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Original Research Article

STUDY OF GLENOID CAVITY OF HUMAN SCAPULA AND ITS CLINICAL IMPORTANCE

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ABSTRACT

Introduction: The morphology of the glenoid cavity is highly variable. It articulates with the head of the humerus at the glenohumeral joint. Shoulder joint is frequently dislocated so the knowledge of anatomic parameters and different shape of glenoid cavity are necessary for complete understanding of the mechanics of shoulder joint. The aim of the present study was to obtain the anthropometric data of the glenoid cavity of the scapula and to study the various shapes of the glenoid cavity which will help in management of shoulder pathology.

Materials and Methods: This study was done on 60 (30 right, 30 left) adult human scapula. Different parameter superior-inferior(SI), anterior-posterior diameter of the lower half(AP-1), anterior-posterior diameter of the upper half(AP-2) of glenoid cavity have been measured with the help of digital vernier calipers and glenoid cavity index was calculated. The shape of the glenoid cavity was classified as inverted comma shaped, pear shaped and oval shaped depending upon the presence or absence of a notch on the glenoid rim.

Results: The average SI diameter on right and the left sides were 37.31±2.91mm and 37.46±2.92 mm respectively. The average AP-1 diameter of the right glenoid was 25.90±2.09 mm and that of the left was 25.70±2.32mm. The mean AP-2 diameter of the right glenoid was 17.89±1.52 mm and that of the left was 18.15±1.80mm. The mean GCI of the right glenoid was 69.54±4.22 mm and that of the left was 68.65±4.12 mm.

Conclusion: All the parameters showed a very close value for the right and left side. The difference seen between the values of present study and that of other workers could be explained on the basis of ethnic and racial variations. This fact may be taken into consideration while performing shoulder arthroplasty and designing glenoid prostheses in rajasthan population. The current study also recorded a higher percentage of the glenoid notch (>80%) in the anterior margin of the glenoid cavity. While evaluating defects and lesions of the glenoid, this fact could be useful. Thus a sound knowledge of various parameters of the glenoid cavity is important for the anatomists, anthropologists, orthopaedicians and prosthetists.

KEY WORDS: Scapula, Glenoid cavity, Glenoid notch, Glenohumeral joint.

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INTRODUCTION

The scapula is a large, flat, triangular bone which lies on the posterolateral aspect of the chest wall, covering parts of the second to sev-

enth ribs. The lateral angle, truncated and broad, bears the glenoid cavity which articulates with the head of the humerus at the glenohumeral joint. It is narrow above and wider below, provides a shallow, and limited, socket for the humeral head [1]. The morphology of the glenoid cavity is highly variable. The glenoid rim presents a notch in its upper and front part [2]. Due to presence of this glenoid notch, various shapes of glenoid cavity are found like pear-shaped, oval or inverted comma shaped [3,4]. Shoulder joint is frequently dislocated inferiorly due to having less support in that region of the joint. During trauma, dislocation with fracture of glenoid are also common. During treatment repair of the labrum, reinforcing the capsule, rearrangement of anterior muscle and total shoulder replacement is also being used as treatment [5].

The knowledge of anatomic parameters and different shape of glenoid cavity are necessary for complete understanding of the mechanics of shoulder joint. Therefore, the present study was carried out which provides valuable anatomic parameters which would help the anatomists, orthopedicians, anthropologists and prosthetists.

The aim of the present study was to obtain the anthropometric data of the glenoid cavity of the scapula and to study the various shapes of the glenoid cavity relevant to rajasthan population which will help in better understanding and management of shoulder pathology.

MATERIALS AND METHODS

This study was done on 60 (30 right, 30 left) adult human scapula of unknown sex obtained from Department of Anatomy, Pacific Medical Collage, Udaipur.

Inclusion criteria- scapula included were dry, complete and showed normal anatomical features with clear intact glenoid cavity

Exclusion criteria- evidence of previous trauma, skeletal disorders, osteoarthritic changes

All the measurements were carried out with the help of vernier calipers and recorded in millimeters.

