

## Original Research Article

# Acromion, coracoid and glenoid processes of scapula: an anatomical study

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### ABSTRACT

**Background:** Acromion morphology has an important role in impingement syndrome and pathogenesis of rotator cuff diseases. Coracoid process is involved in many surgical procedures of shoulder joint. Dimensions of glenoid process are essential in designing glenoid components for total shoulder replacement. Aim of the study was to measure the various dimensions and note the morphology of acromion, coracoid and glenoid processes of scapula.

**Methods:** Forty two scapulae (24 right, 18 left) were used and the dimensions of the three processes were measured with digital Vernier calipers.

**Results:** The findings were as follows- length of acromion- 43.57±5.13 mm; width of acromion- 25.03±3.57 mm; acromio-coracoid distance- 33.09±7.02 mm; acromio-glenoid distance- 25.24±4.05 mm; height of coraco-acromial arch- 15.17±3.8 mm; length of coracoid- 38.73±3.72 mm; width of coracoid- 14.28±2.36 mm; tip thickness of coracoid- 8.61±1.89 mm; height of base coracoid- 12.91±2.88 mm; width of base of coracoid- 22.31±3.54 mm; height of glenoid- 34.18±3.53 mm; superior antero-posterior glenoid length- 15.35±2.35 mm and inferior antero-posterior glenoid length- 23.9±2.52 mm.

**Conclusions:** The results will be highly relevant in orthopaedic surgery and manufacturing shoulder prosthesis.

**Keywords:** Acromion process, Coracoid process, Glenoid process, Morphometry, Shoulder replacement

### INTRODUCTION

The scapula is a flat bone, triangular in shape and lies posterolaterally on the chest wall corresponding to second to seventh ribs. It has three processes namely acromion, coracoid and glenoid. Each process has its unique paramount relevance.

The anatomy of the acromion process and related structures in the glenohumeral joint is required to interpret radiological images and carry out surgical procedures in various shoulder pathologies. Morphology of the acromion process plays an indispensable role understanding impingement syndrome and pathogenesis of rotator cuff diseases.<sup>1</sup> It's a fundamental principle in shoulder surgeries to embark on an approach that's lateral

to the coracoid process. This is done to avoid injury to vital neurovascular structures medial to the coracoid process like brachial plexus and axillary vessels. So, the coracoid process is often referred to as the 'lighthouse of shoulder' in orthopedic literature.<sup>2</sup> The anatomy of the coracoid process is thus highly relevant in surgical procedures involving the shoulder joint. Detail knowledge about the dimensions of the coracoid process is helpful in surgical procedures of the shoulder joint like hardware fixation, drill hole placement and prosthetic positioning.<sup>3</sup>

The glenoid process of scapula articulates with the head of humerus to form the ball and socket type of glenohumeral or shoulder joint. The shoulder joint is a highly mobile joint and its high mobility comprises its

stability. This results in frequent dislocations of the joint. Traumatic fractures of the glenoid process are quite common as well.<sup>4</sup> Prosthesis and arthroplasty are required in the management of these cases. The morphometry and morphology of the glenoid process are highly important in understanding rotator cuff disease, shoulder dislocation and determining proper size of the glenoid component in shoulder arthroplasty.<sup>5</sup>

The current study involves the measurement of different dimensions of the three processes of scapula as well as determination their morphology.

## METHODS

The current study was a descriptive study and included 42 unpaired human scapulae available in the departmental museum of Anatomy of a Medical College in Eastern India. The study period was from January to March 2018.

### Inclusion criteria

- The study included unbroken scapula bones with the three processes intact.

### Exclusion criteria

- Bones having pathological changes were excluded from the study.

All the scapulae belonged to adult males as per the museum records. The study population belonged to Indian race as per the said records. The following measurements (Table 1) were taken with the help of digital Vernier calipers-

- Length of acromion process.
- Maximum width of acromion process.
- Acromio-coracoid distance.
- Acromio-glenoid distance- Distance between supraglenoid Tuberculi of scapula and inferior surface of acromion process.
- Height of coraco-acromial arch- Distance between supraglenoid tubercle and a line joining the tip of acromion process to the tip of coracoid process.
- Length of horizontal part of coracoid process.
- Width of coracoid process- Antero-posterior distance at the midpoint of coracoid process.
- Thickness of coracoid process 1 cm posterior to its tip.
- Base height of coracoid process.
- Base width of coracoid process.
- Height of glenoid process.
- Antero-posterior glenoid diameter-1 (AP-1)- The antero-posterior diameter (breadth) at the midpoint between the superior rim and mid-equator of glenoid process (superior antero-posterior glenoid length).

