance on the right and left sides as 39.03 mm and 39.39 mm respectively.<sup>9</sup> Their study showed that there were no statistically differences between right and left side ( $t = 0.259$ ,  $p = 0.398$ ). Similarly, the acromio-glenoid distance was found to be varied from distances 31.83 mm and 31.97 mm on right and left sides respectively. They noticed that acromio-glenoid distances were same on both sides ( $t = 0.150$ ,  $p = 0.440$ ) According to Sitha et al the coraco-acromion distance 29.5 mm and acromio-glenoid distance 18.1mm was observed.<sup>11</sup> The acromio-coracoid and acromio-glenoid distances between both sides in this present study showed no significance difference, were as when compared the mean values with the findings of the Mansur et al the values were slightly less on the other hand the mean values shown by the Sitha et al were much less than our findings.

We examined the types of acromion according to its slope. Type - I flat was seen in 29 (22.5%), type - II curved in 50 (38.8%) and type - III hooked in 50 (38.8 %) acromion process. According to Coskun et al type - I flat was seen in 9 (10%), type - II curved in 66 (73%) and type - III hooked in 15 of 90 (17%) acromion process. Among the all three acromian types the curved type was reported more by the Coskun et al.<sup>10</sup>

## CONCLUSION

The acromion process plays important role in formation and provides stability to the shoulder joint. Dimensions of scapula and acromion process are important that they differ in morphology and when classified in to different types show linkage to the shoulder girdle pathologies. Study would be helpful for surgeons while working on shoulder joint.

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