

Morphometric Study of Glenoid Cavity of Dry Human Scapula

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ABSTRACT

Introduction: The shoulder joint of the human body is one of the most important joints. The glenoid cavity of the scapula plays a major role in the formation of the joint, as it has got variable morphology. Anatomical variations of glenoid cavity are also important for understanding the various pathologies involving the shoulder joints. The present study tries to determine the measurements of various dimensions of the glenoid cavity including the variations of its shape and surface area.

Materials and methods: The study was carried out on 53 dry, unpaired adult human scapulae of unknown sex in the Department of Anatomy, Sikkim Manipal Institute of Medical Sciences, Gangtok. Out of which, 21 belong to right side and 32 of left side.

Results: The mean superior-inferior diameter of the glenoid cavity was observed, in this study as 34.12 ± 3.16 mm. The mean Anterior Posterior-1 and Anterior Posterior-2 were 23.28 ± 2.99 mm and 18.04 ± 2.57 mm respectively. The mean surface area of the glenoid cavity was observed as 5.56 ± 1.33 mm

Conclusion: The diameters of the glenoid cavity observed in this present study were almost similar to those recorded in

other studies by various authors except for the shapes. An explanation of this finding may be the numbers of the specimens were less. Since the present study was carried out in limited number of specimens, so further cadaveric or radiological studies are required.

KEY WORDS: Humerus, Glenoid cavity, Scapula, Shoulder joint.

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INTRODUCTION

The lateral angle of the scapula is truncated and consists of a pear-shaped shallow glenoid cavity which articulates with the head of humerus and subsequently forms the shoulder joint. The articular surface is narrow above. The floor of the glenoid cavity is covered by articular hyaline cartilage. The glenoidal labrum, which is a fibro-cartilaginous rim is attached to its peripheral margin of the socket except at the supraglenoid tubercle. This supraglenoid tubercle provides intracapsular origin to the long head of biceps brachii. The anterior margin of the articular fossa is grooved for the tendon of subscapularis. The fibrous capsule around the shoulder joint is attached around the periphery of the glenoid cavity outside the labrum in such a way that includes the supraglenoid tubercle but excludes the infraglenoid tubercle.¹

The vertical diameter of the cavity is longer than the transverse diameter. Again the lower transverse diameter is more than the upper transverse diameter.

Fractures with dislocations of the glenoid are quite common in our day to day practice. Out of all joints in the body, the shoulder joint is the most vulnerable joint to be dislocated in trauma and also in sports. It is not only the repair of the labrum or reinforcement of the capsule of the glenoid cavity or muscle arrangement but also a total shoulder replacement is also a treatment of choice nowadays. The variable anatomy of the glenoid with minimal bone

stock and instability makes any procedure in glenoid challenging to the orthopaedic surgeons. The variations of the morphology of the glenoid cavity will be helpful for the surgeons to evaluate the proper size of the glenoid component in the shoulder arthroplasty.² A clear conception regarding the normal anatomical features as well as variations in the glenoid cavity are required for better understanding of shoulder joint surgeries.

The aim of the present study was to obtain a morphometric data of the glenoid fossa including the different diameters of the glenoid cavity, shapes and the surface area which not only will help for better understanding but also the proper treatment of shoulder pathology also to compare with the earlier studies

MATERIALS AND METHODS

The study was carried out on 53 dry, unpaired adult human scapulae of unknown sex in the Department of Anatomy, Sikkim Manipal Institute of Medical Sciences, Gangtok, Sikkim. Out of which, 21 belong to right side and 32 on left side.

Only those bones which are clean and well demarcated are included in this study. Any damage seen in the glenoidal end or any obvious pathology seen are excluded from this study. All parameters are measured by vernier calliper and are recorded in millimetres only.

The following parameters of the fossa are studied.

1. Superior Inferior glenoid diameter (SI): Maximum distance from the inferior point on the glenoid margin to the most prominent point of the supraglenoid tubercle.

2. Upper Anterior Posterior glenoid diameter (AP2): It is the anterior –posterior diameter of the top half of the glenoid cavity at the mid –point between the superior rim and the mid-equator.

3. Lower Anterior Posterior glenoid diameter (AP1): It is the maximum breadth of the articular margin of the glenoid cavity perpendicular to the glenoid cavity height

4. Shape of the glenoid cavity: Shape made by the slightly raised rim of the glenoid cavity.

5. Surface area of the glenoid cavity measured by taking the margin of the glenoid cavity on the tracing paper.

The above parameters of the glenoid cavity were measured as per the study of Mamatha et al.³

The mean and standard error of the glenoid cavity in various dimensions were calculated. Continuous variable will be expressed as mean values \pm SD. Non continuous variable will be expressed as percentages.