- Antero-posterior glenoid diameter-2 (AP-2)- The maximum breadth of the articular margin of the glenoid process perpendicular to the glenoid process height (inferior antero-posterior glenoid length).

The morphology of acromion, coracoid and glenoid processes were noted along the following headings-

- Shape of the acromion process (curved, flat, hooked).
- Shape of the coraco-glenoid space (round bracket, square bracket, fish hooked).
- Shape of the glenoid process (pear shaped, inverted comma shaped, oval).

### Statistical analysis

All the observations were repeated twice to rule out interobserver variations. The data was tabulated and analyzed using Microsoft Excels software. Unpaired t test was applied, and p value was obtained for various parameters. Difference was considered to be statistically significant if p value obtained was less than 0.05.

## RESULTS

All the measurements are displayed in Table 1.

Various measurements were found to be of the following mean values- length of acromion process-  $43.57 \pm 5.13$  mm; width of acromion process-  $25.03 \pm 3.57$  mm; acromio-coracoid distance-  $33.09 \pm 7.02$  mm; acromio-glenoid distance-  $25.24 \pm 4.05$  mm; height of coraco-acromial arch-  $15.17 \pm 3.8$  mm; length of coracoid process-  $38.73 \pm 3.72$  mm; width of coracoid process-  $14.28 \pm 2.36$  mm; tip thickness of coracoid process-  $8.61 \pm 1.89$  mm; height of base of coracoid process-  $12.91 \pm 2.88$  mm; width of base of coracoid process-  $22.31 \pm 3.54$  mm; height of glenoid process-  $34.18 \pm 3.53$  mm; antero-posterior glenoid diameter-1 (AP-1)-  $15.36 \pm 2.35$  MM; antero-posterior glenoid diameter-2 (AP-2)-  $23.9 \pm 2.52$  mm.



**Figure 1: Curved acromion process.**



**Figure 2: Flat acromion process.**



**Figure 3: Hooked acromion process.**



**Figure 4: Round bracket type coraco-glenoid space.**

The shape of the acromion process was found to be curved (Figure 1) in 30 cases (71.43%), flat (Figure 2) in 7 cases (16.66%) and hooked (Figure 3) in 5 cases (11.9%). The shape of the coraco-glenoid space was found to be round bracket like (Figure 4) in 18 cases

(48.25%), square bracket like (Figure 5) in 16 cases (38.09%) and fish hooked like (Figure 6) in 8 cases (19.04%). The shape of the glenoid process was found to be pear shaped (Figure 7) in 22 cases (52.38%), inverted comma shaped (Figure 8) in 14 cases (33.33%) and oval (Figure 9) in 6 cases (14.28%).



**Figure 5: Square bracket type coraco-glenoid space.**



**Figure 6: Fish hooked type coraco-glenoid space.**



**Figure 7: Pear shaped glenoid process.**



Figure 8: Inverted comma shaped glenoid process.



Figure 9: Oval glenoid process.

Table 1: The different measurements of acromion, coracoid and glenoid processes.

Measurement	Right side (in mm), n=24	Left side (in mm), n=18	Total (in mm), n=42	P value
Length of acromion process	42.12±4.97	45.5±4.82	43.57±5.13	0.03
Width of acromion process	24.97±3.46	25.12±3.8	25.03±3.57	0.89
Acromio-coracoid distance	31.26±6.13	35.53±7.56	33.09±7.02	0.58
Acromio-glenoid distance	23±2.73	28.23±3.6	25.24±4.05	0.92
Height of coraco-acromial arch	16.22±4.4	13.78±2.24	15.17±3.8	0.02
Length of coracoid process	37.51±3.78	40.36±3.01	38.73±3.72	<0.01
Width of coracoid process	14.41±2.72	14.11±1.84	14.28±2.36	0.67
Tip thickness of coracoid process	8.11±2.26	9.27±0.94	8.61±1.89	0.03
Height of base of coracoid process	11.33±2.63	15.02±1.54	12.91±2.88	0.94
Width of base of coracoid process	20.92±3.77	24.16±2.18	22.31±3.54	<0.01
Height of glenoid process	34.14±3.78	34.24±3.27	34.18±3.53	0.92
AP-1	14.76±2.55	16.14±1.84	15.36±2.35	0.04
AP-2	24.05±3.06	23.7±1.61	23.9±2.52	0.62

