

MORPHOLOGICAL & MORPHOMETRIC STUDY OF GLENOID CAVITY OF SCAPULA & ITS CLINICAL SIGNIFICANCE

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Abstract

Background: Glenoid cavity of the scapula articulates with the head of the humerus to form glenohumeral joint (shoulder joint). Knowledge about the shape and dimensions of the glenoid cavity and variations in its normal anatomy are important in the designing of prosthesis in total shoulder arthroplasty. It is also essential while dealing with the pathological disorder related to shoulder joint like osteochondral defects, osseous bankart lesion. **Materials and Methods:** The observational study was carried out on 100 undamaged dry adult human scapulae. The bones were collected from the department of Anatomy, PSG IMS & R. Out of these 100 scapulae, 50 belonged to right side and 50 belonged to left side. Parameters studied were maximum scapular length, maximum scapular breadth, Vertical glenoid diameter, Transverse glenoid diameter I, Transverse glenoid diameter II and shape of the glenoid cavity. **Result:** The most common shape of glenoid cavity recorded in the current study was Inverted comma shaped (49%) followed by pear shaped (46%) and the least common shape was oval (5%). The mean maximum scapular length observed was 14.810 ± 1.2117 on the right side and 14.752 ± 1.0416 on the left side. The mean maximum scapular breadth was 9.996 ± 0.6243 on the right side and 9.766 ± 0.6056 on the left side. The mean vertical glenoid diameter was 3.406 ± 0.3106 on the right side and 3.348 ± 0.2991 on the left side. The mean transverse diameter I was 1.638 ± 0.2108 on the right side and 1.834 ± 0.2455 on the left side. The mean transverse diameter II was 2.206 ± 0.2360 on the right side and 2.250 ± 0.2279 on the left side. In all these measurements, bilateral differences were not statistically significant (p value > 0.05). **Conclusion:** Morphological & morphometric analysis of glenoid cavity of scapula help clinicians and orthopaedician in choosing appropriate size of prosthesis for total shoulder arthroplasty. This knowledge is also essential while treating diseases related to the shoulder joint.

INTRODUCTION

The scapula is a large, flat, triangular bone that lies on the posterolateral aspect of the chest wall, covering parts of the 2nd to 7th ribs. It has costal and dorsal surfaces, superior, lateral and medial borders, inferior, superior and lateral angles and three processes, the spine, its continuation the acromion and the coracoid process. The lateral angle is truncated and bears the glenoid cavity for articulation with the head of the humerus. Its outline is piriform,

narrower above and broader below. The concavity of the glenoid fossa is deepened by the glenoid labrum, attached to the margin of fossa. The anterior rim of the glenoid cavity possesses a notch. The glenoid notch marks the articular surface of the shoulder, including the junction of scapula and the coracoid process.^[1] Various shapes of the glenoid cavity have been described based on the presence/ absence of a notch. It has been described that when the notch is present the shape of the cavity is pear/ inverted comma and

when it is absent the shape of the cavity is round/oval.^[2]

The knowledge of variations in the shape and morphometric dimensions of glenoid cavity may help the clinicians or orthopaedician to deal with various medical & surgical problems associated with the glenohumeral joint.^[3] This may also be helpful in designing and to choose the appropriate size of prosthesis in shoulder arthroplasty which reduces the morbidity postoperatively.^[4,5]

MATERIALS AND METHODS

The Observational, Cross sectional study was done on total of 100 dry adult human scapulae obtained from the Department of Anatomy, PSG Institute of medical science & research, Coimbatore after getting ethical clearance. Out of which 50 bones were of right and 50 bones were of left side. Damaged, deformed bones were excluded from the study. Only those bones which are fully ossified, dried, macerated, well demarcated were included in the study.

The parameters were measured by using digital vernier caliper in millimeters with the accuracy of 0.01 mm. Shape and all other parameters of the glenoid cavity were studied.

Shape: Shape made by the slightly raised rim of the glenoid cavity. It was taken by tracing of the raised rim on a white paper with the help of a lead pencil. Three types of shapes were observed: a) Pear shaped b) Inverted comma shaped c) Oval shaped⁴ as shown in [Figure 1].

1. Maximum scapular length
2. Maximum scapular breadth
3. Vertical glenoid diameter
4. Transverse glenoid diameter – I
5. Transverse glenoid diameter – II

1. Maximum scapular length: maximum distance between the summit of superior and inferior angle of scapula⁵ as shown in [Figure 2].
2. Maximum scapular breadth: maximum distance between the root of the spine on the medial border and at the middle of the posterior border of glenoid cavity⁵ as shown in [Figure 3].
3. Vertical glenoid diameter: maximum distance between the most prominent point on the supra-glenoid tubercle to the inferior margin of the glenoid cavity⁵ as shown in [Figure 4].
4. Transverse glenoid diameter I: It is the antero-posterior diameter of the top half of the glenoid cavity at the mid-point between the superior rim and the mid-equator⁵ as shown in [Figure 5].
5. Transverse glenoid diameter II: maximum breadth of the articular margin of the glenoid cavity perpendicular to the glenoid cavity height⁵ as shown in [Figure 6].

