

Morphometrical Study of Scapular Glenoid Cavities

Dr. Girish V.Patil¹

¹ DM-Wayanad Institute of Medical Sciences, Meppadi, Wayanad. kerala.

Received: 16 December 2013 Accepted: 5 January 2014 Published: 15 January 2014

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.

Index terms—

1 Morphometrical Study of Scapular Glenoid Cavities

Dr. Girish V.Patil[?], Dr. Sanjeev I. Kolagi[?] & Dr. Umesh Ramdurg[?] 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 superiorinferior 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 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.

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.

2 I.

3 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 2005 1).

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 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 (Chumny 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 Klmpen 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.

4 II.

5 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.

6 III.

7 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 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.

8 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.

9 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 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 ($P < 0.001$) In this study, the AP 1-glenoid diameter of the right 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 ($P < 0.001$). 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.

10 Volume XIV Issue II Version I

11 Year ()

12 2014

13 H

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 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. 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%. 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%.

14 VI.

15 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 measurement 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

16 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, Volume XIV Issue II Version I Year () 2014¹

¹© 2014 Global Journals Inc. (US)

2

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

Figure 1: Table 2 :

3

Sl.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	

Figure 2: Table 3 :

4

Sl.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	

Figure 3: Table 4 :

5

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

Figure 4: Table 5 :

6

39	Inverted comma	32.5%
54	Pear	45.0%
27	Oval	22.5%
Total-120	-	-

Figure 5: Table 6 :

7

Observers	No of specimens	Mean SI diameter
Mallon ⁴ et al (1992)	28	35±4.1mm
Iannotti ⁵ et al (1992)	140	39±3.5mm
Von Schroeder ⁶ et al (2001)	30	36±4mm
Churchill ⁷ et al (2001)	Male 200 Female 144	37.5±2.2mm 32.6±1.8mm
Luis Rios Frutos ⁸ (2002)	Male-65 Female 38	36.08±2.0mm 31.17±1.7mm
Ozer et al ⁹ (2006)	Male 94 Female 92	38.71±2.71mm 33.79±3.08mm
Karelse et al ¹⁰ (2007)	40	35.9±3.6mm
Present study	Right 104 Left 120	33.68±4.32mm 32.09±4.11mm

Figure 6: Table 7 :

9

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

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

Observers	% of glenoid with notch (inverted comma + pear shaped)	% of glenoid without notch (oval)
Prescher A and Klumpen T (1997)	Right + left -55%	Right + left -45%
Present study (2011)	Right -81.74% Left-77.5%	Right -18.27% Left-22.5%

VII.

Figure 7: Table 9 :

