

A Morphometric Study of the Glenoid Cavity of the Scapula

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Abstract

Aim: To study glenoid morphology, its anatomical patterns and variations in Maharashtra Population to establish possible morphofunctional correlations related to race, geographic region and literature data. *Materials and Methods:* One hundred scapulae of unknown age and sex were studied. Morphological shapes of the glenoid were evaluated. The various diameters of glenoid cavity were measured. Statistical Analysis was done. *Results:* In the present study, the mean value of Superior-Inferior diameter (A) of the glenoid cavity on the right side was 40.82 ± 2.88 mm and on the left side was 39.49 ± 2.72 mm. The mean Anterior-Posterior glenoid diameter (B) was 22.95 ± 2.06 mm on right side and 21.66 ± 2.08 mm on left side. The mean Anterior-Posterior glenoid diameter (C) was 29.08 ± 2.80 mm on right side and 28.09 ± 2.58 mm on left side. The shapes of glenoid cavities studied were oval [45%], pear shaped [34%] or inverted comma shaped [21%]. *Conclusion:* Variations in the size and shape of the glenoid cavity observed in the current study will be of great help for orthopaedic surgeons to understand the shoulder pathology better and to decide the proper size of the glenoid component for the shoulder arthroplasty.

Keywords: Morphometric Study; Glenoid Cavity; Scapula.

Introduction

The scapula (shoulder blade) is a triangular flat bone that lies on the posterolateral aspect of the thorax, overlying the 2nd to 7th ribs. The convex posterior surface of the scapula is unevenly divided by the spine of the scapula into a small supraspinous fossa and a much larger infraspinous fossa. The concave costal surface of the scapula has a large subscapular fossa. The triangular body (blade) of the scapula is thin and translucent superior and inferior to the scapular spine [1]. The lateral angle of Scapula is truncated and bears the glenoid cavity for articulation with the head of the humerus. This part of the bone may be regarded as the head [2].

The phylogenetic, ontogenetic and racial variations of the scapula make it as one of the most interesting

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bones for research [3]. Moreover, the meticulous dimensions of the scapula are of major importance in the patho-mechanics of rotator cuff disease, total shoulder arthroplasty and recurrent shoulder dislocation [4]. Based on the presence of a notch on the anterior glenoid rim, the shapes of the glenoid cavity have been classified into: pear shaped; inverted-comma shaped and oval shaped [5]. Moreover, the inclination of the glenoid has been associated with full thickness rotator cuff tears [6]. Therefore, the variations of shape and size of glenoid cavity of scapula is important for the understanding of shoulder dislocation, rotator cuff disease and to determine the meticulous size of the glenoid component in the shoulder arthroplasty and has a prognostic value on the primary gleno-humeral osteoarthritis [7].

The purpose of the current study was to record the morphometrical data for the glenoid cavity of the scapula specifically and to study the various shapes of the glenoid cavity in the Maharashtra population and to compare the data obtained from the present study with those of other populations in order to establish possible morphofunctional correlations related to other state and literature data. Moreover, these data could have clinical role for better

understanding and management of shoulder pathology; gleno-humeral instability, orthopedic joint replacement and rotator cuff tears management.

Materials and Methods

One hundred (100) dry adult human scapulae were studied from Department of Anatomy at IIMSR, Warudi, Badnapur, Jalna. The bones were completely ossified; unbroken; intact and devoid of any deformity or damage, the exact ages or genders were not known. Out of the 100 scapulae, 50 belonged to the right side and 50 belonged to the left one. Each scapula underwent a morphological evaluation and osteometric measurement for glenoid cavity. The mean and standard deviation of the glenoid cavity in various dimensions were calculated. Statistical Analysis: The morphometric values of the two sides were analysed using an unpaired t-test. Statistical significance was set as ≤ 0.05 . The data were analyzed using the SPSS Software. Following parameters of glenoid cavities were used.

Morphological

The shapes of the glenoid cavity were studied and categorized as oval, pear shaped or inverted comma shaped. These were confirmed as follow; A piece of white sheet was placed on the glenoid cavity and held firmly in position to trace the shape of the glenoid cavity. The side of the point of a lead pencil was rubbed along the rim of the glenoid cavity to get a tracing of the shape of the glenoid cavity on the paper.

Osteometric Evaluation

I) Superior-Inferior glenoid diameter (A) is the maximum distance between the inferior point of the

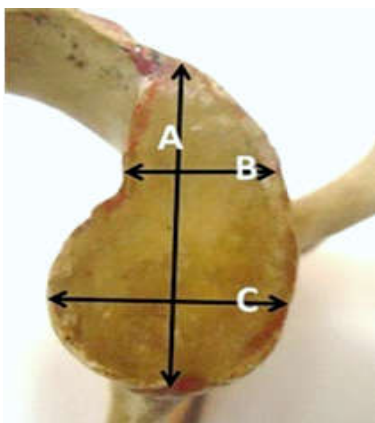


Fig. 1: Showing various diameters of the glenoid cavity. A: Superior-Inferior diameter; B: Anterior-Posterior diameter (AP-1); C: Anterior-Posterior diameter (AP-2)

glenoid border and the most prominent point of the supraglenoid tubercle [Figure 1]. II) Anterior-Posterior glenoid diameter (B) is the maximum breadth of the articular margin of the glenoid cavity perpendicular to the glenoid cavity height [Figure 1]. III) Anterior-Posterior glenoid diameter (C) is the anterior-posterior diameter of the superior half of the glenoid cavity at its mid-point (Figure 1). All these measurements were taken in millimeters using sliding digital vernier caliper (Figure 2).



