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Study of morphology of glenoid cavity of scapula; done on dry bone specimen in the department of anatomy of MGM medical college Jamshedpur

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Abstract
Introduction: Glenoid cavity of scapula is of variable shape and therefore its anatomy has got importance for orthopaedic surgeon and prosthetic designers. Presence of notch in the antero-superior part of glenoid rim affects its morphology. Variations in shape of glenoid cavity are also important for understanding the various pathologies involving the shoulder joint. Present study aims to determine various anthropometric parameters of scapula and glenoid cavity including the variations of its shape.
Materials and Methods: A total of 60 dry scapulae available in the Department of Anatomy were taken for the study.
Results: The mean length and breadth of scapula observed were 138.94±11.76 mm 102.65±6.82mm respectively. The mean length of the glenoid observed in the was 36.78±3.02 mm. The mean AP glenoid diameter 1 and 2 were 22.93±2.54mm and20.62±2.13 mm respectively. The mean Glenoid cavity Index (GCI) found in the present study was 66.29 ± 9.79 mm.
Conclusion: The dimensions of the glenoid observed in the present study were similar to those recorded in the studies done on other populations.

Keywords: scapula, scapular length, scapular breadth, glenoid cavity, glenoid cavity index

Introduction
Scapula is a flat triangular bone situated on the posterolateral aspect of thoracic wall between second and seventh rib. On Superolateral side of the scapula there is a glenoid cavity for articulation with the head of the humerus. The Glenoid cavity has a variable morphology. Due to the Presence of a notch in its antero-superior side of glenoid rim, various shapes of glenoid cavity are observed like pear-shaped, oval or inverted comma shape [1, 2, 3]. The vertical diameter of the glenoid cavity is the longest and it is wider below than above. The shoulder joint is the most frequently dislocated joint in the body. Dislocations with fractures of the glenoid are also quite common in trauma. The variations of shape and size of glenoid cavity of scapula is of importance in understanding the rotator cuff disease, shoulder dislocation and to decide the proper size of the glenoid component in the shoulder arthroplasty.
The aim of the present study was to obtain anthropometric data of scapula and glenoid cavity specifically the diameters of the glenoid cavity and to study various shapes of glenoid cavity relevant to north Indian population which will help in better understanding and management of Shoulder pathology.

Materials and Methods
A total of 60 adult dry scapulae available in the Dept. of Anatomy, were taken for the study. The age and sex of the bones were not known. Out of these 28 scapulae were of left side and 32 were of right side. Those scapulae which were found to be damaged at the glenoidal end were excluded from the study. All the measurements were carried out with the help of vernier calipers by placing the instrument directly on the surface of scapula and glenoid cavity. The measurements were recorded in millimeters.

The following morphometric measurements of scapula and glenoid were taken
Maximum Scapular length: It was taken from point 'C' at summit of superior angle to point 'D' at summit of inferior angle. The points, 'C' & 'D' were marked on white sheet of paper fixed on the osteometric board.

Maximum Scapular breadth
It was taken from point 'A' i.e. middle of the outer border of glenoid cavity to point 'B' where the spine intersects the vertebral border.

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, which is also the maximum height of the glenoid cavity.

Anterior-Posterior glenoid diameter 1(AP-1)
Represents the maximum breadth of the articular margin of the glenoid cavity perpendicular to the glenoid cavity height.

Anterior-Posterior glenoid diameter 2(AP-2)
Represents the anteroposterior diameter (breadth) of the top half of the glenoid cavity at the mid-point between the superior rim and the mid equator

Shape of glenoid cavity
The shape of the glenoid cavity was recorded in the following manner. The side of the point of a lead pencil was rubbed along the rim of the glenoid cavity and tracing of the shape of the glenoid cavity was taken by firmly pressing it on a piece of white paper. On the basis of tracings obtained. Three types of glenoids were observed: Type 1or pear shaped, Type 2 or inverted comal, Type 3 or oval.

