

ORIGINAL ARTICLE

A STUDY OF MORPHOLOGICAL PATTERNS OF GLENOID CAVITY OF SCAPULA

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ABSTRACT

Background: Shoulder arthroplasty offer pain relief and improvement in patients of shoulder arthritis. Appropriate fixation of glenoid component of scapula is essential to evade loosening which is the common indication for revision surgery. The glenoid cavity is small and allows only a restricted spot for limited fixation devices. For this reason, knowledge of the morphology of glenoid cavity is important.

Methodology: In the current study, 5 diameters of glenoid cavity of 43 right sided and 57 left sided dried unpaired human scapulae have been measured with the aid of digital vernier callipers.

Results: Various shapes of glenoid cavity like inverted comma, pear or oval based on the glenoid notch have also been observed. The values of glenoid cavity in the current study are lower than those reported in other studies.

Conclusion: These findings suggest that the difference in size of the glenoid cavity in Gujarati population may have to be taken into consideration while deciding the size of the glenoid component in shoulder arthroplasty in this population.

Key Words: Glenoid cavity, Glenoid notch, Shoulder arthroplasty

INTRODUCTION

The upper and lateral angle of the scapula has a glenoid cavity for articulation with the head of the humerus. The glenoid rim presents a notch in its upper and front part ¹. Due to presence of this glenoid notch, various shapes of glenoid cavity are found like pear-shaped, oval or inverted comma shaped. The shoulder joint is the most frequently dislocated joint in the body. Dislocations with fractures of the glenoid are also quite common in trauma ². For the management of this, prostheses and arthroplasty are required a number of times. The anatomical basis and variations of shape and size of glenoid cavity of scapula is of fundamental importance in understanding of rotator cuff disease, shoulder dislocation and to decide the proper size of the glenoid component in the shoulder arthroplasty.

The aim of the current study was to collect the morphological measurements of the glenoid cavity of the scapula and to study the various shapes of the glenoid cavity for better understanding and management of shoulder pathology.

MATERIAL AND METHOD

All available unpaired scapular dry specimens of the Anatomy collection of skeletons at Medical College

Baroda (Gujarat, India), were examined and they were 100 in number. The age and sex of the bones were not known. 43 scapulae belonged to the right side and 57 scapulae to the left. All measurements were manually performed with the aid of digital vernier callipers and were performed directly by placing the callipers on the glenoid surface. All measurements were carried out by the same instrument throughout the study. The data so obtained was checked for its completeness, quality and internal consistency. The data were then entered and analyzed using the Microsoft Excel 2007.

The following parameters of the glenoid cavity were studied. The first three diameters were measured as per the study of Mamatha et al².

- (1) Superior-Inferior glenoid diameter (SI): represents the maximum distance from the inferior point on the glenoid margin to the most prominent point of the supraglenoid tubercle.
- (2) Anterior-Posterior glenoid diameter (AP-1): represents the maximum breadth of the articular margin of the glenoid cavity perpendicular to the glenoid cavity height.
- (3) Anterior-Posterior glenoid diameter (AP-2): represents the anterior-posterior diameter (breadth) of the top half of the glenoid cavity at

the mid-point between the superior rim and the mid-equator.

- (4) Anterior-Posterior glenoid diameter (AP-3): represents the anterior-posterior diameter at the peak of the glenoid notch. (when glenoid notch present)
- (5) Anterior-Posterior glenoid diameter (AP-4): represents the anterior-posterior diameter between the peak of glenoid notch and the most posterior rim. (when glenoid notch present)
- (6) Shape of the glenoid cavity: shape made by the slightly raised rim of the glenoid cavity.

RESULTS

The data were obtained in 43 scapulae of the right side and 57 scapulae of the left.

The AP-1 glenoid diameter of the right side varied from 15.6mm to 28.8mm, with an average of 23.31 ± 3.00 mm. On the left side the AP-1 diameter of the left side varied from 16.6mm to 29.2mm, with a mean of 22.92 ± 2.80 mm. The AP-2 glenoid diameter of the right and left sides varied from 9.3mm to 21.08mm and 5.4mm to 19mm respectively. The average AP-2 diameter of the right glenoid was 15.10 ± 2.54 mm and that of the left glenoid was 13.83 ± 2.45 mm.

