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Morphological and Morphometrical study of scapulae in Western Indian Population

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Abstract

Scapula a bone of shoulder girdle is among the interesting bones of our body because of variations present in it. Its lateral angle becomes truncated and broadened that bears the glenoid cavity which articulates with the head of the humerus in the shoulder joint. The knowledge of the normal anatomical features and variations in shape and size of the glenoid fossa are required for better understanding of shoulder joint arthroplasty are prerequisites for complete understanding of the mechanics of shoulder joint.

Materials and Method: Total 107 scapulae; 53right sided and 54 left sided were studied macroscopically and morphometrically. Superior-Inferior Glenoid Diameter (SI), Anterior-Posterior Glenoid Diameter-1 (AP-1), Anterior-Posterior Glenoid Diameter-2 (AP-2)were measured using Vernier sliding caliper and Glenoid cavity index (GCI) was calculated also Scapular length & Breadth measured .Data was analyzed using Microsoft excel.

Results: In our morphological study the pear shaped glenoid cavity was most common type followed by inverted comma shaped and the oval glenoid cavity was least common type. Mean length and breadth of scapula was 136.07±14.1mm & 97.13 ± 10.63mm respectively. Mean SI diameter was 36.71±4.14 mm, mean diameter AP-1 was 24.85±3.50 mm, mean diameter AP-2 was 16.27±3.24 mm and GCI was 65.40±8.14%.

Conclusion: Results of our study shows that there are variations in the shape of glenoid cavity and in Indian population pear shaped glenoid cavity is most common. There are minor differences in the dimensions of the glenoid cavity of right and left side but the differences are statistically insignificant.

Keywords: Glenoid cavity, Glenoid notch, Scapulae, Glenoid cavity index, Glenoid diameter.

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Introduction

The scapulae are a pair of triangular, large, flat bones that are situated dorsally in the ribcage in relation with the second to seventh ribs. The scapula has three borders, three processes, and three angles. The Glenoid(Gk. *Gléne* "socket") fossa is oriented at the lateral angle of the bone.(1)

Scapula a bone of shoulder girdle is among the interesting bones of our body because of variations present in it. Its lateral angle becomes truncated and broadened that bears the glenoid cavity which articulates with the head of the humerus in the shoulder joint. The glenoid cavity which is also known as the head of the scapula is connected with the head of the humerus to form shoulder joint. When the arm is swing by the side of the body, the glenoid cavity is directed slightly upwards, forwards and laterally and when the arm is raised above the head level it is directed almost straight upwards.(2) The glenoid cavity shows variable morphology. There is a notch present on its anterosuperior part i.e. on the anterior glenoid rim which gives its different shape. When this glenoid notch is indistinct its shape is like pear (piriform or tear drop), when it is distinct it looks like inverted comma shape and when it is absent its oval shape.(3-5)

The disproportionate sizes of the head of the humerus and the small, shallow glenoid cavity combined with a lax articular capsule give this joint a wide range of movements but make the joint inherently unstable.(4)

The shoulder joint is the most frequently dislocated joint in the body. Dynamic factors of the rotator cuff muscles and the static factors of the glenohumeral ligaments, the labrum and the joint capsule play a role in gleno-humeral joint stability. Alignment of the humerus and the glenoid articular surfaces is one of the predisposing factors for glenohumeral joint instability, which is one of the predisposing factors for rotator cuff pathology.(5,6)

Dislocations may also be associated with fracture of the glenoid cavity; for the management of this, prostheses and arthroplasty are required. The knowledge of the normal anatomical features and variations in shape and size of the glenoid fossa are required for better understanding of shoulder joint arthroplasty are prerequisites for complete understanding of the mechanics of shoulder joint. This information has clinical application in shoulder arthroplasty, gleno-humeral instability and rotator cuff tear management.(7) Aim of the study was, to study morphology (various shapes) & morphometry of the glenoid cavity in 107 adult dry human scapulae (53 right & 54 left) in Indian population to evaluate various parameters of the glenoid cavity.