RESULTS

The most common shape of glenoid cavity recorded in the present study was Inverted comma shaped (49%) followed by pear shaped (46%) and the least common shape was oval (5%). The mean maximum scapular length observed was 14.810 ± 1.2117 on the right side and 14.752 ± 1.0416 on the left side. The mean maximum scapular breadth was 9.996 ± 0.6243 on the right side and 9.766 ± 0.6056 on the left side. The mean vertical glenoid diameter was 3.406 ± 0.3106 on the right side and 3.348 ± 0.2991 on the left side. The mean transverse diameter I was 1.638 ± 0.2108 on the right side and 1.834 ± 0.2455 on the left side. The mean transverse diameter II was 2.206 ± 0.2360 on the right side and 2.250 ± 0.2279 on the left side. In all these measurements bilateral differences were not statistically significant (p value > 0.05).

Table 1: Shape of Glenoid Cavity.

S.No	Shape of the glenoid cavity	Incidence of the shape	
		Right side no 50 (%)	Left side no 50 (%)
1	Inverted comma	28 (56)	21 (42)
2	Pear	18 (36)	28 (56)
3	Oval	4 (8)	1 (2)

Table 2: Different parameters of scapula and glenoid cavity

S.No	Parameters	Group	Sample size	Mean $\pm$ Std. Deviation	P Value
1	Maximum Scapular Length	Right	50	14.810 ± 1.2117	0.798
		Left	50	14.752 ± 1.0416	0.798
2	Maximum Scapular Breadth	Right	50	9.996 ± 0.6243	0.064
		Left	50	9.766 ± 0.6056	0.065
3	Vertical Glenoid Diameter	Right	50	3.406 ± 0.3106	0.344
		Left	50	3.348 ± 0.2991	0.344
4	Transverse Diameter I	Right	50	1.638 ± 0.2108	< 0.001
		Left	50	1.834 ± 0.2455	< 0.001
5	Transverse Diameter II	Right	50	2.206 ± 0.2360	0.345
		Left	50	2.250 ± 0.2279	0.345

Table 3: Comparison of Incidence of different shapes of Glenoid cavity

S.No	Studies	Pear		Invertedcomma		Oval	
		Right%	Left%	Right %	Left%	Right%	Left%
1	Dope et al, ^[6]	57	50	30	35	13	15
2	Mamatha et al, ^[7]	46	43	34	33	20	24
3	Neeta et al, ^[8]	47	55	31	32	22	13
4	Pranoti Sinha et al, ^[9]	23	42	8	13	9	6
5	Joshi et al, ^[10]	46.66	45.55	20.00	14.44	33.33	40.00
6	Vardhan et al, ^[11]	47.28	54.92	21.82	12.68	30.90	32.40
7	Hetal et al, ^[12]	44.44	47.37	16.67	18.42	38.89	34.21
8	Gosavi et al, ^[13]	54.83	45	12.9	11.2	32.25	43.75
9	Arora et al, ^[14]	38	71	27	13	35	15
10	Yogesh et al, ^[15]	20.0	44.4	66.6	38.8	13.3	16.7
11	present study	36	56	56	42	8	2

Table 4: Comparison of mean vertical and Transverse glenoid diameter.

S.No	Studies	Sample Size - 100	VGD	TGD – I	TGD – II
1	Dope et al, ^[6]	Right- 53	37.03±3.55	16.31±3.16	24.61±3.53
		Left- 54	36.52±4.12	16.2±3.64	24.56±4.47
2	Mamatha et al, ^[7]	Right- 98	33.67±2.82	16.27±2.01	23.35±2.04
		Left- 104	33.92±2.87	15.77±1.96	23.05±2.30
3	Neeta et al, ^[8]	Right- 55	38.46±2.81	18.70±2.22	25.04±2.69
		Left- 71	39.03±3.18	18.6±2.07	24.85±2.46
4	Pranoti Sinha et al, ^[9]	Right- 21	33.64±3.01	18.07±2.64	23.22±2.85
		Left- 32	34.44±3.27	18.01±2.56	23.31±3.12
5	Joshi et al, ^[10]	Right-90	35.2±2.9	16.8±2.5	24.2±2.3
		Left- 90	35.8±3.1	16.7±2.4	23.9±2.1
6	Vardhan et al, ^[11]	Right- 32	38.27±3.08	19.70±2.23	24.04±2.67
		Left- 28	38.07±3.22	18.6±2.07	22.85±2.44
7	Hetal et al, ^[12]	Right- 36	38.49±3.17	18.83±2.19	24.76±2.49
		Left- 38	38.06±3.34	17.97±2.08	24.23±2.14
8	Gosavi et al, ^[13]	Right- 62	35.05±5.25	14.56±2.03	24.17±2.57
		Left- 80	35.3±3.41	14.6±1.85	23.9±2.66
9	Arora et al, ^[14]	Right- 48	34.44±2.07	17.48±1.82	22.99±2.77
		Left- 52	34.69±3.01	17.48±2.00	23.61±4.53
10	Yogesh et al, ^[15]	Right - 30	33.71±3.26	24.19±2.56	24.19±2.56
		Left - 36	33.33±2.77	23.11±2.31	23.11±2.31
11	Present study	Right- 50	34.06±3.10	16.38±2.10	22.06±2.36
		Left- 50	33.48±2.99	18.34±2.45	22.50±2.27

