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## Morphometric analysis of glenoid cavity in adult human scapulae and its clinical importance

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**Abstract.** *Background:* The glenoid cavity of scapula is quite small, which allows space for only limited fixation devices. Appropriate fixation of the glenoid component of shoulder is of key importance in total shoulder arthroplasty to prevent loosening, which is a common indication of revision surgery. Orthopedic surgeons and prosthetic designers must have a thorough understanding of the glenoid's dimensions and shape, in order to create the finest feasible prosthesis. *Aims and objectives:* To determine the glenoid cavity index (GCI) and the form of the glenoid cavity, as well as the supero-inferior diameter, shortest antero-posterior diameter, and longest antero-posterior diameter. *Materials and methods:* The study was conducted on 50 dry unpaired adult human scapulae of North Indian population obtained from GMC, Srinagar. All the important morphometric parameters were studied using a vernier calliper. *Result:* Supero-inferior diameter, shortest antero-posterior diameter, and longest antero-posterior diameter were found to have respective mean values of 35.06 mm, 15.8074 mm, and 23.3814 mm. Glenoid cavity index had a mean value of 66.68. 42% of the glenoid cavities had an inverted comma shape, 36% had a pear shape, and 22% had an oval shape. *Conclusion:* The results showed that mean supero-inferior diameter of glenoid is about 35mm while the average prosthesis for shoulder arthroplasty in the market starts from 40mm. This suggests that while developing and fitting glenoid components for total shoulder arthroplasty in the North Indian population, it may be necessary to take into account the smaller dimensions of the glenoid cavities.

**Keywords:** clinical anatomy, orthopedics, glenoid, shoulder joint.

### INTRODUCTION

The scapula, or shoulder blade, is located in the postero-lateral portion of the chest wall. In the glenohumeral joint, it articulates with the head of the humerus and the distal end of the clavicle. Careful study of the scapula's measurement is necessary to comprehend the mechanics of rotator cuff disease, total shoulder arthroplasty, and recurrent shoulder dislocation (1). The glenoid cavity, also known as the upper and lateral angle of the scapula, is a pyriform, shallow anterior surface for articulation with the head of the humerus (2). Based on the presence of a notch on the front of glenoid rim, the morpholo-

gies of the glenoid cavity have been categorised into pear-shaped, inverted comma-shaped, and oval-shaped cavities (3)(4). The body's most unstable joint is the glenohumeral joint since it can do a wide variety of movements (5).

It has been proven that full thickness rotator cuff tears are related to glenoid inclination (6). In order to comprehend shoulder dislocations, rotator cuff pathology, and to precisely estimate the glenoid component in total shoulder arthroplasty, variations in the form and size of the glenoid cavity are crucial (6). It also plays a vital role as a prognostic factor in primary gleno-humeral osteoarthritis.

Nowadays, the majority of the implants consist of a range of 3 to 5 sizes, with progressive increments in both height (superior inferior) and width (anterior posterior). However, all these sizes share a common radius of curvature at the bone/implant interface. Based on the findings of anatomical investigations conducted on healthy (non-arthritic) glenoid articular surfaces, the sizes and radii of curvature of these implants were chosen (7).

#### MATERIAL AND METHODS

For the present study, fifty (50) dry, undamaged scapulae were observed in the Department of Anatomy of GMC, Srinagar. Bones with distinct, unaltered traits were used. The age and sex of the scapulae were unknown. Using sliding Vernier callipers, the glenoid cavity's superior-inferior and antero-posterior dimensions were measured. Data was also used to calculate the Glenoid Cavity Index (GCI). Morphological shape of glenoid cavity was recorded as comma shaped, pear shaped and oval shaped. The various dimensions were taken as follows:

**Superio-inferior diameter:** It was determined to be the greatest distance between the most prominent supra-glenoid tubercle point and the most inferior glenoid margin point (designated as AB in Figure 1).

**Antero-posterior diameter 1:** It was determined to be the maximum width of the articular edge of the glenoid cavity, measured perpendicular to the height (designated as CD in Figure 1).

**Antero-posterior diameter 2:** Diameter of the superior half of glenoid cavity at mid-point between the superior rim and mid-equator (designated as EF in Figure 1).

**Glenoid Cavity Index (GCI):** It can be deduced by the following formula:

$$\text{GCI} = \frac{\text{Antero-posterior diameter 1}}{\text{Superio-inferior diameter}} \times 100$$