## DISCUSSION

Acromion morphology appears to have a predictive value for determining success of conservative or surgical treatment of shoulder joint impingement. People with hooked type of acromion process were found to be suffering more from rotator cuff impingement syndrome.<sup>6</sup> Gosavi et al, and Singh et al, have reported values of dimensions of acromion processes similar to the current study.<sup>6,7</sup> According to Gosavi et al, the mean length of acromion was 43.7±6 mm and the mean width was 22.87±2.7 mm.<sup>6</sup> Distance of the tip of acromion process measured from the tip of coracoid process was 26.9±5.6 mm. Acromio-glenoid distance was 22.68±3.3 mm. Mean height of coraco-acromial arch was 16.54±2.8 mm. They have reported frequency of shape acromion process as highest for curved type followed by flat and hooked type respectively. Singh et al, have reported the dimensions of

acromion process as follows- acromion length as 4.61±0.52 cm, acromion width as 2.32±0.26 cm, acromion thickness as 0.66±0.1 cm, acromio-coracoid distance as 3.75±0.53 cm, acromio-glenoid distance as 2.7±0.4 cm.<sup>7</sup> They have also found highest frequency of curved type of acromion process followed by hooked type and flat type respectively.

Various open surgical and arthroscopic access to the shoulder revolve around coracoid process. So, its morphometry is of pivotal importance in surgeries involving shoulder joint. The dimensions of the coracoid process obtained in the current study match those found out by Verma et al, and Rajan et al.<sup>8,9</sup> Verma et al, have reported mean length of coracoid as 35.54 mm, mean breadth of coracoid as 14.5 mm, mean thickness of tip of coracoid as 7.95 mm and mean height of base of coracoid as 20.1 mm.<sup>8</sup> They have found out the frequency round

bracket type coraco-glenoid space to be the highest followed by square bracket type and fish hooked type respectively which is similar to the current study. Rajan et al, have found out mean length of coracoid process as 40.43 mm, mean width of coracoid process as 13.77 mm, mean tip thickness of coracoid process as 7.03 mm and mean height of base of coracoid process as 15.6 mm.<sup>9</sup>

The knowledge of the dimensions of the glenoid process is very essential for manufacturing and fitting of glenoid components in total shoulder arthroplasty. It is also required for evaluating conditions like rotator cuff disease, osteochondral defects and Bankart's lesion. The findings of the current study are similar to those conducted by Coskun et al, Von Schroeder et al, Mamatha et al, and Akhtar et al.<sup>1,3,4,10</sup> The height of glenoid process was found to be 3.36±0.4 cm by Coskun et al, 3.6±0.4 cm by Von Schroeder et al, 33.67±2.82 mm on right side, 33.92±2.87 mm on left side by Mamatha et al, and 35.8±3.14 mm by Akhtar et al.<sup>1,3,4,10</sup> The horizontal glenoid diameter was found to be 2.4±0.25 cm by Coskun et al, and 2.9±0.3 cm by Von Schroeder et al.<sup>1,3</sup> The antero-posterior glenoid diameter-1 was reported to be 16.27±2.01 mm on right side and 15.77±1.96 mm on left side by Mamatha et al.<sup>4</sup> It was determined to be 16.3±2.16 mm on right side and 16±2.34 mm on left side by Akhtar et al.<sup>10</sup> The antero-posterior glenoid diameter-2 was observed to be 23.35±2.04 mm on right side and 23.05±2.3 mm on left side by Mamatha et al.<sup>4</sup> It was determined to be 23.67±2.53 mm on right side and 23.59±2.47 mm on left side by Akhtar et al.<sup>10</sup> The current study derived the shape of the glenoid process to be pear shaped in most cases followed by inverted comma shaped and oval respectively. The findings of the current study are consistent with the findings of many other authors such as Mamatha et al, and Akhtar et al.<sup>4,10</sup>

## CONCLUSION

The various scapular measurements obtained in this study will be useful in comparative anatomy and manufacturing prosthetic products. The current study will be of immense help in orthopaedic surgeries on the shoulder joint and in biomechanical engineering for designing implants for total shoulder replacement.

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