



A Morphometric Study of The Glenoid Cavity in Dry Adult Human Scapulae – A Study In RIMS, Imphal

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Abstract

Background: The scapula is a flat bone lying on the posterolateral aspect of the upper part of the thorax. It is triangular in shape, with three borders and three angles and dorsal and costal surfaces. Its lateral angle (glenoid cavity) articulates with the head of the humerus forming the glenohumeral joint. The articular surface of the glenoid cavity shows variable morphology. The glenohumeral joint is the most frequently dislocated joint. The size and shape of the glenoid cavity is directly related to the dislocation of the shoulder joint.

Methods and Materials: 136 dry adult scapulae (58 right and 78 left) of unknown sex and age were obtained from Department of Anatomy, Regional Institute of Medical Sciences, Imphal, Manipur. The maximum length and width of the scapulae, the shape of the glenoid cavity and superoinferior diameter and the anteroposterior diameter of the glenoid cavity were measured using a digital vernier calliper. Data obtained was statistically analysed.

Results: The most common shape of the glenoid cavity was pear shape followed by inverted comma shape and the least common was oval shape. The mean length(AB) and breadth of the scapula(CD) were 134.94±13.10mm, 94.05±9.02mm respectively. The mean superoinferior glenoid diameter(SI) was 34.75±3.42mm, the mean anteroposterior diameter(AP1) was 22.868±2.81mm, the mean anteroposterior diameter(AP2) was 16.60±2.45mm.

Conclusion: A precise knowledge of the size, shape, dimension of the glenoid cavity is essential for undergoing shoulder arthroplasty and for designing the glenoid component of the shoulder joint.

Keywords: Glenoid cavity, shoulder arthroplasty

Introduction

The scapula is a large triangular bone that lies over the posterolateral chest wall covering parts of second to seventh ribs with a vertical long (craniocaudal) axis. It has costal and dorsal surfaces; superior, lateral and medial borders; inferior, superior and lateral angles; and three processes: the spine, the acromion and coracoid process. The superior and lateral borders converge laterally at the lateral angle of scapula.^[1]

The lateral angle of the scapula carries the glenoid cavity for articulation with the head of humerus forming the shoulder joint. The rim of glenoid cavity affords attachment all round to glenoid labrum. The oval glenoid cavity is very shallow but is deepened and enlarged by the glenoid labrum.^[2]

Anteriorly, the glenoid labrum is triangular in section; posteriorly it is more ovoid; while inferiorly it may be flattened and almost deficient. The attachment to the edge of the glenoid fossa is secure

superiorly where it blends with the anterior and posterior fasciculi of the long tendon of biceps, less secure posteriorly, but relative more secure antero-inferiorly. There may be an aperture between the deep edge of labrum and the anterior glenoid rim above the midpoint of the fossa. In slightly less than one-fifth of normal shoulders, there may be no anterior labrum.^[1]

The glenoid rim presents a notch in its upper and front part which is better marked in the early state of the bone indicating the junction of the “corocoid” and “scapular” part of the articular surface.^[2]

The notch present in the anterior margin of glenoid rim gives its different shape. When the glenoid notch is indistinct the shape of glenoid cavity is described as pear-shaped or pyriform; when it is distinct it is described as inverted comma shaped and when the notch is absent, the shape of glenoid cavity is described as round or oval.^[3,4,5]

The glenohumeral joint is synovial multiaxial joint between the roughly hemispherical head of the humerus and the shallow glenoid fossa of the scapula. It is the most mobile joint in the body and most frequently dislocated joint in the body. The vast majority of the dislocations are anterior.^[1]

The shape, size, height and width are important anatomical parameters used to design the prosthesis of glenoid cavity. Furthermore, a sound knowledge and understanding of the various shape and normal morphometric parameters as well as variations of the glenoid cavity is of profound importance in glenohumeral dislocation and associated glenohumeral pathologies such as rotator cuff injuries; Bankart’s lesion; labrum tear etc and also for designing the prostheses of glenoid cavity for undergoing total shoulder arthroplasty.^[5,6,7]

Therefore, the present study is aimed to record the shape and morphometric data of the glenoid cavity in Indian population and to compare it with previous studies by various authors.

