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Morphometrical Study of Scapular Glenoid Cavities

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Abstract- Shape and dimensions of the glenoid cavity are important in the design and fitting of glenoid components for total shoulder arthroplasty. An understanding of variations in normal anatomy of the glenoid is essential while evaluating pathological conditions like osseous bankart lesions and osteochondral defects.

In the present study done on 224 dry scapulae, three glenoid diameters were measured. The average superior-inferior diameter on right and the left side were 33.68 ± 4.32 mm and 32.09 ± 4.11 mm respectively. The average anterior-posterior diameter of the lower half of the right glenoid was 23.29 ± 2.34 mm and that of the left glenoid was 24.90 ± 2.95 mm. the mean diameter of the upper half of the right glenoid was 15.74 ± 1.75 mm and that of the left glenoid was 16.81 ± 1.74 mm.

The left glenoid cavity was slightly shorter in length, but broader especially in the upper part as compared to the left glenoid cavity.

The current study also recorded a higher percentage of glenoid cavities having the glenoid notch in the anterior margin of the glenoid as compared to earlier studies. While evaluating defects and lesions of the glenoid, this fact could be useful.

GJMR-H Classification: WE 168, WS 270

MORPHOMETRICALSTUDY OF SCAPULARGLEN OID CAVITIES

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Morphometrical Study of Scapular Glenoid Cavities

Dr. Girish V.Patil ^a, Dr. Sanjeev I. Kolagi ^a & Dr. Umesh Ramdurg ^p

Abstract- Shape and dimensions of the glenoid cavity are important in the design and fitting of glenoid components for total shoulder arthroplasty. An understanding of variations in normal anatomy of the glenoid is essential while evaluating pathological conditions like osseous bankart lesions and osteochondral defects.

In the present study done on 224 dry scapulae, three glenoid diameters were measured. The average superior-inferior diameter on right and the left side were 33.68 ± 4.32 mm and 32.09 ± 4.11 mm respectively. The average anterior-posterior diameter of the lower half of the right glenoid was 23.29 ± 2.34 mm and that of the left glenoid was 24.90 ± 2.95 mm. the mean diameter of the upper half of the right glenoid was 15.74 ± 1.75 mm and that of the left glenoid was 16.81 ± 1.74 mm.

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The current study also recorded a higher percentage of glenoid cavities having the glenoid notch in the anterior margin of the glenoid as compared to earlier studies. While evaluating defects and lesions of the glenoid, this fact could be useful.

Smaller dimensions of the glenoid cavities in the south Indian population may have to be taken into consideration while designing and fitting glenoid components while performing total shoulder arthroplasty.

I. INTRODUCTION

he scapula is an integral part of the connection between the upper extremity and the axial skeleton. Lateral angle of the scapula is a shallow, pyriform articular surface- the Glenoid cavity, also known as Glenoid fossa of the scapula. Glenoid cavity is directed laterally and forward and articulates with the head of the humerus and form Gleno-humeral joint. The vertical diameter of the Glenoid cavity is the longest and it is broader below than above. The surface is covered with hyaline cartilage in the fresh state and its slightly raised margins give attachment to a fibrocartilaginous structure- the glenoid labrum which deepens the cavity (Richard LM, Newell 2005¹).

Shoulder joint between shallow glenoid fossa and hemispherical head of humerus is a ball and socket type of synovial joint. It has maximum movement but less stability. The factors contributing to stability the shoulder joint are the deepening of the glenoid cavity by the glenoid labrum; the suprahumeral support provided

Author α : Dept of Anatomy, DM- Wayanad Institute of Medical Sciences, Wayanad, Kerala. e-mail: girivpatil@yahoo.co.in Author σ : Dept of Anatomy, SNMC Bagalkot, Karnataka. Author p: Dept of Community medicine, SNMC Bagalkot, Karnataka. by the coracoacromial arch, the capsule is strengthened by the fusion of tendons of rotator cuff muscles and glenohumeral and coracohumeral ligaments.

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 and reinforcing the capsule by an overlapping repair and rearrangement of anterior muscle, total shoulder replacement is also being used as treatment (Chummy S. Sinnatomby 20062).

Total shoulder arthroplasty has proven to provide predictable improvement in pain and function in patients with a degenerative shoulder joint and an intact rotator cuff.

Various shapes of the glenoid cavity have been described based on the presence of a notch on anterior glenoid rim. It has been found that if the notch is distinct then the glenoid labrum is not fixed to the bony margin of the notch but bridges the notch itself. This could make the shoulder joint less resistant to dislocating forces (Prescher A. and KImpen T. 19973)

Because of unusual and complex morphology features of the scapula, and the lack of complete quantitative anatomic studies, the current study was undertaken to describe the glenoid cavity quantitatively with its dimensions and shape.