Difference in continuous variables among two or more groups will be analysed by one way analysis of variance (ANOVA) SPSS 16.0 will be used for data analysis. $P \leq 0.05$ will be considered as significant.

RESULTS

In this present study, the superior-inferior diameter of the glenoid fossa on the right side varied from 29.15mm to 38.54mm with mean of 33.64 ± 3.01 mm On the left side, the superior-inferior diameter varied from 28.31mm to 40.16mm with mean of 34.44 ± 3.27 mm. In this study, the AP-1 glenoid diameter of the right side varied from 18.73mm to 29.25mm. The average AP-1 diameter of the right side was 23.22 ± 2.85 mm. The AP-1 glenoid diameter of the left side varied from 16.35mm to 29.85mm. The average AP-1 diameter of the left side was 23.31 ± 3.12 mm. The AP-2 diameter of the right glenoid cavity was 13.39mm to 23.07mm and the mean of the same was 18.07 ± 2.64 mm. The AP-2 diameter of the left side of the glenoid cavity was 14.18mm to 22.84mm with the average of 18.01 ± 2.56 mm. The mean surface area of the right glenoid cavity observed 5.44sq.mm with standard deviation of ± 1.21 sq.mm and that in the left glenoid cavity was 5.64sqmm with standard deviation of ± 1.41 sq.mm. Out of 53 glenoid cavities examined, 32 were in the left side, out of which 22 were found to be pear-shaped, 7 were oval shaped and 3 were comma shaped. The percentage of these shapes were 41.50, 13.20 and 5.66 respectively. The number of glenoid cavities examined in the right side was 21. Out of which 12 were pear-shaped, 4 were oval shaped and 5 were coma shaped and the percentage of these shapes were 22.64, 7.54 and 9.43 respectively.

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

	Left	Right	F-value	P-value
AP2				
MEAN	18.017	18.08	3.24	.03
N	32	21		
SD \pm	± 2.57	± 2.64		
SI				
MEAN	34.45	33.61	.402	.75
N	32	21		
SD \pm	± 3.27	± 3.01		
SA				
MEAN	5.69	5.44	.915	.44
N	32	21		
SD \pm	± 1.42	± 1.21		
AP1				
MEAN	23.31	23.23	1.65	.19
N	32	21		
SD \pm	± 3.12	± 2.85		

DISCUSSION

An effort was made in this present study to measure the average diameters of the glenoid cavity of the scapula as well as the various sizes and shapes and also the surface area of the glenoid cavity

It has already been attempted by many authors to measure the diameters of the glenoid cavity in a similar pattern; also an attempt was made to determine the glenoid diameters in different populations by many authors. That was also performed in various ways including direct measurements of dry scapula, direct measurements of fresh or embalmed cadavers, radiographic measurements of scapula or radiographic measurements in living patients. The present study has been correlated with the other

studies for any similarity or difference. In this study, the surface area of the glenoid cavity was also measured.

In this present study, the average superior- inferior (SI) diameter of the glenoid cavity was 34.12 ± 3.16 mm, Lannotti et al, reported the superior- inferior diameter of the glenoid cavity in their study was 39 ± 3.5 mm which was much more than the present value.⁴ The mean SI dimension of the present study of the right glenoid cavity was 33.64 ± 3.01 mm and that of the left side was 34.45 ± 3.28 mm. In this present study, the left glenoid cavity is slightly larger than the right but it was not significant statistically. The averages SI were compared with various other studies by different authors. Rajput et al, measured in the right side was 34.76 ± 3.0 mm and in left side was 34.43 ± 3.21 mm.⁵ Mamatha et

al, in a study, measured in the right side was 33.67 ± 2.82 and in the left side, 33.92 ± 2.87 mm (Mamatha T, Pai SR, Murlimanju BV, Kalthur SG, Pai MM 2011). Kavitha et al also, published a data of right side 35.2 ± 3.0 mm and in left side measured as 34.7 ± 2.8 mm.⁶ In another study by Neeta et al, they measured the right side average SI diameter was 38.46 ± 2.81 mm and in left side was 39.03 ± 3.18 mm.⁷ Churchill et al. and Ozer et al. measured the SI diameters of male and female glenoid cavities separately.

The mean SI diameter in the male and female glenoid cavity was 37.5 ± 2.2 mm and 32.6 ± 1.8 mm respectively as documented by Churchill et al.⁸

In another study, Ozer et al. the mean SI diameter of male and female glenoid cavity was 38.71 ± 2.71 mm and 33.79 ± 3.08 mm.⁹ In this present study, the sex identification of the scapula was not done. The studies by various authors are compared in the following table.