Table 5: Comparison of Mean Maximum Scapular Length and Breadth by Different Researches

S.No	Studies	Sample Size	Mean Maximum Scapular Length (mm)	Mean Maximum Scapular Breadth (mm)
1	Flower W H, ^[16]	200	155.54	101.42
2	Singal et al, ^[17]	162	141.7 ± 8.9	96.4 ± 7
3	Krishnaiah et al, ^[18]	50	143.27 ± 11.44	105.6 ± 5.08
4	Presesnt study	Right – 50	148.10 ±12.117	99.96 ± 6.243
		Left – 50	147.52±10.416	97.66 ± 6.056

**Figure 1:(a) showed Pear shaped Glenoid cavity****Figure 1: (b) showed Oval shaped Glenoid cavity**



Figure 1: (c) showed Inverted comma shaped Glenoid cavity



Figure 2: showed Measurement of Scapular length



Figure 3: showed Measurement of Scapular breadth



Figure 4: showed Measurement of Vertical Glenoid Diameter



Figure 5: showed Measurement of Transverse Glenoid Diameter I



Figure 6: showed Measurement of Transverse Glenoid Diameter II

DISCUSSION

The glenoid cavity was studied morphometrically using adult human scapulae. The measurements of the scapula and glenoid cavity in the present study was compared to those obtained by various authors to study the differences as well as commonalities. In the present study, the common shape of glenoid cavity observed was Inverted comma followed by pear shaped and oval shaped glenoid cavity as showed in [Table 1]. Other morphometric measurements of glenoid cavity of scapula was depicted in [Table 2]. Many other authors reported pear shaped glenoid cavity as a common shape. Dope et al,^[6] Mamatha et al,^[7] Neeta et al,^[8] Pranoti et al,^[9] reported pear shaped glenoid cavity as the most common type followed by Inverted comma shaped and oval shaped. Few other authors namely Joshi et al,^[10] Vardhan et al,^[11] Hetal et al,^[12] Gosavi et al,^[13] Arora et al,^[14] reported pear shaped glenoid cavity to be most common type. Yogesh et al,^[15] reported his findings which coincides with the present study that Inverted comma shaped glenoid cavity as most common type and pear shaped glenoid cavity as second common type as showed in [Table 3].

The mean maximum scapular length of glenoid cavity of scapula in present study was $148.10 \text{ mm} \pm 12.117$ on the right side and $147.52 \text{ mm} \pm 10.416$ on the left side. The mean maximum scapular breadth of

glenoid cavity of scapula in present study was $99.96 \text{ mm} \pm 6.243$ on the right side and $97.66 \text{ mm} \pm 6.056$ on the left side. The mean vertical glenoid diameter was 3.406 ± 0.3106 on the right side and 3.348 ± 0.2991 on the left side. The mean transverse diameter I was 1.638 ± 0.2108 on the right side and 1.834 ± 0.2455 on the left side. The mean transverse diameter II was 2.206 ± 0.2360 on the right side and 2.250 ± 0.2279 on the left side. In all these measurements bilateral differences were not statistically significant ($p \text{ value} > 0.05$). Comparison of mean Vertical, Transverse-I and Transverse-II diameter of Glenoid cavity of present study with the measurements reported by different researches was shown in [Table 4].

The values of mean maximum scapular length and scapular breadth measured by Flower W H et al,^[16] was slightly higher than the values compared to the present study. The measurements reported by Singal et al,^[17] Krishnaiah et al,^[18] were comparatively lower than the values reported in this present study as showed in [Table 5].

CONCLUSION

The morphological and morphometric measurements of Glenoid cavity of Scapula that was recorded in the present study was compared with the findings of various research authors. The differences and similarities obtained between the studies would be greatly helpful to clinicians for better understanding of anatomy of glenohumeral joint. Application of the knowledge would be useful in designing the right size prosthesis in shoulder arthroplasty. This is also essential while dealing with the disease related to shoulder joint like osteochondral defects, osseous bankart lesion.

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