Implication/purpose of the study

The knowledge of the dimensions and shape of the Glenoid cavity has important clinical implications in the prognosis and treatment of various orthopedic pathologies like primary gleno-humeral osteoarthritis, gleno-humeral instability, osseous Bankart lesion and osteochondral defects. Similarly dimensions of the glenoid cavity are important in designing and fitting of glenoid components for total shoulder arthroplasty. Thus understanding of the variations in its normal anatomy is essential for accurate diagnosis and treatment of same. The present study was done to determine and analyze the morphological types and diameters of the glenoid fossa in adult scapulae of western Indian population to improve the efficacy and minimize the failure rates in shoulder arthroplasty particularly those involving the glenoid component of the shoulder joint.

Materials and Method

A total of dry 140 unpaired scapula bones collected from anatomy department, Government Medical College, Aurangabad in the state of Maharashtra. After macroscopic inspection 33 scapulae with damaged/deformed glenoid cavity were excluded from this study. Remaining 107 scapulae were firstly segregated depending on the side of the bone, either they belong to right or left side was determined & two groups were made. There were 53 scapulae from right side and 54 were from left side. The scapulae included in this study were completely ossified adult human scapulae, exact age and gender of the bones was not known. The bones were segregated and inspected macroscopically.

The slightly raised rim of the glenoid fossa in each scapula was used to define the border of the fossa. The presence or absence of a glenoid notch was used in classifying shape of the glenoid fossa as previously described by Schrumpf M *et al*[8] into three types; pear-shaped or inverted comma shape in presence of a glenoid notch & oval in absence of notch. The pear shaped has indistinct glenoid notch and the inverted comma shaped has a distinct notch. The number and incidence of each type in the studied scapulae was registered and tabulated.

All measurements were taken to the nearest millimeter using the Vernier sliding caliper which is accurate to 0.1 millimeter.[6] The mean and standard deviation of the glenoid cavity in various dimensions were calculated. The data was analyzed using the Microsoft excel 2010 Software. The morphometric values of the two sides were analyzed using an unpaired t-test. Following parameters of glenoid cavities were measured.[9,10]

Superior-Inferior Glenoid Diameter (SI): Maximum distance from inferior point on the glenoid margin to the most prominent point of supraglenoid tubercle, which is also the maximum height of glenoid cavity.

Anterior-Posterior Glenoid Diameter-1 (AP-1): Represents the maximum breadth of articular margin of the glenoid cavity perpendicular to glenoid cavity height

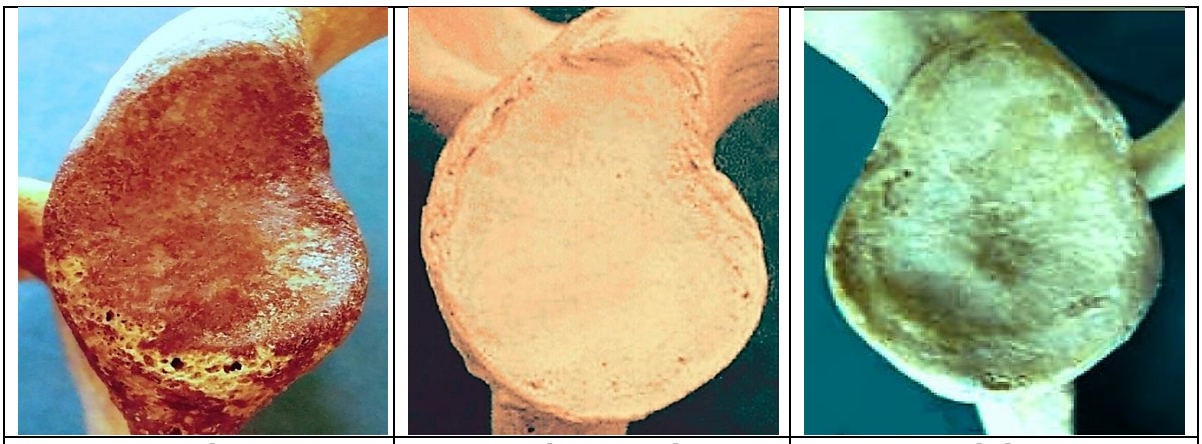
Anterior-Posterior Glenoid Diameter-2 (AP-2): It is the anterior-posterior diameter (breadth) of the tophalf of the glenoid cavity at the mid-point between the superior rim and the mid equator.