Table 1: Comparison of measurements of right and left glenoid cavity

Parameters	Range(mm)		Mean (mm)		Standard Deviation (mm)		Z Value
	Right	Left	Right	Left	Right	Left	
SI diameter	27.5-39.2	26.2-42.03	34.76	34.43	3.00	3.21	0.52
AP -1 diameter	15.6-28.8	16.6-29.2	23.31	22.92	3.00	2.80	0.29
AP -2 diameter	9.3-21.08	5.4-19	15.10	13.83	2.54	2.45	2.54
AP -3 diameter	8.4-22.1	10.2-18.7	16.2	15.24	3.23	2.04	1.71
AP -4 diameter	14.6-28.8	17.1-26.1	23.08	22.64	3.15	2.13	0.79

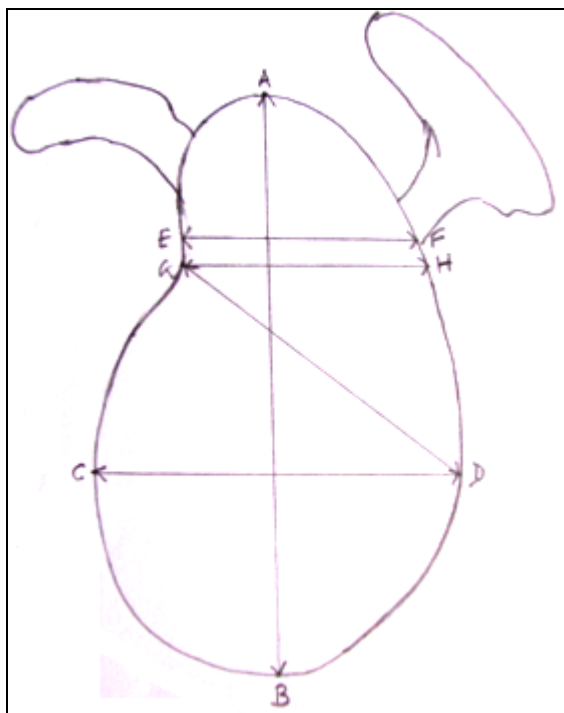


Fig 1: Schematic diagram showing diameters of the glenoid cavity

- A-B: Superior-Inferior glenoid diameter (SI)
- C-D: Anterior-Posterior glenoid diameter (AP-1)
- E-F: Anterior-Posterior glenoid diameter (AP-2)
- G-H: Anterior-Posterior glenoid diameter (AP-3)
- G-D: Anterior-Posterior glenoid diameter (AP-4)

It was observed that the average Superior-Inferior diameter of the glenoid cavity on the right side was of 34.76 ± 3.00 mm, which varied from 27.5mm to 39.2mm. On the left side the Superior-Inferior

diameter varied from 26.2mm to 42.03 mm, with an average of 34.43 ± 3.21 mm.

The AP-3 glenoid diameter of the right side varied from 8.4mm to 22.1mm with an average of 16.2 ± 3.23 mm. On the left side the AP-3 diameter varied from 10.2mm to 18.7mm, with a mean of 15.24 ± 2.04 mm. The AP-4 glenoid diameter of the right and left sides varied from 14.6mm to 28.8mm and 17.1mm to 26.1mm respectively. The average AP-4 diameter of the right glenoid was 23.08 ± 3.15 mm and average AP-4 diameter of the left glenoid was 22.64 ± 2.13 mm.

Table 2: comparison between the shape of right and left glenoid cavity

Shape of glenoid	Incidence of shape	
	Right Glenoid	Left Glenoid
Inverted Comma	35%	39%
Pear	49%	46%
Oval	16%	15%

$X^2=0.673, p>0.05$

A total of forty three glenoid cavities on right side were measured. Out of them 15 were of inverted comma shaped, 21 were found to be pear shaped and 7 were of oval shaped. On the right side incidence of inverted comma shaped was 35%, pear shaped was 49% and oval shaped was 16%. Fifty seven glenoid cavities were measured on the left side. Out of them inverted comma shaped glenoids were 22, pear shaped glenoids were 26 and oval shaped glenoids were 9 in number. On the left side incidence of inverted comma shaped was 39%, of pear shaped was 46%, and of oval shaped was 15.