- [Wilde ()] , De Wilde , LF . 2004. 26 p. . (about the variability of the shape of the glenoid cavity. Surgical radiological anatomy)
- [Pfahler ()] 'Age-related changes of the glenoid labrum in normal shoulders'. M Pfahler . *Journal of shoulder and Elbow surgery* 2003. 12 p. .
- [Cooper ()] *Anatomy, Histology and Vascularity of the glenoid labrum. The journal of bone and joint surgery*, D E Cooper . 1992. p. .
- [Determination of sex from the clavicle and scapula in a Guatemalan contemporary rural population The Americal journal of Forensic medicine and Pathology 2002. 23 (3) p. . (Frutos LR)
- [O'brien ()] 'Developmental anatomy of the shoulder and anatomy of the glenohumeral joint. shoulder instability'. S J O'brien . *Skeletal Radiology* 2004. 29 (4) p. .
- [Prescher and Klumpen ()] 'Does the area of the glenoid cavity of the scapula show sexual dimorphism?'. A Prescher , T Klumpen . *Journal of anatomy* 1995. 186 p. .
- [Halder ()] 'Effects of the glenoid labrum and glenohumeral abduction on stability of the shoulder joint through concavity compression'. A M Halder . *The journal of bone and joint surgery* 2001. (7) p. .
- [Breathnach ()] 'Frazer,s Anatomy of the human skeleton, sixth edition'. A S Breathnach . *J and A Churchill Ltd* 1965. p. .
- [Gries ()] 'Glenohumeral articular contact areas and pressures following labral and osseous injury to the anteroinferior quadrant of the glenoid'. P E Gries . *J Shoulder Elbow Surgery* 2002. 11 (5) p. .
- [Sugaya ()] 'Glenoid rim Morphology in recurrent anterior glenohumeral instability'. H Sugaya . *The journal of Bone and joint Surgery* 2003. 85 (5) p. .
- [Churchill ()] 'Glenoid size, inclination, and version: An anatomic study'. R S Churchill . *J Shoulder elbow surg* 2001. 10 p. .
- [Howell and Galinat ()] 'Glenoid-Labral socket. A constrained articular surface'. S M Howell , B J Galinat . *Clinical orthopaedics and related research*, 1989. 243 p. .
- [Richard and Newell ()] 'Gray's anatomy. The anatomical basis of clinical practice. Thirty-nine edition'. L Richard , Newell . *Harcourt publications*, (London) 2005. p. .
- [Jobe et al. ()] 'Gross anatomy of the shoulder'. C M Jobe , M J Coen , C A Rockwood , Jr . *The shoulder*, (Saunders) 2004. p. . (third edition)
- [Chummy and Sinnatamby ()] *Last's anatomy, Regional and applied*, S Chummy , Sinnatamby . 2006. London. p. . (Eleventh edition. Churchill livingstone)
- [Schroeder et al. ()] 'Osseous anatomy of the scapula'. Von Schroeder , H P Kuiper , S D Botte , MJ . *Clinical orthopedics and related research* 2001. (383) p. .
- [Js et al. ()] 'Osteochondral defect of the glenoid fossa: Cross-sectional imaging features'. Yu Js , G Greenway , D Resnick . *Radiology* 1998. 2006. p. .
- [Weishaupt ()] *Posterior glenoid rim deficiency in recurrent (atraumatic) posterior*, D Weishaupt . 2000.
- [Burkhart ()] 'Quantifying glenoid bone loss arthroscopically in shoulder instability'. S S Burkhart . *Arthroscopy* 2002. 18 p. .
- [Ebraheim ()] 'Quantitative anatomy of the scapula'. N A Ebraheim . *American journal of orthopedics* 2000. 29 (4) p. .
- [Itoi (2003)] 'Quantitative assessment of classic bony bankart lesions by radiography and computed tomography'. E Itoi . *Am J Sports Med* 2003. Jan-Feb. 31 (1) p. .
- [Edwards et al. ()] 'Radiographic analysis of the bone defects in chronic anterior shoulder stability'. T B Edwards , A Boulahia , G Walch . *Arthroscopy* 2003. 19 p. .
- [Mallon ()] 'Radiographic and geometric anatomy of the scapula'. W J Mallon . *Clinical orthopedics* 1992. 277 p. .
- [Ozer ()] 'Sex determination using the scapula in medieval skeletons from east Anatolia'. Ozer . *Coll.Antropol* 2006. 2006. 30 p. .
- [Tuite ()] 'Sublabral foramen and Buford complex: inferior extent of the unattached or abscent labrum in 50 patients'. M J Tuite . *Radiology* 2002. 223 p. .
- [Fehringer ()] 'The anteroinferior labrum helps center the humeral head on the glenoid'. E V Fehringer . *Journal of shoulder and Elbow surgery* 2003. 12 p. .
- [Prescher and Klumpen ()] 'The glenoid notch and it's relation to the shape of the glenoid cavity of the scapula'. A Prescher , T Klumpen . *Journal of Anatomy* 1997. 190 p. .

- 197 [Iannotti ()] 'The normal glenohumeral relationship'. J P Iannotti . *Journal of Bone and Joint surgery* 1992. p. .
- 198 [Karelse et al. ()] 'The Pillars of the scapula'. A Karelse , L Kegels , De Wilde L ; Rockwood , C A Jr . *The*
- 199 *shoulder*, (Philadelphia) 2007. WB Saunders. 20 p. . (third edition)
- 200 [Pavlov ()] 'The Roentgenographic evaluation of anterior shoulder instability'. H Pavlov . *Clinical orthopedics*
- 201 *and Related research* 1985. 194 p. .
- 202 [Anetzberger and Putz ()] 'The Scapula principles of construction and stress'. H Anetzberger , R Putz . *Acta*
- 203 *Anat Basel* 1996. 156 p. .
- 204 [Burkhart and Beer ()] 'Traumatic glenohumeral bone defects and their relationship to failure of arthroscopic
- 205 bankart repairs: Significance of the inverted-pear glenoid and the humeral engaging Hill-Sachs lesion'. S S
- 206 Burkhart , De Beer , JF . *Arthroscopy* 2000. 16 p. .