Glenoid cavity index (GCI): It was calculated with the help of following formula.

$$\text{GCI} = \frac{\text{Anterior-Posterior Glenoid Diameter- 1}}{\text{Superior-Inferior Glenoid Diameter}} \times 100$$

Results

In the present study there were 107 scapulae, 53 from right side and 54from left side were studied. On the basis of presence or absence of the glenoid notch. 57%, 30% & 13% glenoid cavities of right side were pear shaped, inverted comma shaped and oval shaped respectively. Where as on the left side 50%, 35% & 15%were pear shaped, inverted comma shaped and oval shaped respectively. Total data suggested that 53.27% glenoid cavities were pear shaped, 32.71% were inverted comma shaped and 14.01% were oval shaped. (Table 1 & Fig. 1, 2)



Pear Shape	Inverted Comma Shape	Oval Shape

Fig. 1: Different shapes of the glenoid cavity

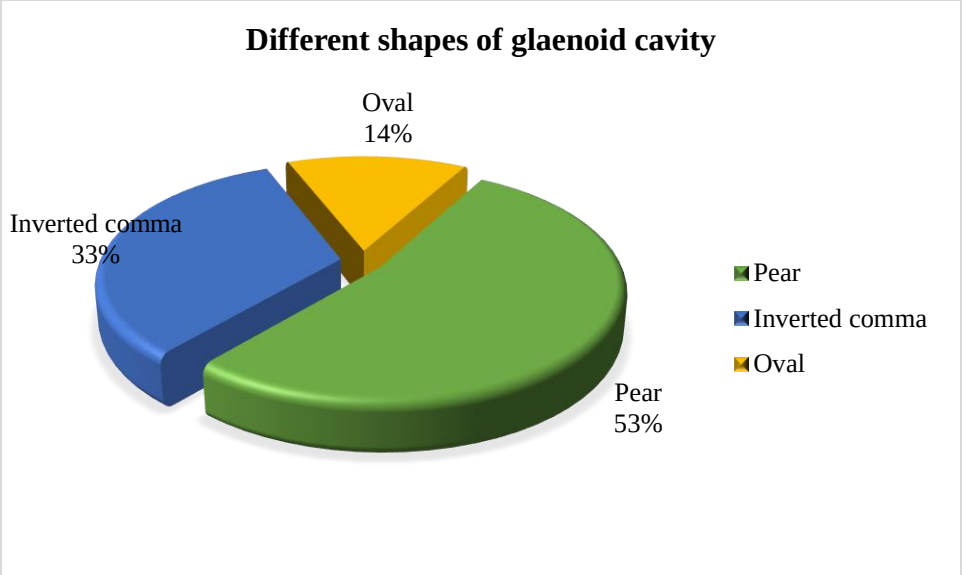


Fig. 2: Pie chart of percent*age of shapes of glenoid cavity*

Table 1: Different shapes of Glenoid cavity

Shape	Right Side (n= 53)	Left Side (n= 54)	Total (n=107)
Pear	30 (57%)	27(50%)	57(53.27%)
Inverted comma	16 (30%)	19(35%)	35(32.71%)
Oval	07 (13%)	08 (15%)	15(14.01%)

Average length and breadth of scapulae included in this study was136.07±14.13 mm and97.13±10.63 mm respectively. The average measurements glenoid cavity were taken and tabulated in the Table 2. The difference between length, breadth, Supero inferior Glenoid Diameter (SI), AP glenoid Diameter-1, AP Glenoid Diameter-2, Glenoid cavity index on right and left side of the scapulae was statistically non-significant.(p value >0.05)

Table 2: Observations of different parameters of scapula and Glenoid cavity

Parameter	Range of Measurements		Mean±SD		Average Mean±SD	T value	P value
	Right (n=53)	Left(n=54)	Right	Left			
Length of scapula	111.16 - 152.74mm	112.79 - 154.40 mm	136.74±13.82 mm	134.29±15.54mm	136.07±14.13 mm	0.64	0.49
Breadth of scapula	77.56 - 116.70 mm	77.85 - 114.98 mm	97.97±9.07mm	96.13±0.30 mm	97.13±10.63 mm	0.63	0.51
Supero inferior (SI) Glenoid Diameter	31.53 - 42.45mm	28.52 - 42.21mm	37.03±3.55mm	36.52±4.12	36.71±4.14 mm	0.78	0.44
AP glenoid Diameter-1	17.5 - 30.32 mm	17.24 -27.74 mm	24.61±3.53mm	24.56±4.47 mm	24.85±3.50 mm	0.10	0.89
AP Glenoid Diameter-2	13.7 - 22.88 mm	13.20 - 22.87 mm	16.31±3.16mm	16.2.±3.64 mm	16.27±3.24mm	0.92	0.35
Glenoid cavity index	47.89 - 88.79%	45.72 - 90.26%	65.13±7.67%	65.73±8.47%	65.40±8.14%	0.43	0.63