Glenoid Cavity Index (GCI)
It was calculated from the observed values of SI and AP1 of the glenoid cavity. The formula used for calculating the GCI is:-

$$\frac{\text{Antero-posterior glenoid diameter 1}}{\text{Supero-inferior glenoid diameter}} \times 100$$

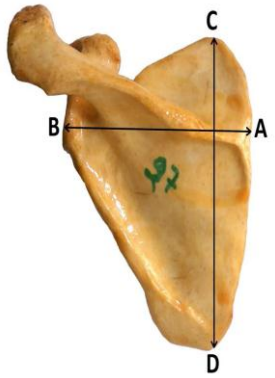

Fig 1: Photograph showing various points on scapula taken for measurements

Result
A total of 60 scapulae were studied. Out of which 28 were of left side and 32 of right side. The mean and standard deviation of the scapula and glenoid cavity in various dimensions and GCI were calculated. The data was analyzed using the SSPS 15. The results of the study are represented as per Table 1.

Maximum Scapular Length
The length of scapula ranged from116 mm to 172 mm. The mean length of scapula and SD observed were 138.94mm and 11.76 mm respectively. It was 137.94±12.76 mm on the left side and 137.93±12.88 mm on the right side.

Maximum Scapular Breadth
The breadth of scapula ranged from 84.5 mm to 123 mm. The mean and SD were 102.65 and 6.82 mm respectively. The average breadth of scapula observed was 102.76±7.16 mm on left side and 102.64± 6.41 mm on right side.

Supero-Inferior glenoid diameter (SI)
The mean SI glenoid diameter observed in the present study was 36.77mm with a SD of 3.03 mm. The SI diameter of left glenoid varied from 32.33 mm to 44.7 mm with a mean of 38.07±3.22 mm while the right glenoid varied from 32.5 mm to 42.5 mm with a mean of 38.27±3.08 mm.

Antero-Posterior glenoid diameter 1(AP- 1)
The mean AP glenoid diameter 1 was 23.93±2.55 mm. On the left it varied from 19.04 mm to 31.62mm with a mean of 22.85±2.44 mm and on right side it varied from 19.48 mm to 32.89 mm with a mean of 24.04±2.67 mm.

Antero-Posterior glenoid diameter 2 (AP-2)
The mean AP glenoid diameter 2 was 17.66± 2.14 mm

Fig 2: Photograph showing various shapes of the glenoid cavity

It varied from 15.96 mm to 25.09 mm on the left side with a mean and standard deviation of 18.6 mm and 2.07 mm respectively. On the right side it varied from 13.32 to 21.70 mm with a mean and SD of 19.70± 2.23 mm.

Shape of glenoid cavity
In the present study 54.92% (15) scapulae on the left had glenoid cavity of the shape of pear while on the right side this shape was found only in 47.2% (15). Next in order of frequency was oval shape which was found in 32.4%(9) scapulae on left side and 30.9% (10) on right side. The least common type of shape encountered in the present study was inverted comma type which was observed in 12.6% (04) scapulae on left side and 21.82% (07) on right side. (Table 1)

Glenoid Cavity Index (GCI)
The correlation between breadth and length of glenoid is expressed as glenoid cavity index which range from 62.5 to 89.6. The mean Glenoid cavity Index (GCI) was 65.08±4.44 mm. It was 70.67±3.76 mm on the left side and 62.81±5.11 mm on the right side.

Table 1: Showing the various shapes of the glenoid cavity.

Shape	Left Side	Right Side
1 Pear shaped	15(54.92)	15(47.28)
2 Oval	9 (32.40)	10 (30.90)
3 Inverted comma	4 (12.68)	7 (21.82)

Discussion
In this study various dimensions of scapula and glenoid cavity have been measured and compared with other studies. Similar studies have been carried out by several other authors also where they have attempted to determine the scapula and glenoid diameters on different.

Table 2

S. No.	Measurements	Total mean + SD	Lf mean +SD	Rt mean +SD
1	Length of scapula	138.94 ± 11.76	137.94.94 ± 12.76	137.93 ± 12.88
2	Breadth of scapula	102.65 ± 6.82	102.76 ± 7.16	102.64 ± 6.41
3	SI glenoid diameter	36.77 ± 3.03	38.07 ± 3.22	38.27 ± 3.08
4	AP glenoid diameter 1	23.93 ± 2.55	22.85 ± 2.44	24.04 ± 2.67
5	AP glenoid diameter 2	17.66 ± 2.14	18.6 ± 2.07	19.70 ± 2.23
6	Glenoid cavity Index	65.08 ± 4.44	70.67 ± 3.76	62.81 ± 5.11

Populations. This has been performed by direct measurements of dry scapulae. On comparing data of the present study with that obtained by several authors several differences as well as similarities in the measurements of scapula and glenoid cavity were observed. This may be due to population variation and measurement techniques.