All the data were entered and analysed by the microsoft office excel 2010.

The following parameters of the glenoid cavity of scapula were studied.

Superior- Inferior Glenoid Diameter (SI): maximum distance from the inferior point on the glenoid margin to the most prominent point of the supra -glenoid tubercle (fig.1).

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

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(fig.1)

Glenoid Cavity Index (GCI):

$$GCI = \frac{\text{Antero-posterior glenoid diameter 1x100}}{\text{Supero-inferior glenoid diameter}}$$

Shape Of The Glenoid Cavity: The tracing of the shape of the glenoid cavity was taken on a white paper with the help of a lead pencil. on the basis of tracings drawn: Three types of glenoid were found inverted comma shaped, oval and pear shaped(fig.2).

Fig. 1: Schematic diagram showing various diameters of the glenoid cavity. A-B: Superior-Inferior diameter (SI), C-D: Anterior Posterior diameter-1 (AP-1), E-F: Anterior-Posterior diameter-2 (AP-2).

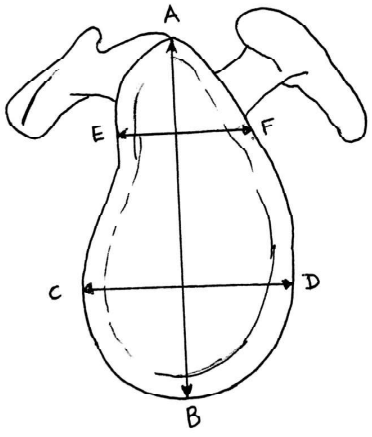
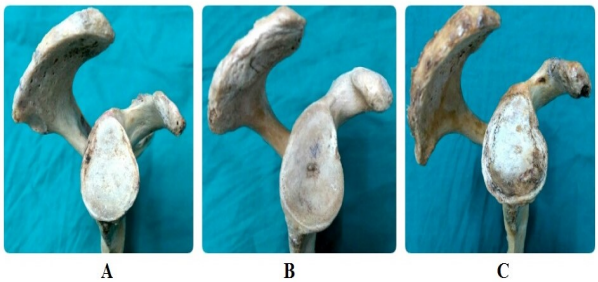


Fig. 2: Photograph showing various shapes of the glenoid cavity, A- Oval, B- Pear , C- Inverted comma.



RESULTS

Table 1 shows SI diameter of glenoid cavity on the right side varies from 30.94 to 41.69mm, with an average of 37.31±2.91 mm and on left side varies from 29.06 to 43.80 mm, with an average of 37.46±2.92 mm.

Table 1: SI diameter of right and left side glenoid cavity.

Side	Range	Mean ±SD	Statistical significance
Right	30.94 to 41.69mm	37.31±2.91 mm	t = 0.20
Left	29.06 to 43.80 mm	37.46±2.92 mm	P = 0.84

Table 2 shows AP1 diameter of glenoid cavity on the right side varies from 20.68 to 30.34 mm, with an average of 25.90±2.09 mm and on left side varies from 19.94 to 30.60 mm, with an average of 25.70±2.32 mm.

Table 2: AP1diameter of right and left side glenoid cavity.

Side	Range	Mean ±SD	Statistical significance
Right	20.68 to 30.34 mm	25.90±2.09 mm	t = 0.36
Left	19.94 to 30.60 mm	25.70±2.32 mm	P = 0.71

Table 3 shows AP2 diameter of glenoid cavity on the right side varies from 14 to 22.39 mm, with an average of 17.89±1.52 mm and on left side varies from 13.86 to 22.5 mm, with an average of 18.15±1.80 mm.

Table 3: AP2 diameter of right and left side glenoid cavity.

Side	Range	Mean ±SD	Statistical significance
Right	14 to 22.39 mm	17.89±1.52 mm	t = 0.61
Left	13.86 to 22.5 mm	18.15±1.80 mm	P = 0.54

Table 4 shows different shapes of glenoid cavity. There was oval, pear and inverted comma shape of glenoid cavity found. On right side out of 30 scapula 6(20.00%) oval shaped, 16(53.34%) pear shaped, 8(26.66%) inverted comma shaped glenoid cavity found. On left side out of 30 scapula 5(16.66%) oval shaped, 14(46.67%) pear shaped, 11(36.30%) inverted comma shaped glenoid cavity found.