Fig 2: Photograph showing various shapes of the glenoid cavity

DISCUSSION

In the current study, the various dimensions and incidence of various shapes of the glenoid cavity have been measured and compared with other studies. The average Superior-Inferior (SI) diameter of the right glenoid was 34.76 ± 3 mm and of the left glenoid was 34.43 ± 3.21 mm. The right glenoid value was slightly higher than the left. The comparison was made with

the values of those of other authors (table no.3). Mamatha T et al, worked on 202 dried scapulae and measured the Superior-Inferior diameter of glenoid on the right side (no.of specimens 98) as 33.67 ± 2.82 mm and on the left side (no. of specimens 104) as 33.92 ± 2.87 mm², which were slightly lower than the values got in the current study.

Table 3 Comparison of Superior-Inferior and Anterior-Posterior-1 diameters by various authors

Observers	Specimens	Mean Superior-Inferior diameter (mm)	Mean Anterior-Posterior -1 diameter (mm)
Luis Rios Frutos(2002) ³	Male -65	36.08 ± 2.0	26.31 ± 1.5
	Female-38	31.17 ± 1.7	22.31 ± 1.4
Sitha piyawinijwong et al (2004) ⁴	Male-50	38.1 ± 2.2	29.1 ± 2.6
	Female-46	33.6 ± 3.0	25.6 ± 2.5
Ozer et al(2006) ⁵	Male-94	38.71 ± 2.71	27.33 ± 2.4
	Female-92	33.79 ± 3.08	22.72 ± 1.72
Coskun N (2006) ⁶	90	36.3 ± 3	-
Karelse et al (2007) ⁷	40	35.9 ± 3.6	27.2 ± 3
Mamatha et al(2009) ²	Right-98	33.67 ± 2.82	23.35 ± 2.04
	Left-104	33.92 ± 2.87	23.02 ± 2.30
Present study(2012)	Right-43	34.76 ± 3	23.31 ± 3.0
	Left-57	34.43 ± 3.21	22.92 ± 2.80

Coskun N et al and Karelse et al, found the Superior-Inferior diameter of the glenoid to be 36.3 ± 3 mm and 35.9 ± 3.6 mm respectively^{6,7}. These values were higher than what were recorded in the current study. Luis Rios Frutos, Sitha Piyawinijwong et al and Ozer et al^{3,4,5} had measured the Superior-Inferior diameter of the male and female glenoid separately. The average SI diameter of the male glenoid observed by Luis Rios Frutos was 36.08 ± 2.05 mm, that measured by Sitha Piyawinijwong et al was 38.1 ± 2.2 mm and that measured by Ozer et al was 38.71 ± 2.71 mm^{3,4,5}. All these measurements were higher than those reported in the current study. The SI diameter of the female glenoid measured by Sitha Piyawinijwong et al and Ozer et al was 33.6 ± 3.0 mm and 33.79 ± 3.08 mm respectively^{4,5}. These values were quite similar to those reported in the current study. In the current study, the

sex of the scapulae was not known therefore, male and female bones could not be measured separately.

The average Anterior-Posterior diameter (AP-1) of the lower half of the glenoid of the right side was 23.31 ± 3.0 mm and that of the left side was 22.92 ± 2.80 mm in the current study. This suggests that right glenoid was broader than the left glenoid. In the study of Mamatha T et al, the average Anterior-Posterior diameter (AP-1) of the lower half of the glenoid of the right side was 23.35 ± 2.04 mm and that of the left side was 23.02 ± 2.30 mm², which was quite close to what was recorded in current study. The combined average diameter of both sides was 22.62 ± 2.9 mm in the current study, this value was very close to the values of the female glenoids recorded by Luis Rios Frutos, and Ozer et al; who found it to be 22.31 ± 1.49 mm and 22.72 ± 1.9 mm respectively^{3,5}. The

AP-1 diameter for the female glenoid measured by Sitha Piyawinijwong et al was 25.6 ± 2.5 mm⁴ which was higher than what was recorded in the current study. The values recorded for the male glenoids were 26.31 ± 1.57 mm by Luis Rios Frutos, 29.1 ± 2.6 mm by Sitha Piyawinijwong et al and 27.33 ± 2.4 mm by Ozer et al^{3, 4, 5}. The AP-1 diameter recorded by Karelse et al was 27.2 ± 3 mm⁷. All these values were higher than our combined average of both right and left sides which was 22.62 ± 2.9 mm.