Materials And Methods

The study was carried out in the Department of Anatomy, Regional Institute of Medical Sciences, Imphal, Manipur. A total number of 136 dry adult human scapulae (58 right and 78 left) of unknown sex and age were collected and studied. Scapulae

which are damaged and with abnormalities were excluded from the study.

The following parameters were taken–

A. Shape of the glenoid cavity- Shape made by the outer raised margin of the glenoid cavity as shown in Figure 1.

- a. inverted comma shaped– presence of a glenoid notch
- b. pear shaped– presence of indistinct glenoid notch
- c. oval shaped– absence of a glenoid notch

B. Measurements of scapula– as shown in Figure 2A

1. Length of the scapula (AB)– Distance between the highest point of the superior angle(A) and the lowest point of the inferior angle (B)
2. Width of the scapula (CD)– Distance between from where the spine intersects the medial border (C) and at the middle of the posterior border of glenoid cavity (D).

C. Measurements of Glenoid cavity- as shown in Figure 2B

3. Superior – Inferior glenoid diameter (SI)– distance from the most prominent point of the supraglenoid tubercle to the inferior point on the glenoid margin
4. Anterior – Posterior glenoid diameter (AP-1)– distance of the maximum breadth of the articular margin of the glenoid cavity perpendicular to the glenoid cavity height
5. Anterior – Posterior glenoid diameter (AP-2)– distance of the anterior-posterior diameter (breadth) of the top half of the glenoid cavity at the mid-point between the superior rim and mid-equator.

The above parameters were measured in millimetres using a sliding digital calliper with accuracy of 0.01 millimetre. The measurements were taken by two individuals independently and the mean was taken to remove observer’s bias. The mean and standard deviation of the various parameters were calculated. The data were analyzed using the SPSS version 21. The morphometric values of the two sides were analyzed using an unpaired t-test.

Figure 1. Showing different shapes of the glenoid cavity. A. Inverted comma shaped B. Pear shaped C. Oval shaped

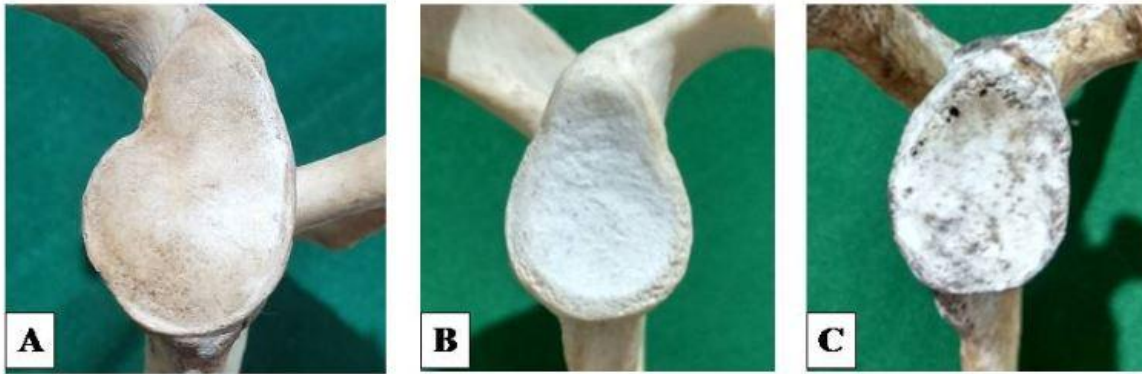
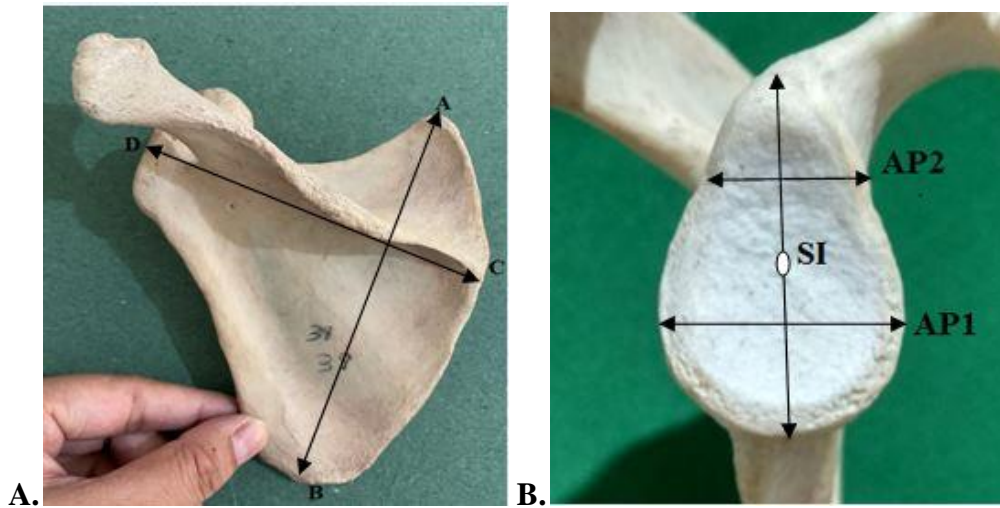


