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GEOMETRIC MORPHOMETRY OF GLENOID CAVITY IN DRY ADULT SCAPULA AND ITS RADIOLOGICAL, SURGICAL,ORTHOPAEDIC AND ANTHROPOMETRIC SIGNIFICANCE

Anatomy

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ABSTRACT

Introduction: Morphometric study of variable shape and size of Glenoid cavity of scapula was done. As Anatomy of Glenoid cavity is important for orthopaedic surgeons, radiologists and prosthetic designers. The curvature of glenoid rim differs with morphology of glenoid labrum. Anatomical variations of glenoid cavity are important for understanding the various pathologies involved in surgical cases(1). Detailed anatomy and morphometry of the scapula were obtained to provide scapular Anatomy and functions, describe its radiological features, co relating with information for surgical procedures such as hardware fixation, Laterjet surgery, drill hole placement, arthroscopic portal placement, and prosthetic positioning. Glenoid cavity dimensions were taken in three different planes-supero-inferiorly,antero-posteriorly above and below.(2)

KEYWORDS

Materials and Methods:
Glenoid cavity of scapula in 50 dry human scapulae irrespective of age and sex was done. The study was conducted at Apollo Institute of Medical Sciences,Hyderabad,Telangana State,India. Only bones with clear and intact features were used for the study while damaged scapulae were not used. Morphological evaluation and morphometric measurements for glenoid cavity were done in each scapula. All linear measurements (in millimeters) were ascertained by using digital Vernier caliper (accuracy 0.01mm). The tracing of the shape of the glenoid cavity was taken on a white paper with the help of a lead pencil. (5) Three types of glenoid were found on the basis of tracings drawn: (a) Pear shape (b) Inverted comma shape and (c) Oval shape. The three glenoid diameters measured were the superior-inferior diameter, antero-posterior diameter (AP-I) of lower half and antero-posterior diameter (AP-II) of upper half of the glenoid cavity. The morphometric values were analyzed statistically by using unpaired t-test.

Fig.1: Digital Vernier Caliper

Fig.2: Showing measurement of the Superior- Inferior (SI) Glenoid Diameter

Fig.3:Showing measurement of the Anterior-Posterior (AP) Glenoid Diameter

$$\text{Glenoid Cavity Index (GCI)} = \frac{\text{Antero-posterior glenoid diameter 1x100}}{\text{Supero-inferior glenoid diameter}}$$

The results were documented by photographs.

RESULTS:

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

side	range	Mean ±SD	Statistical significance
Right	31.04 to 40.52mm	36.24±3.02 mm	t = 0.20 P = 0.84
Left	29.06 to 43.80 mm	36.24±3.02 mm	

Table 1 shows SI diameter of glenoid cavity on the right side varies from 31.04 to 40.52mm, with an average of 36.24±3.02 mm and on left side varies from 29.06 to 43.80 mm, with an average of 36.24±3.02 mm.

Table 2: AP1diameter of right and left side glenoid cavity

side	range	Mean ±SD	Statistical significance
Right	19.94 to 30.12mm	25.04±2.02 mm	t = 0.36 P = 0.71
Left	18.96 to 30.20 mm	26.24±2.02 mm	

Table 2 shows AP1 diameter of glenoid cavity on the right side varies from 19.94 to 30.12 mm, with an average of 25.04±2.02 mm and on left side varies from 18.96 to 30.20 mm, with an average of 26.24±2.02 mm.

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

side	range	Mean ±SD	Statistical significance
Right	13.96 to 21.12mm	16.94±2.14 mm	t = 0.61 P = 0.54
Left	12.86 to 21.20 mm	18.04±1.08mm	

Table 3 shows AP2 diameter of glenoid cavity on the right side varies from 13.96 to 21.12 mm, with an average of 16.94±2.14 mm and on left side varies from 12.86 to 21.20 mm, with an average of 18.04±1.80 mm.

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	5	20%	4	16%
Pear	14	56%	12	48%
Inverted comma	6	24%	9	36%

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

25 scapulae 5(20.00%) oval shaped, 14(56%) pear shaped, 6(24%) inverted comma shaped glenoid cavity found. On left side out of 25 scapulae 4(16%) oval shaped, 12(48%) pear shaped, 9(36%) inverted comma shaped glenoid cavity were found(6).