Maximum Scapular Length

The findings of the present study coincided with the values obtained by Singhal *et al.* [7] in Gujarati population & Krishnaiah *et al.* [8] in people of Nalgonda region where they found a mean length of 141.7±8.9 mm and 143.27±11.44 mm respectively. However the findings of the present study were quite different when compared to studies done by Flower W H [9] on European race where he found an average length of 155.54 mm. Thus the scapular length of European region is higher than that of our study. This may be due to population variation.

Maximum Scapular Breadth

The mean scapular breadth found in the present study was very similar to those observed by Krishnaiah *et al.* [8] in Nalgonda region & Flower WH [9] on European population where they found an average breadth of 101.42 mm & 105.6 mm respectively

Supero-Inferior glenoid diameter (SI)

Rajput HB [6] & Mamatha *et al.* [10] have reported the mean values of vertical diameter in the right glenoid cavity as 34.76 mm and 33.67 mm and left glenoid as 34.43 mm and 33.92 mm respectively. Both these values are lower than those obtained in the present study. Kavita *et al.* [11] recorded mean SI diameters of 35.2±3.0 mm on right side and 34.7±2.8 mm on the left side. These values are also lower than those obtained in the present study. Churchill *et al.*, Luis Rios Frutos and Ozer *et al.*, measured the SI diameter of the male and female glenoid separately. The average SI diameter of the male glenoid measured by Churchill *et al*., was 37.5±2.2 mm, by Luis Rios Frutos was 36.08±2.05 mm and that measured by Ozer *et al.*, was 38.71±2.71 mm. The SI diameter of the female glenoid measured by these three authors was 32.6±1.8 mm, 31.7±1.7 mm and 33.79±3.0 mm respectively [12-14]. All these three measurements on female glenoids were significantly lower than that reported in the present study. The findings of the present study were more or less in consonance with the measurements done by these authors on the male scapula. In their study side of scapula was not mentioned but in our study sex of the scapula was not known.

Antero-Posterior glenoid diameter 1(AP-1)

The mean AP glenoid diameter 1 in the present study was 23.93±2.55 mm. It was 22.85±2.44 mm on the left side and 24.04±2.67 mm on right side. This suggests that the right glenoid was broader than the left. Kavita *et al.* [11] found combined mean AP glenoid diameter 1 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. These findings are quite similar to what was recorded in the present study

Anterior-Posterior glenoid diameter 2 (AP-2)

In the present study the mean AP diameter 2 of left side was 18.6± 2.07 mm and on the right side it was 19.70±2.23 mm. The Anterior-Posterior diameter 2 (AP-2) of the upper half of the right glenoid observed by Rajput HB [6] & Mamatha *et al.* [10] was 15.10±2.54 mm and16.27+2.01 mm while that of the left glenoid was 13.83±2.45 mm & 15.77+1.96 mm. Both these values were lower than what was observed in the present study. Kavita *et al.* [11] found a mean width taken of the upper half of right glenoid cavity at 16.8±1.3 mm and left glenoid as 16.3±2.0 mm which was also quite different from the values recorded in the present study. The combined AP diameter 2 in the present study was 18.66±2.13 mm. This was much lower than what was observed by Iannotti *et al.* [15] at 23±7.7 mm. By observing the tables in the discussion it can be implied that the values observed in the present study, though coinciding with that of some of the studies are mostly more than that recorded by many of the observers.