Table 4: Shapes of right and left side glenoid cavity.

Shape of glenoid	Right		Left	
	No. of bones	Incidence of shape	No. of bones	Incidence of shape
Oval	6	20.00%	5	16.66%
Pear	16	53.34%	14	46.67%
Inverted comma	8	26.66%	11	36.30%

Table 5 shows the glenoid cavity index, on the right side varies from 59.73 to 75.35 mm, with an average of 69.54±4.22 mm and on left side varies from 59.15 to 75.03 mm, with an average of 68.65±4.12 mm.

Table 5: GC Index of right and left side glenoid cavity.

Side	Range	Mean ±SD	Statistical significance
Right	59.73 to 75.35 mm	69.54±4.22 mm	t = 0.82
Left	59.15 to 75.03 mm	68.65±4.12 mm	P = 0.41

DISCUSSION

Many studies have been done by various workers on different races and groups of population about the morphometry of scapula and glenoid cavity in a variety of way like direct measurement on embalmed cadavers, direct measurement of dry scapulae, radiographic measurements of scapulae harvested from the cadavers and radiographic measurements in the living patients etc. The present study was performed on dry human scapulae. The comparison of data between present study and previous studies found several differences as well as similarities in the dimensions of the scapula and glenoid cavity (Table 6).

In the present study the average superior-inferior diameter of the right glenoid was 37.31±2.91 mm and the average superior-inferior diameter of the left glenoid was 37.46±2.92 mm. Von Schroeder et al [7], Coskun et al [10] and Karelse et al [11] reported the SI diameter to be 36±4mm, 36.3±3 mm and 35.9±3.6 mm respectively. All these values are lower than what was recorded in our study. Mamatha et al [12], Rajput et al [13] and Patil et al [14], measured the SI diameter of right and left side separately. The mean SI diameter of right side measured by these three authors was 33.67 ± 2.82mm, 34.76±3 mm and 35.2±3.0 mm respectively and of the left side was 33.92 ± 2.87 mm, 34.43±3.21mm and 34.7±2.8 mm respectively.

Frutos LR [8], Taser F et al [9] measured the SI diameter of the male and female glenoid separately. The average SI diameter of male glenoid measured by these authors was 36.08±2.05 mm and 37.1±3.4 mm respectively. All these measurements are near to that reported in our present study. In our study the

Table 6: Comparison of different parameters of glenoid cavity by various authors.

S. no.	Author	No of specimen	Mean SI diameter (mm)	Mean AP1 diameter (mm)	Mean AP2 diameter (mm)
1	Iannoti et al(6) (1992)	140	39 ± 3.5	29 ± 3.2	23±2.7
2	Von Schroeder et al(7) (2001)	30	36 ± 4	28.6 ± 3.3	
3	Luis rios frutos(8) (2002)	Male-65 Female-38	36.08 ± 4 31.17±1.7	26.3 ± 1.5 22.31±1.4	
4	Taser F & Basaloglu H (9) (2003)	Male-13 Female-39	37.1±3.4 34.1±2.9	26.6±2.1 25.0±2.7	
5	Coskun et al(10) (2006)	90	36.3 ± 3	24.6 ± 2.5	
6	Karelse et al(11) (2007)	40	35.9 ± 3.6	27.2 ± 3.0	
7	Mamatha et al(12) (2009)	Right-98 Left-104	33.67 ± 2.82 33.92 ± 2.87	23.35 ± 2.04 23.02 ± 2.30	
8	Rajput et al(13) (2012)	Right-43 Left-57	34.76±3 34.43±3.21	23.31±3 22.92±2.80	
9	Patil et al(14) (2014)	Right:104 Left: 120	33.68±4.32 32.09±4.11	23.29±2.34 24.90±2.95	15.74±1.75 16.81±1.74
10	Present study(2017)	Right-30 Left-30	37.31±2.91 37.46±2.92	25.90±2.09 25.70±2.32	17.89±1.52 18.15±1.80

sex of the scapulae was not known, therefore we could not measure them separately.