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

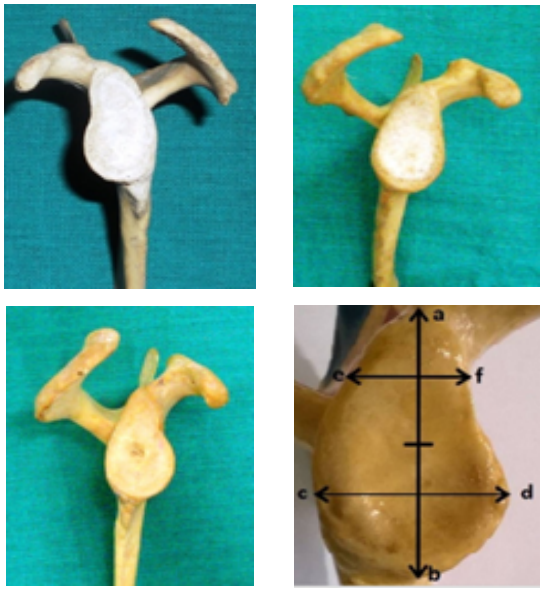
side	range	Mean ±SD	Statistical significance
Right	58.96 to 76.12mm	68.94±4.14 mm	t = 0.80
Left	58.86 to 74.20 mm	68.04±3.98mm	P = 0.40

Table 5 shows the glenoid cavity index, on the right side varies from 58.96 to 76.12 mm, with an average of 68.94±4.14 mm and on left side varies from 58.86 to 74.20 mm, with an average of 68.04±3.98 mm.

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 36.24±3.02 mm and the average superior-inferior diameter of the left glenoid was 36.24±3.02 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 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 25.04±2.02 mm and on left side was 26.24±2.02 mm. The combined average of both sides was 25.60 ± 2.06mm. 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, 25.60 ± 2.06mm. 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 25.60 ± 2.02mm. In the present study the average AP2 diameter of glenoid cavity on the right side was 16.94±2.14 mm and on left side was 18.04±1.08mm 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, 56% pear, 24% inverted comma shaped glenoid cavity found on right scapula. 16% oval, 48% pear, 36% 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% 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 68.94±4.14 mm and on left side68.04±3.98 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.

Fig.4 SHAPES OF THE GLENOID CAVITY-PEAR, OVAL, INVERTED COMMA,DIMENSIONS OF GLENOID SI,AP1,AP2.



Author	Year	No. of Specimen	Mean SI Diameter(mm)	Mean AP Diameter(mm)
von Schroeder et al[8]	2001	30	36 ± 4	29± 3
Frutos LR [14]	2002	Male-65	36.08 ± 2.0	26.31 ± 1.5
		Female-38	31.17 ± 1.7	22.31±1.4
Taser F & Basaloglu H [15]	2003	Male-13	37.1±3.4	26.6±2.1
		Female-39	34.1±2.9	25.0±2.7
Ozer et al [16]	2006	Male-94	38.71 ± 2.71	27.33 ± 2.4
		Female-92	33.79 ± 3.08	22.72 ± 1.72
Coskun et al [9]	2006	90	36.3 ± 3	24.6 ± 2.5
Karelse et al [10]	2007	40	35.9 ± 3.6	27.2 ± 3.0
Mamatha et al[11]	2009	Right-98	33.67 ± 2.82	23.35 ± 2.04
		Left-104	33.92 ± 2.87	23.02 ± 2.30
Rajput et al [12]	2012	Right-43	34.76±3	23.31±3.0
		Left-57	34.43±3.21	22.92±2.80
Kavita et al [13]	2013	Right-67	35.2±3.0	25.0±2.7
		Left-62	34.7±2.8	24.9±2.4
Present Study	2018	Right-25	36.24±3.02 mm	25.04±2.02 mm
		Left-25	36.24±3.02 mm	26.24±2.02 mm

CONCLUSION:

This study of basic anatomic geometry defines the anatomic relationships of the proximal humerus and glenoid cavity that allow for a precise bone-implant fit and assesses the match between the shape of existing components and the patient's anatomy. It also concludes that the shape and size of glenoid cavity do not only vary in races but also in samepopulation .Hence, this information is valuable for the surgeons during operations around shoulder joint. Glenoid morphology measurements are useful for patients with primary glenohumeral osteoarthritis. The goal is to adapt the design of current glenoid implant components, as needed, based on morphological data on a larger scale. This is especially important for the radius of curvature of the bone/implant interface. It should be as close as possible to the radius of

curvature of the native pathological glenoid to preserve an optimal amount of subchondral bone during reaming. Radiology processing methodology also allows us to continue developing tools to help with 3D preoperative planning, as some have already advocated and tools for intraoperative navigation during total shoulder arthroplasty.The standard available smallest glenoid component in the market is 40mm which may not fit the glenoid in our study population. 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 for total shoulder arthroplasty in this population. 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 will help the orthopedicians, prosthetists and 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 will be under taken in future.

REFERENCES

[1]. Standring S., Gray's Anatomy- Anatomical basis of clinical practice, 39th ed., p. 819-820.
[2]. Breathnach AS. Frazer's Anatomy of the Human Skeleton.6th ed. London: J and A Churchill Ltd; 1965;63-70.
[3]. Prescher A, Klumpen T. The glenoid notch and its relation to the shape of the glenoid cavity of the scapula. J Anat 1997;190(3):457–60.
[4]. Churchill RS, Brems JJ, Kotschi H. Glenoid size, inclination, and version: An anatomic study. J Shoulder Elbow Surg 2001;10(4):327–32.
[5]. Chummy S Sinnatamby. Last's anatomy, Regional and applied. Eleventh edition. Churchill livingstone (London).2006:50-52.
[6]. Iannotti JP, Gabriel JP, Schneck SL, Evans BG, Misra S. The normal glenohumeral relationships. An anatomical study of one hundred and forty shoulders. J Bone Joint Surg Am 1992;74:491-500.
[7]. Von Schroeder HP, Kuiper SD, Botte MJ. Osseous anatomy of the scapula. Clinical orthopedics and related research, 2001;383:131-139.
[8]. Frutos LR. Determination of sex from the clavicle and scapula in a Guatemalan contemporary rural indigenous population. Am J Forensic Med and Pathol. 2002;23:284-8.
[9]. Taser F, Basaloglu H. Morphometric Dimensions of the Scapula. Ege Journal of Medicine 2003;42(2):73- 80.
[10]. Coskun N, Karaali K, Cevikol C, Demirel BM, Sindel M. Anatomical basics and variations of the scapula in Turkish adults. Saudi Med J 2006;27(9):1320-5.
[11]. Karelse A, Kegels L, De Wilde L. The pillars of the scapula. Clin Anat 2007;20:392-9.
[12]. Mamatha T, Pai SR, Murlimanju BV, Kalthur SG, Pai MM, Kumar B. Morphometry of Glenoid Cavity. Online J Health Allied Scs 2011;10(3):1-4.
[13]. Rajput HB, Vyas KK, Shroff BD. A Study of Morphological Patterns of Glenoid Cavity of Scapula. Natl J Med Res 2012;2(4):504-7.
[14]. Patil GV, Kolagi SI, Ramdurg U. Morphometrical study of scapular glenoid cavities. Global Journal of Medical Research: Orthopedics and Musculoskeletal system. 2014;14(2):9-14.
[15]. Polguj M, Jedrzejewski KS, Podgorski M, Topol M. Correlation between morphometry of the suprascapular notch and anthropometric measurements of the scapula. Folia Morphol 2011;70(2);109-15.
[16]. Dhindsa GS, Singh Z. A study of morphology of glenoid cavity. Journal of Evolution of Medical and Dental Sciences. 2014;3:7036-43.
[17]. Sinnatamby CS. Last's Anatomy, Regional and Applied. 11th ed. London: Churchill Livingstone; 2006. p. 50-52.
[18]. Anetzberger H, Putz R. The scapula: principles of construction and stress. Acta Anat Basel 1996;156:70-80.
[19]. Yu JS, Greenway G, Resnick D. Osteochondral defect of the glenoid Fossa: Cross-sectional imaging features. Radiol 1998;206:35-40.