

## A STUDY OF MORPHOLOGICAL AND MORPHOMETRIC ANALYSIS OF THE GLENOID FOSSA

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### ABSTRACT

**Background:** The scapula is a large, flat, triangular bone lying posterolaterally on the chest wall, overlying second to seventh ribs. The variations of shape and size of glenoid cavity of scapula is of importance in understanding the rotator cuff disease, shoulder dislocation and to decide the proper size of the glenoid component in the shoulder arthroplasty.

**Aims and objectives:** Present study aims to determine various anthropometric parameters of glenoid cavity including the variations of its shape.

**Materials and Methods:** A total of 106(Rt -52, Lt - 54) dry scapulae available in the Department of Anatomy of Calcutta National Medical College, Kolkata and N R S Medical College, Kolkata were taken for the study. The glenoid fossa were measured in supero-inferior(SI) diameter, and antero-posterior diameter at three places from upper to lower direction( AP1, AP2, AP3), The depth of Glenoid (Gd): The depth of glenoid was measured by filling the glenoid fossa with modelling dough, and keeping it on to a plane surface to make the outer surface plane and at the middle of this mould the highest thickness was measured. The measurements are taken via spreading slide calipers in millimeters. For observing the shape the edge of glenoid fossa were highlighted with coloured chalk.

**Results:** Bothsided scapulae were analysed separately for shape and their morphometric analysis done. Pear and comma shaped glenoid were of equal number in right side and pear shape were predominant in left side. both sided oval shape were least common. Mean values for SI were 35.065+3.59mm (Right side) and 34.149+3.50mm (Left side). Mean values for AP1 were 15.34+1.67mm (Right side) and 15.29+1.96mm (Left side). Mean values for AP2 were 22.08+3.56mm (Right side) and 21.47+3.17mm (Left side). Mean values for AP3 were 23.46+3.21mm (Right side) and 23.46+3.21mm (Left side). Mean values for depth of glenoid (Gd) 3.54+0.73mm (Right side) and 3.692+0.62mm (Left side). No statistically significant difference in findings recorded between the right and left side.

**Conclusion:** This study will contribute some relevant data and help the orthopaedicians in dealing with cases of shoulder pathology and shoulder arthroplasty cases.

**KEY WORDS:** Glenoid cavity of scapula, Morphometry and Morphology.

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### INTRODUCTION

Scapula is a flat triangular bone situated on the posterolateral aspect of thoracic wall extending

from second and seventh rib. The glenoid cavity of the scapula, lying on its superolateral aspect articulates with the head of the humerus to form

the Shoulder joint. The Glenoid cavity has a variable morphology. Due to the Presence of a notch in its antero-superior side of glenoid rim, various shapes of glenoid cavity are observed like Pear-shaped, Oval or Inverted Comma shape [1-3]. The Vertical/Supero-inferior diameter (SI) of the glenoid cavity is the longest. The shoulder joint is the most frequently dislocated joint in the body. Dislocations with fractures of the glenoid are also quite common in trauma. The variations of shape and size of glenoid cavity of scapula is of importance in understanding the rotator cuff disease, shoulder dislocation and to decide the proper size of the glenoid component in the shoulder arthroplasty. The aim of the present study was to obtain anthropometric data of the glenoid cavity of scapula specifically the diameters of the glenoid cavity and to study various shapes of glenoid cavity relevant to Indian population which will help in better understanding and management of Shoulder pathologies.

## MATERIALS AND METHODS

A total of 106 (Rt- 52,Lt- 54) adult dry scapulae collected from the Dept. of Anatomy, both of Calcutta National Medical College,kolkata and N R S Medical College,Kolkata for the study. The age and sex of the bones were not known. Out of these 54 scapulae were of left sided and 52 were of right sided. Those scapulae which were found to be damaged at the glenoidal end were excluded from the study.

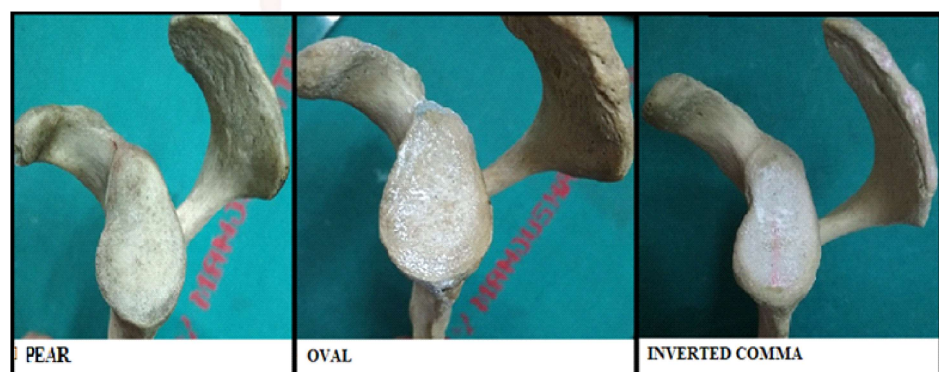
**Morphology of glenoid cavity:** The edge of the glenoid fossa is highlighted with coloured chalk and the photographs are taken. Based on tracings obtained, the glenoid cavities are classified into three types:

**Type 1-** Pear shaped

**Type 2 -**Inverted comma shaped

**Type 3-** Oval shaped

**Fig.1:** Different morphology of scapular glenoid fossa.



**Then for Morphometric analysis:** Following diameters of glenoid cavities of the scapula were measured with the help of verniercalipers by placing the instrument directly on the surface of scapula and glenoid cavity. The measurements were recorded in millimetres.