Figure 2. A. Showing measurements of the scapula. Following legends were used- AB= Length of the scapula; CD= Width of the scapula. B. Showing various measurements of the glenoid cavity. Following legends were used – SI = superior inferior glenoid index; AP1= Anterior- Posterior glenoid diameter 1; AP2= Anterior– Posterior glenoid diameter 2



RESULTS

In the present study, a total number of 136 dry adult human scapulae (58 right and 78 left) were examined. Out of the 136 scapulae, the most common shape of the glenoid cavity were pear shaped (51.47%) which were followed by inverted comma shaped (32.35%) and the least common were oval shaped (16.17%). The mean length of the scapula (AB) were 134.94±13.00 mm, the mean width of scapula (CD) were 94.05±9.02 mm; the mean supero-inferior

glenoid diameter (SI) were 34.89±3.32 mm (right) and 34.61±3.53 mm (Left); the mean antero-posterior diameter (AP1) were 23.51±2.75 mm (right) and 22.38±2.79 mm (left), the mean antero-posterior diameter (AP2) were 16.48±2.44 mm (right) and 16.69±2.49 mm (left).

The bilateral differences of all the above measured parameters was found to be statistically not significant i.e P-value >0.05.

Table 1. Observation of presence of glenoid notch

Glenoid notch	Incidence
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	Right	Left	Total
Found	48 (82.75%)	68 (87.17%)	116 (85.29%)
Absent	10 (17.24%)	10 (12.82%)	20 (14.70%)
Total	58 (100%)	78 (100%)	136 (100%)

Table 2. Observation of different shapes of glenoid cavity

Glenoid shape	Incidence		
	Right	Left	Total
Pear-shaped	24 (41.37%)	46 (58.97%)	70 (51.47%)
Inverted comma shaped	22 (37.93%)	22 (28.20%)	44 (32.35%)
Oval shaped	12 (20.68%)	10 (12.82%)	22 (16.17%)
Total	58 (100%)	78 (100%)	136 (100%)

Table 3. Measurement of different parameters of scapula.