Fig. 2: Photograph showing method of measuring superior-inferior Diameter of glenoid cavity

Results

In the present study, the mean value of Superior-Inferior diameter (A) of the glenoid cavity on the right side was 40.82 ± 2.88 mm and the left side was 39.49 ± 2.72 mm. The mean Anterior-Posterior glenoid diameter (AP-1), B was 22.95 ± 2.06 mm on right side and 21.66 ± 2.08 mm on left side. The mean Anterior-Posterior glenoid diameter (AP-2), C was 29.08 ± 2.80 mm on right side and 28.09 ± 2.58 mm on left side (Table 1).

The shapes of glenoid cavities studied are oval, pear shaped or inverted comma shaped (Figure 3). Out of the 50 right side glenoid cavities 10 were found to have inverted comma shape the incidence of this shape was found to be 20%. The number of glenoid cavities having pear shape on the right side was 18 and the incidence was found to be 36%. Oval glenoid cavities were 22 in number on the right side and the incidence was 44%. On the left side, glenoid cavities

with the inverted comma shape were observed to be 11 in number out of the total 50 scapulae examined and the incidence of inverted comma shaped glenoid was 22%. The pear shape glenoid cavities were

observed to be 16 similarly 23 were oval on the left side. Incidence of pear shaped glenoid was 32% and that of oval glenoid cavities was 46% respectively (Table 2).

Table 1: Measurements of various diameters of right and left glenoid Cavity

| Parameters | Right side Mean \pm SD | Left side Mean \pm SD | Total mean Mean \pm SD | P value |
|---|-----------------------------|----------------------------|-----------------------------|---------|
| Superior-inferior glenoid diameter (A) | 40.82 \pm 2.63 | 39.49 \pm 2.73 | 39.52 \pm 2.80 | 0.394 |
| Anterior-posterior glenoid diameter 1 (B) | 22.62 \pm 2.06 | 21.66 \pm 2.08 | 21.85 \pm 2.68 | 0.470 |
| Anterior-posterior glenoid diameter 2 (C) | 29.08 \pm 2.80 | 28.09 \pm 2.60 | 28.90 \pm 2.58 | 0.90 |

Table 2: Various shapes of right and left glenoid cavities

| Shape of glenoid cavity | Right side | | Left side | | Total mean | |
|-------------------------|------------|----|-----------|----|------------|----|
| | No | % | No | % | No | % |
| Oval | 22 | 44 | 23 | 46 | 45 | 45 |
| Pear | 18 | 36 | 16 | 32 | 34 | 34 |
| inverted comma | 10 | 20 | 11 | 22 | 21 | 21 |



Fig. 3: Photograph showing various shapes of the glenoid cavity

Discussion

Many studies have attempted to determine the glenoid diameters in a variety of ways, including direct measurement of dry scapulae, direct measurement of fresh or embalmed cadavers, radiographic measurement of scapulae harvested from cadavers and radiographic measurement in living patients. The present study was done on dry human scapulae obtain from cadavers. The results of present study were compared with those of previous workers. In the present study the mean superior inferior diameter (A) of the right glenoid cavity was 40.82 \pm 2.88 mm and the mean superior-inferior diameter of the left side was 39.49 \pm 2.72 mm. Though the right glenoid value was slightly more on right

side but was statistically not significant. The mean values of present study were compared to the values recorded in other studies (Table 3). Mallon *et al* (1992) [8] studied 28 glenoid cavities they found mean SI to be 35 \pm 4.1 mm. Similarly, Karelse *et al* (2007) [9] found mean SI to be 35.9 \pm 3.6 mm. (Both these values were nearly same as that of present study).

Iannotti *et al.* (1992) [10] and Von Schroeder *et al.* (2001) [11] reported the superior-inferior diameter of the glenoid to be 39 \pm 3.5 mm and 36 \pm 4 mm respectively which were more than the present study. Mamtha *et al* (2011) [12] in their study performed on 98 right and 104 left sided scapulae found that mean SI diameter on right and left side were 33.67 \pm 2.82 mm and 33.92 \pm 2.87 mm respectively which were comparatively lower than present study (Table 3).