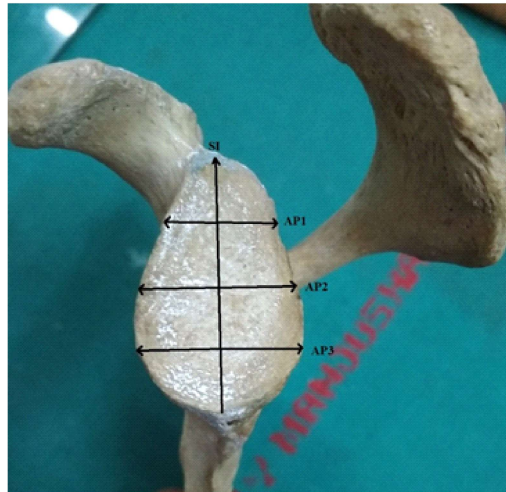
**The Supero-Inferior diameter(SI):** The SI diameter is measured from superior to inferior bony points over the margin of glenoid.

**Anteroposterior diameters(AP1,AP2,AP3):** Now the SI was divided in 4 equal parts by 3 horizontal lines across the glenoid ,which represents 3 horizontal diameters i.e. **AP1,AP2,AP3** from above downward. These 3 antero-posterior diameters were also measured.

**The depth of Glenoid(Gd):** The depth of glenoid was measured by filling the glenoid fossa with modelling dough ,and keeping it onto a plane surface to make the outer surface plane and at the middle of this mould the highest thickness was measured.

All the measurements were taken in millimetres.

**Statistical method:** To reduce the inter-observer error each measurement were taken by one researcher at three different times. All the data were tabulated and analysed by using SPSS version 22.0. Mean, minimum and maximum values of all parameters were derived with Standard deviation. The values of right and left side were analysed and compared by using unpaired t-test. The p-value  $\leq 0.05$  was taken as statistically significant. As we have taken 3 Antero posterior diameters (AP1,AP2,AP3) and the measuring procedure is different from the reference studies so these data could not be compared wisely with other reference studies. Only the Supero anterior diameter(SI) is compared with other studies.



**Fig. 2:** Different dimensions of glenoid for morphometric analysis.

**RESULTS**

Data analysed following statistical method and results are represented in tabular forms.

**Table 1:** Morphological percentage of the glenoid fossa of Right and Left sided scapula.

Shapes of glenoid	Right side (n=52)	Percentage	Left side (n=54)	Percentage	Total (n=106)	Percentage
Oval shape	14	26.92	10	18.52	24	22.64
Pear shape	19	36.54	27	50	46	43.46
Comma shaped	19	36.54	17	31.48	36	33.96

**Table 2:** Distribution of cases according to different dimensions of Glenoid cavity.

	RT (n=52)			LT(n=54)		
	Max	Min	Mean+SD	Max	Min	Mean+SD
SI	41.12mm	29.51mm	35.065+3.59	42.04mm	26.95mm	34.149+3.50
AP1	18.83mm	12.07mm	15.34+1.67	20.72mm	11.65mm	15.29+1.96
AP2	28.12mm	16.82mm	22.08+3.56	28.16mm	15.94mm	21.47+3.17
AP3	30.20mm	18.12mm	23.46+3.21	30.02mm	15.67mm	22.59+3.28
Gd	5.02mm	2.18mm	3.54+0.73	4.93mm	2.38mm	3.692+0.62

The maximum SI diameter measured was 41.12mm in a right sided scapula and 29.51mm in a left sided scapula. Minimum SI diameter was 29.51mm in a right sided scapula and 26.95mm in left sided scapula.

The maximum AP1 diameter measured was 18.83mm in a right sided scapula and 12.07mm in a left sided scapula. Minimum API diameter was 12.07mm in a right sided scapula and 11.65mm in left sided scapula.

The maximum AP2 diameter measured was 28.12 mm in a right sided scapula and 15.94 mm in a left sided scapula. Minimum AP2 diameter was 16.82 mm in a right sided scapula and 15.94 mm in left sided scapula.

The maximum AP3 diameter measured was 30.20 mm in a right sided scapula and 30.02 mm in a left sided scapula. Minimum AP3 diameter was 18.12 mm in a right sided scapula and

15.67 mm in left sided scapula.

The maximum depth measured was 5.02 mm in a right sided scapula and 4.93 mm in a left sided scapula. Minimum depth was 2.18 mm in a right sided scapula and 2.38 mm in left sided scapula.