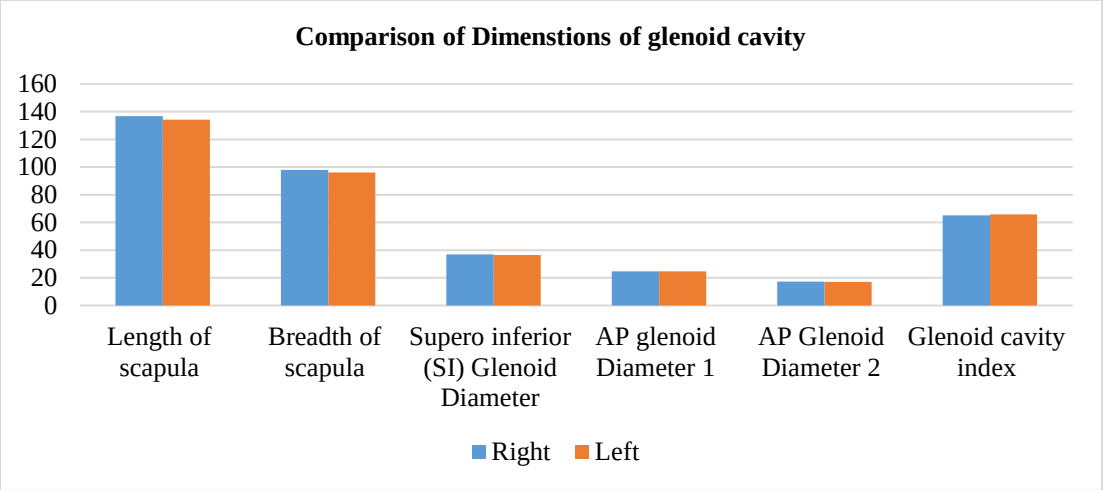


Fig. 3: Comparison of Dimensions of glenoid cavity on right and left side

Discussion

Table 3: Incidence of different shapes of glenoid cavity

Author	No. of specimen studied	Pear shaped (%)	Inverted comma shaped (%)	Oval shaped (%)
Mamatha et al[5]	Right - 98	46	34	20
	Left - 104	43	33	24
Rajput et al[11]	Right - 43	49	35	16
	Left - 57	46	39	15
Gamal Hamed ESH[6]	Right - 38	44.74	31.58	23.68
	Left - 30	46.67	30	23.33
Wael Amin NED et al[13]	Right - 80	35	16.25	48.75
	Left - 80	27.5	20	52.50
Sarwar et al[12]	Right - 50	56	24	20
	Left - 50	64	20	16
Present study	Right - 53	57	30	13
	Left - 54	50	35	15

Table 4: Comparison of Superior-Inferior diameter (SI) and anterior-posterior (AP-1&2) by various studies

Author	Sample size	Superior-Inferior diameter	Anterior-Posterior (AP-1)	Anterior-Posterior (AP-2)
Karelse et al[9] (2007)	40	35.9±3.6mm	27.2 ± 3.mm	
Mamtha et al[5](2011)	Right-98 Left-104	33.67 ± 2.82mm 33.92 ± 2.87mm	23.35 ± 2.04mm 23.02 ± 2.30mm	16.21±2.1mm 15.77±1.96mm
Rajput H.B et al[11](2012)	Right-43 Left -57	34.76+3 mm 34.43+3.21 mm	23.31+3.0mm 22.92+2.80mm	15.10±2.55mm 13.83±2.45mm
Sarwar et al[12] (2015)	Right-50 Left-50	35.22 ± 3.26mm 34.53 ± 3.21mm	23.95 ± 2.78mm 23.64 ± 2.37mm	16.16±2.38mm 15.34±2.17mm
Present study	Right -53 Left-54	37.03±3.55 mm 36.52±4.12 mm	24.61±3.53 mm 24.56±4.47 mm	16.31±3.16 mm 16.2 ±3.64 mm