II. MATERIALS

This study was done on 224 dry, unpaired adult human scapulae of unknown sex obtained from department of Anatomy Srinivas Institute of medical Sciences, Mangalore. Scapula having clear and intact glenoid cavity were selected for the study. All the measurements were taken in millimeters using sliding calipers.

III. Methods

The following parameters were studied in the glenoid cavity of the dry scapula

- 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. Shape of the glenoid cavity: A piece of white sheet was placed on the glenoid cavity and held firmly in position to trace the shape of the glenoid cavity. The side of the point of a lead pencil was rubbed along the rim of the glenoid cavity to get a tracing of the shape of the glenoid cavity on the paper.

IV. STASTICAL EVALUATION

The mean and standard error of the glenoid cavity in various dimensions were calculated. The morphometric values of both sides were analyzed using an unpaired t-test.

V. Observation and Results

In 224 dry scapulae, 104 belonging to the right side and 120 to the left side. Abbreviations used in the following tables are

- 1. SI- superior inferior glenoid diameter
- 2. AP 1- anterior- posterior glenoid diameter (maximum breadth of the articular surface)
- 3. AP 2- anterior –posterior glenoid diameter of the upper half of the glenoid cavity.
- 4. SD standard deviation
- 5. P P value
- 6. mm- millimeters

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Table 2 : comparison of	I diameter of the right and left side
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Points	Right	Left
Number of bones	104	120
Range	25 to 42	25 to 42
Mean	33.68	32.09
Standard deviation	4.32	4.11
Statistical significance	t =31.8, P<0.001	
	Points Number of bones Range Mean Standard deviation Statistical significance	PointsRightNumber of bones104Range25 to 42Mean33.68Standard deviation4.32Statistical significancet = 31.8, P<0.001

In the present study, the superior – inferior diameters of the glenoid cavity on the right side varied from 25 to 42 mm, with an average of 33.68 ± 4.32 mm. on left side the superior –inferior diameter from 25 to 42, with a mean of 32.09 ± 4.11 mm.

Statistically Highly significant value was found while comparing the SI diameters of the right glenoid with that of the left glenoid cavity (P<0.001)

Table 3 : comparison of the AP-1 diameter of the right and left side

SI.No	Points	Right	Left
1	Number of bones	104	120
2	Range	17 to 27	17 to 28
3	Mean	23.29	24.90
4	Standard deviation	2.34	2.95
5	Statistical significance	t =20.32, P<0.001	

In this study, the AP 1- glenoid diameter of the ight and left sides varies from 17 to 27mm and 17 to 28mm respectively. The average maximum breadth of the right glenoid was 23.29 ± 2.34 mm and the maximum breadth of the left glenoid was 24.90 ± 2.95 mm.

Statistically Highly significant value was found while comparing the AP 1 diameter of the right glenoid with that of the left glenoid (P<0.001).

Table 4 : comparison of the AP-2 diameter of the right and left side

SI.No	Points	Right	Left
1	Number of bones	104	120
2	Range	12 to 20	12 to 21
3	Mean	15.74	16.81
4	Standard deviation	1.75	1.74
5	Statistical significance	t =53.5, P<0.001	

The range for the AP2 diameter of the glenoid cavity was 12 to 20mm and the mean for the same was 15.74 ± 1.75 mm. the AP2 diameter for the left glenoid varied from 12 to 21mm, while the mean for the left glenoid was 16.81 ± 1.74 mm.

While comparing the AP2 diameter of the right and left glenoid cavities, statistically important difference was found (P<0.001).

While examining the various shapes of the glenoid cavity in the present study. It was found that the

shapes could mainly be of 3 types. It was classified as inverted comma shaped if the anterior glenoid notch was distinct, as pear shaped if the anterior glenoid notch was indistinct and as oval shaped if the anterior glenoid notch was absent.

Table 5 : Table showing number and incidence of various shapes of the right glenoid cavity

Number of bones	Shape of glenoid	Incidence of shape
36	Inverted comma	34.62%
49	Pear	47.12%
19	Oval	18.27%
Total- 104	-	-

On the right side out of the total 104 glenoid cavities examined 36 were found to have inverted comma shape. And the incidence of this shape was calculated to be 34.62%. the number of glenoids having

pear shape on the right side was 49 and the incidence was found to be 47.12%.oval glenoid cavities were 19 in number on the right side and the incidence was 18.27%.

Table 6 : Table showing number and incidence of various shapes of the left glenoid cavity

Number of bones	Shape of glenoid	Incidence of shape
39	Inverted comma	32.5%
54	Pear	45.0%
27	Oval	22.5%
Total- 120	-	-

On the left side, glenoids with the inverted comma shape were 39 in number out of the total 120 scapulae examined. The incidence of inverted comma shaped glenoid was 32.5%. 54 glenoids on the left side were found to have the pear shape and incidence of pear shaped glenoid was 45%. The oval glenoid cavities were 27 in number and the incidence of oval glenoid was 22.5%.