Fig 1: Different shapes of Glenoid Cavity

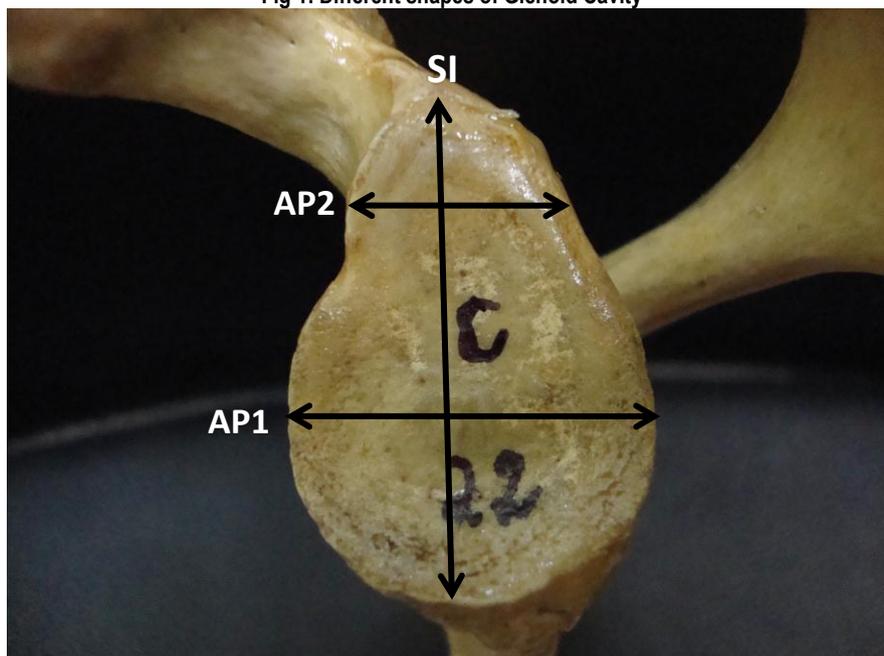


Fig 2: Different measurements of Glenoid Cavity. (SI: Superior Inferior glenoid diameter, AP1: Anterior Posterior diameter 1, AP2: Anterior Posterior diameter 2).

Table- 2: Comparison of SI diameter by various authors

SL No.	Observer	No of specimens	Mean SI diameter(mm)
1	Lannotti et al. (1992)	140	39.0 ± 3.5
2	Rajput HB et al. (2012)	Right-43 Left - 57	34.76 ± 3.0 34.43 ± 3.21
3	Mamatha et al. (2011)	Right-98 Left- 104	33.67 ± 2.82 33.92 ± 2.87
4	Kavitha et al. (2013)	Right-67 Left-62	35.2 ± 3.0 34.7 ± 2.8
5	Neeta et al. (2015)	Right-55 Left-71	38.46 ± 2.81 39.03 ± 3.18
6	Churchill et al. (2001)	Male-200 Female-144	37.5 ± 2.2 32.6 ± 1.8
7	Ozer et al. (2006)	Male-94 Female-92	38.71 ± 2.71 33.79 ± 3.08
8	Present study (2016)	Right-21 Left- 32	33.64 ± 3.01 34.44 ± 3.27

In this present study, the average antero-posterior diameter (AP-1) of the lower half of the right glenoid cavity was 23.22 ± 2.85 mm and that of the left side was 23.31 ± 3.12 mm. The total mean average was 23.28 ± 2.99 mm. The left glenoid cavity in this present study is slightly larger than the right side. Kavitha et al. observed combined mean AP 1 glenoid diameter as 24.9 ± 2.5 mm with a mean of 24.9 ± 2.0 mm on the left side and 25.07 ± 2.7 mm on the right side.⁶ This finding are more or less similar to

the present study. In another study by Rajput HB et al, and Mamatha et al, recorded an average AP 1 glenoid diameter of 23.31 ± 3.0 mm and 23.35 ± 2.04 mm on the right side and 22.92 ± 2.80 mm and 23.05 ± 2.30 mm on the left side respectively.^{3,5} Both these studies are similar with the present study. In another study by Neeta et al, they found an average mean AP1 diameter in right side was 25.04 ± 2.69 mm and in the left side was 24.85 ± 2.46 mm which was little broader than the present study.⁷