Shape of glenoid cavity: In the present study pear shaped glenoid of scapula was found in 57% of the scapulae of the right side and 50% of the left side, which was most common type. We observed and second most common type was inverted comma which was found 30% in right side and 35% in left side. Mamatha et al,[5] Gamal Hamed ESH,[6] Rajput et al[11] and Sarwar et al[12] also reported pear shaped glenoid was most common and inverted comma shaped glenoid was second most common type in the contrary to our finding. Wael Amin NED[13] reported comma shaped glenoid being the most common and pear shaped glenoid as second most

common type in Egyptian population. Oval shaped glenoid cavity was found in 13% of right sided scapulae and 15% of left sided scapulae. Similar results were recorded by Mamatha et al,[5] Rajput et al[11] and Sarwar et al.[12] So results of our study are in agreement of the other Indian studies and it can be said that in the Indian population pear shaped glenoid cavity is most common followed by inverted comma shaped and oval shaped glenoid cavity is least common.

Maximum scapular length: The mean length of scapula observed in the present study was 136.74±13.82 mm on right side and 134.29±15.54 mm on left side with an average of 136.07±14.13 mm. Our findings are very similar to the values obtained by Patel et al[14] they studied the scapular length in Gujarati population of India where they found a mean length of 136.03±11.49mm in male scapulae and 119.63±8.81mm in female scapulae. However our findings were quite different when compared to the studies Wael Amin NED et al[13] which were done on European population. There was no statistically significant difference between scapulae of right side and left side (p>0.05).

Maximum scapular breadth: The mean breadth of scapula observed in the present study was 97.97±9.07mmon right side whereas it was 96.13±0.30 mm on left side and average scapular breadth was 97.13±10.63 mm which is very nearer to the values obtained by Singal et al[15] in Gujarati population where they found a mean breadth of96.4±7mm.Patel et al[14] also reported mean breadth of scapula were 93.52±4.38 mm in female scapulae. While Wael Amin NED et al[13] reported higher value of mean breadth of the scapula.

Supero inferior glenoid diameter: The mean SI glenoid diameter and SD was 37.03±3.55 mm on right side and36.52±4.12 on left side, with an average of 36.71±4.14 mm. The measurements of SI glenoid diameter of right side were slightly higher than left, but were statistically insignificant (p>0.05). The observations of Sarwar et al[12] were very similar to our study while Mamatha et al,[5] Rajput HB et al[11] & Patel et al[14] reported lower value than those obtained in the present study.

Antero posterior glenoid diameter-1: The mean AP glenoid diameter-1 in the present study was 24.85±3.50 mm. It was 24.61±3.53 mm on right side while 24.56±4.47 mm on left side. The difference of right and left side was statistically insignificant(p>0.05).

The findings of Mamatha et al[5] (on both right and left side), Rajput HB et al[11] in right sided scapula and Patel et al[14]in male scapula were also very near to our findings, these studies were from India so it might be a normal standard for Indian population.

Antero posterior glenoid diameter-2: The mean AP glenoid diameter-2 in the present study was 16.27±3.24mm. It was 16.31±3.16mm on right side while 16.2±3.64 mm on left side. These differences of right and left side were also not statistically significant. The observations of Mamatha et al[5] and Sarwar et al[12] were near to our results. Only Karelse *et al*[9] reported lower values than us. Findings which were different may be due to racial variation.

Glenoid cavity index (GCI): The mean glenoid cavity index (GCI) found in the present study was 65.40±8.14%. It was 65.13±7.67% on the right side and 65.73±8.47% on the left side. The mean cavity index of 70.37±4.08% on right side while 68.59±4.36% on left side recorded by Dhindsa et al,[7] while Polguj et al[16] observed combined glenoid cavity index was 72.35±5.55% in their study. The mean glenoid cavity index recorded by Gamal Hamed ESH[6] were 73.67±9.08% in right side and 76.71±8.37% in left side. The values of all the above three workers were quite higher than our observations.

Conclusion

In our study the pear shaped glenoid cavity was most common type followed by inverted comma shaped and the oval glenoid cavity was least common type. Mean SI Diameter was 36.71±4.14 mm, mean AP Diameter-1 was 24.85±3.50 mm, the mean AP Diameter-2 was16.27±3.24 mm and glenoid cavity index was 65.40±8.14%respectively. Our study suggest that there are statistically non-significant difference between the dimensions of the glenoid cavity of right and left side.

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