Table 3: Comparison of Superior-Inferior diameter by various studies

| Observers | No of specimens | Mean SI Diameter A |
|---|-----------------|--------------------|
| Mallon <i>et al</i> (1992) ⁸ | 28 | 35 ± 4.1 mm |
| Iannotti <i>et al</i> (1992) ¹⁰ | 140 | 39 ± 3.5 mm |
| Von Schroeder <i>et al</i> (2001) ¹¹ | 30 | 36 ± 4 mm |
| Karelse <i>et al</i> (2007) ⁹ | 40 | 35.9 ± 3.6 mm |
| Mamtha <i>et al</i> (2011) ¹² | Right-98 | 33.67 ± 2.82 mm |
| | Left-104 | 33.92 ± 2.87 mm |
| Present Study (2015) | Right-50 | 40.82 ± 2.88 mm |
| | Left-50 | 39.40 ± 2.72 mm |

In present study the mean anterior-posterior diameter (AP-1) (B) of the lower half of the glenoid of the right side was 23.95 ± 2.78 mm and that of the left side was 23.64 ± 2.37 mm. The right glenoid was broader than the left glenoid. This was very close to what was observed in the study of Mamtha *et al* (2011) [12] in which they found that the mean AP-1 diameters on right and left sides were 23.35 ± 2.04 mm and 23.02 ± 2.30 mm respectively. Studies carried out by Iannotti *et al* (1992) [10] on 140 scapulae, Von Schroeder *et*

al (2001) [11] on 30 scapulae and Karelse *et al* (2007) [8] on 40 scapulae found AP-1 diameter to be 29 ± 3.2 mm, 28.6 ± 3.3 mm and 27.2 ± 3 mm. All these three values were higher than our combined mean of both right and left sides which was 23.79 ± 2.57 mm. However Ozer *et al* (2006) [13] in the study on 94 male and 104 female scapulae, found that the mean AP-1 in male was 27.33 ± 2.4 mm which was higher than present study but in female the mean AP-1 was 22.72 ± 1.72 mm which was lower than our study (Table 4).

Table 4: Comparison of the anterior-posterior (AP-1) diameter by various studies

| Observers | No of specimens | Mean SI Diameter A |
|---|-----------------|--------------------|
| Mallon <i>et al</i> (1992) ⁸ | 28 | 24 ± 3.3 mm |
| Iannotti <i>et al</i> (1992) ¹⁰ | 140 | 29 ± 3.2 mm |
| Von Schroeder <i>et al</i> (2001) ¹¹ | 30 | 28.6 ± 3.3 mm |
| Karelse <i>et al</i> (2007) ⁹ | 40 | 27.2 ± 3. mm |
| Mamtha <i>et al</i> (2011) ¹² | Right-98 | 23.35 ± 2.04 mm |
| | Left-104 | 23.02 ± 2.30 mm |
| Ozer <i>et al</i> (2006) ¹³ | Male -94 | 27.33 ± 2.4 mm |
| | Female -92 | 22.72 ± 1.72 mm |
| Present Study (2015) | Right-50 | 22.62 ± 2.06 mm |
| | Left-50 | 21.66 ± 2.08 mm |

The mean anterior-posterior diameter (AP-2) of the upper half of the right glenoid was 29.08 ± 2.80 mm and that of the left glenoid was 28.09 ± 2.60 mm in the current study. The right glenoid cavity was slightly broader than the left glenoid cavity. The combined mean on both sides was 28.90 ± 2.58 mm. This was much larger than what was observed by Iannotti *et al* (1992) [10], they found it to be 23 ± 2.7 mm. Study conducted by Mamtha *et al* (2011)¹² found that mean AP-2 of the right glenoid was 16.27 ± 2.01 mm and that of the left side was 15.77 ± 1.96 mm, these values were smaller in the present study.

The various types of glenoid cavity depending on their shape observed in the present study were oval shaped on the right side 44 % while left side 46 %, pear shaped on right side 36% while left side 32% and inverted comma shaped on right side 20% while left side 22%.

The current findings indicate that the most common type of glenoid cavity is the oval shaped while the least one is the inverted coma shaped. These results match with others [7,14]. However, the current

results don't match with other reports [12,14].

Racial and sexual differences can interfere in the development of bone projections, providing alterations such as size and morphology. These alterations can occur in scapulae and may affect the glenohumeral stability. When the glenoid notch is distinct, the glenoid labrum is often not attached to the rim of the glenoid at the site of the notch and can be a predisposing factor in anterior dislocation of the shoulder joint [7].

Conclusion

In the present study, the mean value of Superior-Inferior diameter (A) of the glenoid cavity on the right side was 40.82 ± 2.88 mm and on the left side was 39.49 ± 2.72 mm. The mean Anterior-Posterior glenoid diameter (B) was 22.95 ± 2.06 mm on right side and 21.66 ± 2.08 mm on left side. The mean Anterior-Posterior glenoid diameter (C) was 29.08 ± 2.80 mm on right side and 28.09 ± 2.58 mm on left side. The

shapes of glenoid cavities studied were oval [45%], pear shaped [34%] or inverted comma shaped [21%].

Variations in the size and shape of the glenoid cavity which were observed in the current study will be of great help for orthopedic surgeons to understand the shoulder pathology better and to decide the proper size of the glenoid component for the shoulder arthroplasty. Also it will be important for radiologists, anthropometrists, anatomists and other.

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Conflict of Interest

nil

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