Table- 3: Comparison of AP-1 diameter by various authors

SL No.	Observer	No of specimens	Mean AP-1 diameter(mm)
1	Rajput HB et al. 2012	Right-43	23.31 ± 3.0
		Left - 57	22.92 ± 2.80
2	Mamatha et al. 2011	Right-98	23.35 ± 2.04
		Left- 104	23.05 ± 2.30
3	Kavitha et al. 2013	Right-67	25.07 ± 2.7
		Left-62	24.9 ± 2.0
4	Neeta et al. 2015	Right-55	25.04 ± 2.69
		Left-71	24.85 ± 2.46
5	Churchill et al. 2001	Male-200	27.86 ± 1.6
		Female-144	23.6 ± 1.5
6	Ozer et al. 2006	Male-94	27.33 ± 2.4
		Female-92	22.72 ± 1.72
7	Present study	Right-21	23.22 ± 2.85
		Left- 32	23.31 ± 3.12

The mean AP 2 diameter in this study in the right side was 18.07 ± 2.64 mm and in the left side 18.01 ± 2.56 mm. The anterior-posterior diameter of the upper half of the right glenoid observed by Rajput HB et al. and Mamatha et al. were 15.10 ± 2.54 mm and 16.27 ± 2.01 mm where as in the left glenoid cavity were 13.83 ± 2.45 mm and 15.77 ± 1.96 mm respectively.^{3,5} In another study by Kavitha et al, the mean AP2 diameter was 16.8 ± 1.3 mm

in the right glenoid cavity and 16.3 ± 2.0 mm in the left side.⁶ All these parameters were less than the present observation. In another study by Neeta et al, the right glenoid cavity AP2 diameter was 18.70 ± 2.22 mm and that of in the left side was 18.6 ± 2.07 mm.⁷ which resembles with the present observation. The comparison data of various observers are listed in the following table.

Table 4: Comparison of AP-2 diameter by various authors

SL No.	Observer	No of specimens	Mean AP2 diameter(mm)
1	Rajput HB et al. 2012	Right-43	15.10 ± 2.54
		Left - 57	13.83 ± 2.45
2	Mamatha et al. 2011	Right-98	16.27 ± 2.01
		Left- 104	15.77 ± 1.96
3	Kavitha et al. 2013	Right-67	16.8 ± 1.3
		Left-62	16.3 ± 2.0
4	Neeta et al. 2015	Right-55	18.70 ± 2.22
		Left-71	18.6 ± 2.07
5	Present study	Right-21	18.07 ± 2.64
		Left- 32	18.01 ± 2.56

In this present study, the pear shaped glenoid cavity was 23% on the right side and in the left side it was 42%. Whereas, Rajput et al and Mamatha et al reported an incidence of pear shaped glenoid cavity 49% and 46% in the right side and 46% and 43% in the left side respectively. The oval shaped in Rajput et al and in Mamatha et al both in right and left sides are 16%, 20% and 15%, 24% respectively. The findings of inverted coma types in both Rajput et

al and Mamatha et al are almost identical.^{3,5} An observation was made in comparison of present study with various authors was that the percentage of shapes of present study was different rather low. The reason behind this may be due to less number specimens. The least common types of shape encountered in this present study were inverted coma which was also observed in one study done by Kavitha et al.

Table-5: Comparison of various shapes of glenoid cavity

SL No	Observers	No. of Specimens	Pear shape (%)	Oval shape (%)	Inverted coma (%)
1	Rajput et al, 2013	Right-43	49	16	35
		Left-57	46	15	39
2	Mamatha et al, 2011	Right- 98	46	20	34
		Left-104	43	24	33
3	Kavitha et al, 2013	Right-67	58	30	11
		Left-62	58	30	11
4	Neeta et al, 2015	Right-55	47	31	22
		Left-71	55	32	13
5	Present study	Right-21	23	08	9
		Left-32	42	13	6

The total mean surface area of this present study was 5.56 ± 1.33 , with right side mean measurement 5.44 ± 1.21 and left side was 5.64 ± 1.41 .

CONCLUSION

It is important to know the shape and diameter of the glenoid cavity, in the designing and fitting of the glenoid component during total shoulder arthroplasty. A variation of normal anatomy is quite obvious and it is also essential to know the variations while evaluating the pathological conditions like osseous Bankart lesions and osteochondral defects.

By comparing the various tables in the discussion, it was noted that different diameters of glenoid cavity by various authors and present author are almost identical except the shapes of the glenoid cavity which is relatively different. An explanation of this finding may be the number of the specimen was less. Since the present study was carried out in limited number of specimens, so further cadaveric or radiological studies are required.

ABBREVIATIONS

SD: Standard Deviation

mm: millimetre

SI: Superior – Inferior glenoid diameter

AP-1: Anterior – Posterior diameter 1

AP-2: Anterior – Posterior diameter 2

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