Measurement of Scapula	Right	Left	Total
Mean Length of Scapula (AB)	135.06±12.36	138.84±13.62	134.94±13.00
Mean Width of Scapula (CD)	94.65±9.58	93.61±8.68	94.05±9.02

Table 4. Measurement of different parameters of glenoid cavity

Measurements of various parameter of glenoid cavity	Right	Left	Total
Mean Supero-inferior glenoid diameter (SI)	34.89±3.32	34.61±3.53	34.75±3.42
Mean Antero posterior glenoid diameter(AP-1)	23.51±2.75	22.38±2.79	22.86±2.81
Mean Antero posterior glenoid diameter(AP-2)	16.48±2.44	16.69±2.49	16.60±2.45

Discussion

The different shape and dimension of glenoid cavity is important for designing the glenoid component for

total shoulder arthroplasty; also for evaluation of rotator cuff disease; Bankart's lesion etc ^[5,6,7]. In the present study, the shape and various dimensions of glenoid cavity, the length and breadth of the scapula was observed. The findings of this study were

compared with other studies done by various authors in India and also with other countries to know the presence of any geographical differences as shown in Table 5,6,7,8.

Table 5. Showing the comparison of the findings of various diameters of the glenoid cavity by different authors with the present study.

Authors	No. of specimen	Mean Diameter	SI	Mean API	Mean AP2
Ozer et al ⁸ (2006) Turkish population	Male- 94	38.79±3.08		27.33±2.4	
	Female- 92	33.79±3.08		22.72±1.72	
Mamatha et al ⁷ (2011) South Indian population	Right- 98	33.67±2.82		23.35±2.04	16.27±2.01
	Left- 104	33.92±2.87		23.05±2.30	15.77±1.96
HB Rajput et al ⁹ (2012) Indian Population	Right- 43	34.76±3		23.31±3.0	15.10±2.54
	Left- 57	34.43±3.21		22.92±2.80	13.83±2.45
Wael Amin NED et al ¹⁰ (2015) Egyptian population	Right- 80	38.88±2.63		21.33±2.49	28.31±2.38
	Left- 80	39.01±2.49		21.69±2.06	27.99±2.55
Akthar et al ⁵ (2016) Indian population	Right- 126	36.03±3.15		23.67±2.53	16.30±2.16
	Left- 102	35.52±3.12		23.59±2.47	16±2.34
Ghule et al ¹¹ (2018) Indian population	Right- 60	35.55 ± 3.48		22.51 ± 2.51	
	Left- 63	35.04 ± 3.61		22.81 ± 2.88	
R Khan et al ¹² (2019) South African population	Right- 80	35.2±3.1		24.5±2.9	18.4±3.3
	Left- 84	34.9±3.0		23.6±2.6	17.5±2.9
	Male- 68	35.3±3.1		24.2±2.7	18.2±3.3
	Female- 96	34.6±2.8		23.7±2.8	17.4±2.6
Rajani ⁶ (2020) North Indian population	Right- 91	33.4±3.0		24.1±3.2	15.4±2.0
	Left- 81	33.9±3.6		23.1±2.9	15.3±2.2

Present study (2021) Indian population	Right- 58	34.89±3.32	23.51±2.75	16.48±2.44
	Left- 78	34.61±3.53	22.38±2.79	16.69±2.49

Table 6. Showing comparison of Mean scapular length(mm) by different authors.

AUTHORS	No. of specimen studied	Mean length of scapula (mm)
Wael Amin NED et al ¹⁰	160	151.16±10.32
Coskun et al ¹³	90	98.8±7
Krishnaiah et al ¹⁴	50	143.27±11.44
Akhtar MJ et al ⁵	228	135.07±14.23
Present study	136	134.94±13.00

Table 7. Showing comparison of Mean breadth of scapula (mm) by different authors.

AUTHORS	No. of specimen studied	Mean breadth of scapula (mm)
Wael Amin NED et al ¹⁰	160	107.22±9.74
Krishnaiah et al ¹⁴	50	105.6±5.08
Akhtar MJ et al ⁵	228	97.55±9.63
Present study	136	94.05±9.02

Table 8. Showing comparison of shapes of glenoid cavity by different authors.