Shape of Glenoid cavity

In the present study 54.92% (15) scapulae on the left had glenoid cavity of the shape of pear while on the right side this shape was found only in 47.2% (15).Next in order of frequency was oval shape which was found in 32.4%(9) scapulae on left side and 30.9% (10) on right side. The least common type of shape encountered in the present study was inverted comma type which was observed in 12.6% (04) scapulae on left side and 21.82% (07) on right side. (Table 1). In the studies done by Kavita *et al.* [11] pear shaped glenoid cavity was found in 58%. Next in order of frequency in present study was oval shape which was found in 31% on right side and 32% on left side. Rajput HB [6] recorded an incidence of oval shape in 16% and 15% on the right and left glenoids respectively. Mamatha *et al.* [10] recorded an incidence of 20% oval shape on the right side and 24% on left side while Kavita *et al.* [11] found oval type in 30 % of the total samples which more or less coincided with findings of the present study. The least common type of shape encountered in the study was inverted comma type which was observed in 22 % on right side and 13% on left side. Rajput HB & Mamatha *et al.* recorded an incidence of inverted comma shape in 35% & 34%, on right and 39% & 33% on left side. [6, 10] These findings were quite different when compared to those found in the present study.

Glenoid Cavity Index (GCI)

The mean Glenoid cavity Index (GCI) found in the present study was 65.08±4.44 mm. It was 70.67±3.76 mm on the left side and 62.81±5.11 mm on the right side. Dhindsa *et al.*

[16] observed mean of Glenoid cavity Index (GCI) of 70.37±4.08 mm on the right side and 68.59±4.36 mm on the left side.

Conclusion

Knowledge of the shape of glenoid cavity is 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 Bankart lesions and osteochondral defects. Most of the dimensions of the glenoid observed in the present study were more or less similar to those recorded in the studies done on other populations except for the shape. The current study recorded a higher percentage of glenoid cavities without a definitive notch accounting for higher percentage of oval shape as compared to other studies. While evaluating defects/lesions of the glenoid, this fact could be useful. Since the current study was performed on a limited number of scapulae, further studies are indicated.

References

1. Moore KL, Dalley AF, Agur AM. Clinical oriented anatomy. 6th Ed. Lippincott Wiliams & Wilkins Philadelphia, 2010.
2. Standring S, ed. Gray's Anatomy. 40th Ed., New York, Churchill Livingstone, 2008, 794-821.
3. Breathnach AS. Frazer's Anatomy of the human skeleton, 6th ed. London: J and A Churchill ltd, 1965, 63-70.
4. Sinnatamby CS. Last's Anatomy, Regional and Applied.11th ed. London: Churchill Livingstone, 2006, 50-52.
5. Prescher A, Klumpen T. The glenoid notch and its relation to the shape of the glenoid cavity of the scapula. J Anat. 1997; 190:457-460.
6. Rajput HB, Vyas KK, Shroff BD. A study of morphological patterns of the glenoid cavity of scapula. National J of Medical Research. 2012; 2(4):504-7.
7. Singhal *et al*. A study of measurements and indices of human scapula at Jamnagar Medical College. Int J Res Med. 2013; 2(1):65-8.
8. Krishnaiah M, Nagaraj S, Praveen Kumar M, Sherke AR. Study of scapular measurements and scapular indices of Andhra Pradesh region. Journal of dental and medical sciences. 2014; 13(16):117-120.
9. Flower WH, Garson JG. The scapular index as a race character in man. Journal of anatphysiol. 1879; 14(1):13-17.
10. Mamatha T, Pai SR, Murlimanju BV, Kalthur SG, Pai MM, Kumar B. Morphometry of glenoid cavity. Online J Health Allied Scs. 2011; 10(3):7.
11. Kavita P, Jaskaran S, Geeta. Morphology of coracoids process and glenoid cavity in adult human scapulae. IJAPBS. 2013; 2(2):19-22.
12. Churchill RS, Brems JJ, Kotschi H. Glenoid size, inclination, and version: An anatomic study. J Shoulder Elbow Surg. 2001; 10:327-32.
13. 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.
14. Özer I, Katayama K, Sagir M, Gulec E. Sex determination using the scapula in medieval skeletons from East Anatolia. Coll Antropol. 2006; 30:415-419.
15. 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.
16. Dhindsa GS, Singh Z. A study of morphology of glenoid cavity. Jr of Evolution of Medical and Dental sciences. 2014; 3:7036-43.
17. Polguj M, Jêdrzejewski KS, Podgórski M, Topol M. Correlation between morphometry of the suprascapular notch and anthropometric measurements of the scapula. Folia Morphol. 2011; 70:109-115.