VI. DISCUSSION

In the present study an effort has been made to find the average diameters of the glenoid cavity of the scapula and the incidence of various shapes of the glenoid cavity in the south Indian population. Several authors have attempted to determine the glenoid diameters in the course of their research. This has been performed in a variety of ways, including direct measurement of dry scapulae, direct measurement of fresh or embalmed cadavers, radiographic measureement of scapulae harvested from cadavers and radiographic measurement in living patients. These studies have been performed on different populations. In evaluating the data presented in this study, a comparison to work by others reveals several differences as well as similarities

Observers	No of specimens	Mean SI diameter
Mallon4 et al (1992)	28	35±4.1mm
lannotti5 et al (1992)	140	39±3.5mm
Von Schroeder6 et al (2001)	30	36±4mm
Churchill7 et al (2001)	Male 200 Female 144	37.5±2.2mm 32.6±1.8mm
Luis Rios Frutos8 (2002)	Male- 65 Female 38	36.08±2.0mm 31.17±1.7mm
Ozer et al9 (2006)	Male 94 Female 92	38.71±2.71mm 33.79±3.08mm
Karelse et al10 (2007)	40	35.9±3.6mm
Present study	Right 104 Left 120	33.68±4.32mm 32.09±4.11mm

Table 7: comparison of superior-inferior diameter by various authors

Table 8 : comparison of superior-inferior diameter by various authors

Observers	No of specimens	Mean SI diameter
Mallon et al (1992)	28	24±3.3mm
lannotti et al (1992)	140	29±3.2mm
Von Schroeder et al (2001)	30	28.6±3.3mm
Churchill et al (2001)	Male 200	27.8±1.6mm
	Female 144	23.6±1.5mm

Luis Rios Frutos (2002)	Male- 65	26.31±1.5mm
	Female 38	22.31±1.4mm
Ozer et al (2006)	Male 94	27.33±2.4mm
	Female 92	22.72±1.72mm
Karelse et al (2007)	40	27.2±3mm
Present study	Right 104	23.29±2.34mm
	Left 120	24.90±2.95mm

Table 9 : Comparison of the anterior –posterior (AP-2) diameter by various authors

Observers	No of specimens	Mean AP2 diameter
lannotti et al (1992)	140	23±2.7mm
Present study	Right 104	15.74±1.75mm
	Left 120	16.81±1.74mm

Table 10: Comparison of percentage of occurrence of glenoid notch by various authors

Observers	% of glenoid with notch (inverted	% of glenoids without
	comma + pear shaped)	notch (oval)
Prescher A and Klumpen T (1997)	Right + left – 55%	Right + left – 45%
Present study	Right – 81.74%	Right – 18.27%
(2011)	Leii- 77.3%	Leil- 22.5%

VII. Summary and Conclusion

Knowledge of the shape and dimensions of the glenoid are important in the design and fitting of glenoid components for total shoulder arthroplasty. An understanding of variations in normal anatomy of the glenoid is essential while evaluating pathological conditions like osseous bankart lesions and osteochondral defects.

In the present study done on 224 dry scapulae, three glenoid diameters were measured. The superiorinferior, anterior-posterior diameter of the lower half of the glenoid and the anterior-posterior diameter of the upper half of the glenoid. The average superior-inferior diameter on right and the left side were 33.68 ± 4.32 mm and 32.09 ± 4.11 mm respectively. The average anteriorposterior diameter of the lower half of the right glenoid was 23.29 ± 2.34 mm and that of the left glenoid was 24.90 ± 2.95 mm. The mean diameter of the upper half of the right glenoid was 15.74 ± 1.75 mm and that of the left glenoid was 16.81 ± 1.74 mm.

The left glenoid cavity was slightly shorter in length, but broader especially in the upper part as compared to the right glenoid cavity.

The current study also recorded a higher percentage of glenoid cavities having the glenoid notch in the anterior margin of the glenoid as compared to earlier studies. While evaluating defects and lesions of the glenoid, this fact could be useful.

By observing the tables in the discussion it can be implied that the values observed in the present study, through coinciding with that of some of the studies are mostly less than that recorded by many of the observers. This implies that the smaller dimensions of the glenoid cavities in the south Indian population may have to be taken into consideration while designing and fitting glenoid components while performing total shoulder arthroplasty in this population,

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[.] Diameters of the glenoid cavity



Inverted comma-shaped glenoid



Oval-shaped glenoid



Pear-shaped glenoid