AUTHOR	No. of specimens studied	Pear shape (%)	Inverted comma shape (%)	Oval shape (%)
Mamatha et al ⁷ (2011) South Indian population	Right- 98	46	34	20
	Left- 104	43	33	24
HB Rajput et al ⁹ (2012) Indian Population	Right- 43	49	35	16
	Left- 57	46	39	15
Wael Amin NED et al ¹⁰ (2015) Egyptian population	Right- 80	35	16.25	48.75
	Left- 80	27.5	20	52.50
Akhtar et al ⁵ (2016) Indian	Right- 126	51.59	34.92	13.49
	Left- 102	49.02	37.25	13.73

population				
Present study	Right- 58	24(41.37%)	22(37.93%)	12(20.68%)
	Left- 78	46(58.97%)	22(28.20%)	10(12.82%)

After comparing and evaluating the present study to other studies by different authors the following were observed.

In the present study, the mean SI glenoid diameter on the right and left sides were 34.89 ± 3.32 mm and 34.61 ± 3.53 mm respectively. Our findings was similar to the observations of HB Rajput et al^[9] whereas Wael Amin NED et al^[10], Akhtar et al^[5] and Ghule et al^[11] reported a higher value while Rajani^[6] and Mamatha et al^[7] reported a lower value than those observed in our study. Ozer et al^[8] and R Khan et al^[12] studied on male and female glenoid cavities separately. The mean SI diameter observed by R Khan et al^[12] in male and female were similar to our findings while Ozer et al^[8] reported a higher value in contrast to our study.

The mean antero-posterior diameter (AP1) were 23.51 ± 2.75 mm on the right and 22.38 ± 2.79 mm on the left in the present study. These findings were similar to the findings of HB Rajput et al^[9] and very close with the findings of Mamatha et al^[7], HB Rajput et al^[9], Akhtar et al^[5] and Ghule et al^[11]. However, Ozer et al^[8], R Khan et al^[12], Rajani^[6] reported a higher value and Wael Amin NED et al^[10] reported a lower value.

The mean antero-posterior diameter (AP2) were 16.48 ± 2.44 mm on the right and 16.69 ± 2.49 mm on the left in the present study. Akhtar et al^[5] and Mamatha et al^[7] observed a similar finding with our study while Wael Amin NED et al^[10] reported a very high value. The findings of higher value may be due to racial and geographical differences. While HB Rajput et al^[9] and Rajani^[6] reported a lower value compared to our study.

According to our study, the mean length of the scapula were 134.94 ± 13.00 mm which was close to the findings of Akhtar et al^[5]. While Wael Amin NED et al^[10] and Krishnaiah et al^[14] reported a higher value. Only Coskun et al^[13] reported a lower value compared to our findings.

According to Wael Amin NED et al^[10], Krishnaiah et al^[14] and Akhtar et al^[5] reported higher value of the mean width of scapula where in the present study, the mean width of scapula (CD) were 94.05 ± 9.02 mm.

In the present study, the most common shape of the glenoid cavity was pear shaped 24 (41.37%) on the right side and 46 (58.97%) on the left side; followed by inverted comma shaped 22 (37.93%) on the right and 22 (28.20%) on the left and the least common shape in the present study was oval shaped 12 (20.68%) on the right and 10 (12.82%) on the left. Mamatha et al^[7], HB Rajput et al^[9], Akhtar et al^[5] also observed pear shaped glenoid cavity as their most common shape which was followed by inverted comma shape and oval shaped glenoid cavity as the least common. In contrast to our finding, Wael Amin NED et al^[10] observed oval shaped glenoid cavity as the most common shape followed by pear shaped and inverted comma shaped as the least common.

Conclusion

The shape, size, height and width are important anatomical parameters used to design the prosthesis of glenoid cavity. Therefore, a sound knowledge and understanding of the various shape and normal morphometric parameters as well as variations of the glenoid cavity is of profound importance in glenohumeral dislocation and associated glenohumeral pathologies such as rotator cuff injuries; Bankart's lesion; labrum tear etc and also for designing the prostheses of glenoid cavity for undergoing total shoulder arthroplasty.^[5,6,7] Furthermore, a study in dry adult human scapula has not been done in our region i.e. Imphal, Manipur, India by any other author from which developed the interest to do the present study.

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