Table 4 Comparison of Anterior-Posterior (AP-1) diameter by various authors

Observers	Specimens	Mean diameter	AP-1
Luis Rios	Male -65	26.31 ± 1.5 mm	
Frutos(2002) ³	Female-38	22.31 ± 1.4 mm	
Sitha piyawinijwong et al (2004) ⁴	Male-50	29.1 ± 2.6 mm	
	Female-46	25.6 ± 2.5 mm	
Ozer et al(2006) ⁵	Male-94	27.33 ± 2.4 mm	
	Female-92	22.72 ± 1.72 mm	
Karelse et al (2007) ⁷	40	27.2 ± 3 mm	
Mamatha et al(2009) ²	Right-98	23.35 ± 2.04 mm	
	Left-104	23.02 ± 2.30 mm	
Present study(2012)	Right-43	23.31 ± 3.0 mm	
	Left-57	22.92 ± 2.80 mm	

The Anterior-Posterior diameter (AP-2) of the upper half of the right glenoid was 15.10 ± 2.54 mm and that of the left glenoid was 13.83 ± 2.45 mm in the current study. This suggest that right glenoid cavity was broader than the left glenoid cavity. Mamatha et al recorded the average AP-2 diameter of upper half of the right glenoid was 16.27 ± 2.01 mm and that of the left glenoid was 15.77 ± 1.96 mm². Both these values were higher than what was observed in the current study.

The average Anterior-Posterior diameter (AP-3) of the right glenoid was 16.2 ± 3.23 mm and that of the left glenoid was 15.24 ± 2.04 mm in the current study. This suggests that the right glenoid cavity was slightly broader than the left glenoid cavity.

The average Anterior-Posterior diameter (AP-4) of the right glenoid was 23.08 ± 3.15 mm and that of the left glenoid was 22.64 ± 2.13 mm in our study. This suggests that the right glenoid cavity was broader than the left glenoid cavity. The combined average of AP-4 diameter of both sides was 22.86 ± 2.64 mm. Sitha Piyawinijwong et al recorded the average AP-4 diameter of the male glenoid was 27.8 ± 1.8 mm and AP-4 of female glenoid was 24.3 ± 2.1 mm. The combined average AP-4 diameter was 26.0 ± 2.6 mm⁴ which was higher than what was recorded in the current study.

In the current study, various shapes of glenoid cavity and the percentage of incidence was recorded. 35% of the right and 39% of left glenoids were inverted comma shaped with a distinct notch. The pear shaped glenoids were 49% on the right side and 46% on the left side with an indistinct notch. On the right side 16% were oval and on the left side 15% were oval without

any recognisable notch. This suggests that there is no significant difference in the presence of notch on the right and left side.

The percentage of glenoids with both indistinct and distinct notch was 84% on the right side and 85% on the left side. Mamatha et al had found it to be 80% on the right side and 76% on the left side². Prescher and Klumpen had observed it to be 55%⁸ which was much lesser than in the current study. In the current study, oval glenoids comprised only of 16% on the right side and 15% on the left side. As compared to Mamatha et al who found it to be 20% on the right side and 24% on the left side². Prescher and Kulmpen observed that 45% of the glenoids were oval shaped⁸. In the study of eighty eight shoulders, Shortt et al found 85% ovoid glenoids and 15 % notched glenoids⁹. Coskun N et al studied 90 scapulae and found that, in 72% of the specimens, the glenoid notches of the scapulae were absent or oval shaped, whereas in 28% the notch was well expressed and the glenoid cavity was pear shaped⁶. These findings were higher than that of the current findings.

CONCLUSION

Variations in the size and shape of the glenoid cavity which were observed in the current study will be helpful for orthopaedic surgeons to decide proper size of the glenoid component for the shoulder arthroplasty and to understand the shoulder pathology better. Since the current study was performed on a limited number of scapulae, further cadaveric, radiological and clinical studies are indicated.

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