**Shape of Glenoid:** Placing the paper over the glenoid cavity and firmly holding it there while drawing

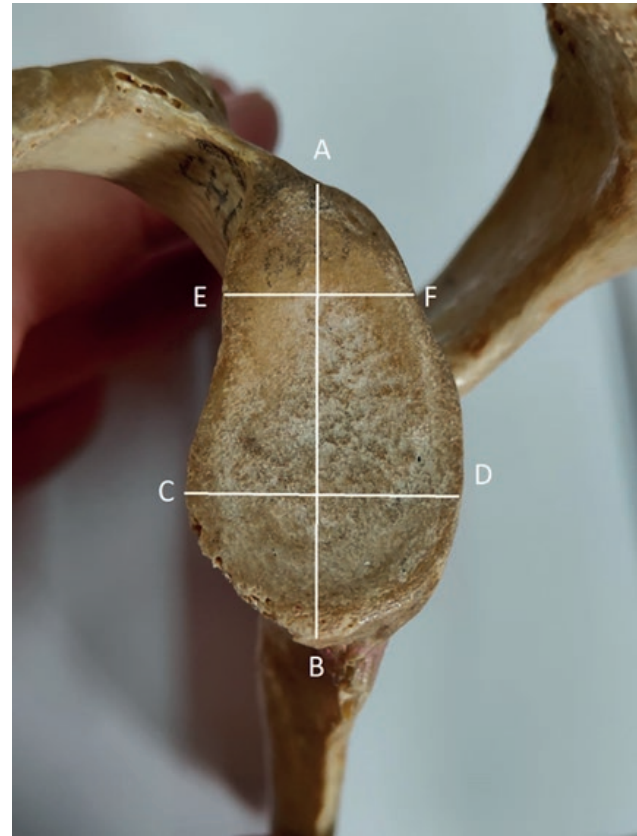


Figure 1. Various parameters of Glenoid cavity taken.

the shape with a pencil allowed the shape to be seen on the plain paper. The three most common shapes seen in the Glenoid are shown in Figure 2.

#### RESULTS

Measurements related to Glenoid cavity dimensions are documented in Table 1. The values observed are presented as mean and standard deviation (mean  $\pm$  SD).

In the present study, the maximum recorded supero-inferior diameter (AB) was 40mm while the minimum diameter was 26mm. The mean diameter came out to be  $34.97 \pm 3.62$ mm. The maximum antero-posterior diameter (CD) at the widest breadth was 28mm while the minimum breadth was 17mm. The mean diameter was  $23.45 \pm 2.69$ mm. The maximum recorded antero-posterior diameter (EF) was 28mm while the minimum recording was 10mm. The mean diameter was  $16.82 \pm 3.06$ mm. The Glenoid Cavity Index was also measured for all the scapulae and the minimum value obtained was 55.2 while the maximum value calculated was 82.3. The shape of glenoid was also observed; the three most common shapes



Figure 2. Various shapes of glenoid seen.

Table 1. Various parameters of Glenoid cavity with their mean and standard deviation.

S. No	Parameters	Number of scapulae	Minimum Value (mm)	Maximum Value (mm)	Mean (mm)	Standard deviation
1.	Supero-inferior diameter (AB)	50	26	40	34.97	3.62315
2.	Antero-posterior diameter 1 (CD)	50	17	28	23.459	2.699162
3.	Antero-posterior diameter 2 (EF)	50	10	28	16.821	3.069968
4.	Glenoid Cavity Index (GCI)	50	55.2	82.3	66.796	6.058884

Table 2. Various shapes of Glenoid cavity with their percentage.

S. No	Shape of the glenoid	Total scapulae	Number	Percentage
1.	Inverted comma shape	50	21	42%
2.	Oval shape	50	11	22%
3.	Pear shape	50	18	36%

seen were inverted comma shaped, pear shaped and oval shaped. Out of 50 scapulae, 21 (42%) were inverted comma shaped, 18 (36%) were pear shaped and 11 (22%) were oval shaped. The various shapes of glenoid recorded are tabulated in Table 2.

## DISCUSSION

In present study the Superio-inferior diameter of glenoid cavity varied from 26mm to 40mm with mean

of 34.97mm. The antero-posterior diameter 1 of glenoid cavity varied from 17mm to 28mm with mean of 23.45mm. The Antero-posterior diameter 2 varied from 10mm to 28mm with the mean of 16.82mm. These values when compared with the data obtained from other countries show that the supero-inferior diameter and the antero-posterior diameter 1 seen in Indian population is lesser than those countries. Coskun et al. (2006) (8) with their study based in Turkish population, shows a mean supero-inferior diameter of 36.3mm, while von Shroeder et al. (2001) (9) shows the mean supero-inferior diameter as 36.4mm in the Canadian population. Cho et al. (2011)(10) also shows a mean supero-inferior diameter of 35.2mm in the Korean population. The parameters seen in comparison with foreign authors are in Table 3.

## CONCLUSION

The glenoid cavity dimensions are required by prosthetic engineers and orthopaedic surgeons to design a

**Table 3.** Comparison of SI diameter and widest AP diameter with foreign authors.

S. No	Authors	Country	Supero-inferior diameter (mm) [AB]	Antero-Posterior diameter (mm) [CD]
1	Coskun et al. (2006) (8)	Turkey	36.3	24
2	Von Schroeder et al. (2001) (9)	Canada	36.4	29
3	Cho et al. (2011) (10)	Korea	35.2	-
4	Present study	India	34.9	23.4

workable and reliable prosthetic for total shoulder arthroplasty. The mean supero-inferior diameter and mean antero-posterior diameter in the present study show a lower value than what is seen in some other countries. This indicates that the prosthetic design for the Indian population needs to be tailored to the specific dimensions to reduce the incidence of failure of the surgery.

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