In the present study the average AP1 diameter of glenoid cavity on the right side was 25.90±2.09 mm and on left side was 25.70±2.32 mm. The combined average of both sides was 25.80 ± 2.21mm. This was very higher to what was observed in the female glenoids studied by Churchill et al [4], Luis Rios Frutos [8]. Churchill et al [4], recorded the average AP-1 diameter to be 23.6 ± 1.5mm and Luis Rios Frutos [8] found it to be 22.31 ± 1.49mm. The values recorded for the AP-1 diameter for the male glenoids were 27.8 ± 1.6mm by Churchill et al [4]. and 26.31 ± 1.57mm by Luis Rios Frutos [8]. All these values were very close to our combined average of both right and left sides, 25.80 ± 2.21mm. The AP-1 diameter for female recorded by Taser F et al [9], which was 25.0±2.7mm was quite close to what was recorded in the present study which was 25.80 ± 2.21mm.

In the present study the average AP2 diameter of glenoid cavity on the right side was 17.89± 1.52mm and on left side was 18.15±1.80mm. The combined average of both sides was 18.02 ± 1.66mm. This was much lower than what was observed by Iannotti et al [6], which was 23 ± 2.7mm. Average AP2 diameter of present study found very close to what observed in study by Patil et al [14], which were 15.74±1.75mm on right side and 16.81±1.74 on left side.

In the present study, 20 % oval, 53.34% pear, 26.66% inverted comma shaped glenoid cavity found on right scapula. 16.66% oval, 46.67% pear, 36.30% inverted comma shaped glenoid cavity found on left scapula. Mamatha et al [12] reported that on the right side 34% glenoid cavities were inverted comma shaped, 46% pear shaped and 20% oval shaped and on the left side they were 33%, 43% and 24% respectively. Rajput et al [13] recorded the incidence of inverted comma shaped, pear shaped and oval shaped as 35%, 49 % and 16 % respectively on the right side and 39%, 46 % and 15% respectively on the left side.

In the present study, oval glenoids were only of 20% on the right side and 16.66% on the left side. As compared to Mamatha et al [12] who found it to be 20% on the right side and 24% on the left side. Prescher and Kulmpen [3] observed that 45% of the glenoids were oval shaped Coskun N et al [10] 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 shaped. These findings were higher than that of the present study.

The percentage of glenoids with both indistinct and distinct notch was 80% on the right side and 83% on the left side. Mamatha et al [12] had found it to be 80% on the right side and 76% on

the left side. Prescher and Klumpen [3] had observed it to be 55% which was much lesser than in the present study.

In the present study, mean glenoid cavity index(GCI) on the right side was 69.54±4.22 mm and on left side 68.65±4.12 mm. The combined average of both sides was 69.09± 4.16mm. Polguj M et al [15] noted the combined GCI to be 72.35±5.55, which was higher than the present study. 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 [16] were found very close to present study.

CONCLUSION

The knowledge of the variation in the different shape and dimensions of the glenoid cavity are important in better understanding of the shoulder pathology and in designing and fitting of glenoid components for total shoulder arthroplasty.

The mean values of SI, AP1, AP2 diameter on both right and left side are almost similar. The above data on the different shape and dimensions of the glenoid cavity may not only help the orthopedicians and prosthetists but also helpful to anthropologists for studying about the evolution of the bipedal gait in human being. Since the present study had taken a smaller number of scapula and were not of the same skeleton, further cadaveric, radiological and clinical studies are indicated.

ABBREVIATIONS

SI - Superior-Inferior Diameter
AP-1 - Anterior-Posterior Diameter Of The Lower Half
AP-2 - Anterior-Posterior Diameter Of The Upper Half
GCI - Glenoid Cavity Index
mm - millimetre
SD - standard deviation

Conflicts of Interests: None

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