**Table 3:** Morphometric values of total glenoid cavity irrespective of side.

	Mean (mm)±SD	Minimum (mm)	Maximum (mm)
SI	34.60 + 3.56	26.95 mm	42.04 mm
AP1	15.32 +1.81	11.65mm	20.72mm
AP2	21.77 + 3.26	15.94mm	28.16mm
AP3	23.02 +3.26	15.67mm	30.20mm
Gd	3.62 +0.68	2.18mm	5.02mm

**DISCUSSION**

The present study though done including a small number of scapulae ,the findings were comparable to previous authors i.e. shapes of glenoid we observed in our study was comparable to

**Table 4:** Comparison among different observer findings on glenoid shape with present study.

Name of studies	Number right & left	Pear shaped Percentage		Oval shaped Percentage		Inverted comma shaped Percentage	
		Right	Left	Right	Left	Right	Left
Rajput HB et al., [5]	R=43 L=57	49	46	16	15	35	39
Mamatha T et al., [6]	R=98 L=104	46	43	20	24	34	33
Akhtar MJ et al., [7]	R=126 L=102	51.59	49.02	13.49	13.73	34.92	37.25
Sinha P et al., [8]	R=21 L=32	23	42	8	13	9	6
D.S. Ankushrao et al., [9]	R=53 L=54	57	50	13	15	30	35
Nasr El-Din WA et al., [11]	R=160 L=80	35	27.5	48.75	52.5	16.25	20
Present study	R=52 L=54	36.54	50	26.92	18.52	36.54	31.48

**Table 5:** comparison among different observer findings on Supero Inferior Diameter (SI) with present study.

Name of Studies	Number Right & Left	SI (Mean±SD) mm	
		Right	Left
Rajput HB et al., [5]	R=43 L=57	34.76±3.0	34.43±3.21
Mamatha T et al., [6]	R=98 L=104	33.67±2.82	33.92±2.87
Akhtar MJ et al., [7]	R=126 L=102	36.03±3.15	35.52±3.12
Sinha P et al., [8]	R=21 L=32	33.64±3.01	34.44±3.27
D. S Ankushrao et al., [9]	R=53 L=54	37.03±3.55	36.52±4.12
Nasr El-Din WA et al., [11]	R=160 L=80	38.88±2.63	39.01±2.49
Present study	R=52 L=54	35.07±3.59	34.50±3.50

**Table 6:** Among different observer findings on antero posterior diameters (SI) with present study.

Name of studies	Number Right & Left	AP1 (mean±SD) mm		AP2 (mean±SD) mm		AP3 (mean±SD) mm	
Rajput HB et al., [5]	R=43 L=57	23.31±3	22.92±2.80	15.10±2.54	13.83±2.45	-----	-----
Mamatha T et al., [6]	R=98 L=104	23.35±2.04	23.05±2.30	16.27±2.01	15.77±1.96	-----	-----
Akhtar MJ et al., [7]	R=126 L=102	23.67±2.53	23.59±2.47	16.30±2.16	16±2.34	-----	-----
Sinha P et al., [8]	R=21 L=32	23.22±2.85	23.31±3.12	18.07±2.64	18.01±2.56	-----	-----
D.S Ankushrao et al., [9]	R=53 L=54	24.61±3.53	24.56±4.47	16.31±3.16	16.2±3.64	-----	-----
Gosavi S.N et al., [10]	R=62 L=80	24.17±2.57	23.9±2.66	14.56±2.03	14.6±1.85	17.72±21.89	16.82±2.18
Nasr El-Din WA et al., [11]	R=160 L=80	28.31±2.38	27.99±2.55	21.33±2.49	21.33±2.49	-----	-----
Present study	R=52 L=54	15.35±1.67	15.29±1.96	22.08±3.36	21.47±3.17	23.46±3.21	22.6±3.28

the other studies as featured in Table 4, and the supero inferior diameters we measured in our study was equivalent to the other studies as featured in Table 5. As we measured 3 Antero posterior diameters (AP1,AP2,AP3) and the similar studies measuring 3 Antero posterior diameters were limited even in reference 10, sites of the diameters measuring were different than our study so it could not be adequately compared with. All the other findings were equivalent to others. There were no statistically significant difference in findings recorded between the right and left side.

**Limitation:** The sample size we taken were small though relevant and similar studies measuring 3 antero-posterior diameters of glenoid fossa was limited so could not be wisely compared.

## CONCLUSION

The proper knowledge of the diameters of glenoid cavity is important in the design and fitting of glenoid components for total shoulder arthroplasty. The understanding of variations in normal anatomy of the glenoid is essential while evaluating several pathological conditions. We have recorded the 3 Antero-posterior diameters (AP1,AP2,AP3), and we found one reference study [10] almost similar to our study with measurements. This specific work will contribute some relevant data and help the orthopaedicians in case of shoulder pathology and shoulder arthroplasty cases.

**Conflicts of Interests: None**

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