

## MORPHOMETRY OF GLENOID FOSSA IN ADULT EGYPTIAN SCAPULAE

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### ABSTRACT

**Background:** Knowledge of normal variations in shape and size of the glenoid fossa are required to improve efficacy and minimize failure rates in shoulder arthroplasty, particularly those involving the glenoid component of shoulder joint. Studies concerning glenoid morphometry among Egyptian population are scarce. The objective of the present study was to determine morphological types and diameters of glenoid fossa in adult Egyptian scapulae .

**Material and methods:** A total of 68 dry adult unpaired scapulae of unknown age and sex were randomly selected. The shape and diameters of glenoid fossa in each specimen were recorded and collected data were statistically analyzed.

**Results:** Glenoid fossa revealed a superior - inferior diameter of  $3.31 \pm 0.39$  and  $2.87 \pm 0.41$  centimeters and an anterior - posterior diameter of  $2.44 \pm 0.44$  and  $2.21 \pm 0.44$  centimeters on the right and left sides respectively. The anterior margin of glenoid fossa presented a notch in 76.47% of studied scapulae, and accordingly the fossa was classified into three morphological types; pear-shaped (45.59%), inverted comma-shaped (30.88%) and oval – shaped (23.53%).

**Conclusion:** The documented findings about glenoid fossa in the present study would help to decide the proper size of glenoid component in shoulder arthroplasty among Egyptians. Moreover, approximately one third of Egyptians are liable to Bankart lesion.

**KEY WORDS:** Egyptian scapula, Glenoid fossa, Glenoid cavity, glenoid notch, Shoulder arthroplasty.

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### INTRODUCTION

The lateral angle of the scapula is truncated and bears the glenoid cavity for articulation with the head of the humerus. This part of the bone may be regarded as the head, and it is connected to the plate-like body by an inconspicuous neck [1]. The glenoid cavity of scapula (cavitas glenoidalis scapulae) is called also glenoid fossa of scapula [2]. The glenoid notch (incisura acetabuli) a common finding and not a rare anatomical variant being found in 55% of scapulae from German individuals. When a notch is present in the anterior margin of the glenoid cavity, the

shape of the glenoid cavity can be described as pear-shaped or as inverted comma-shaped. When it is absent, the cavity is round or oval shaped [3].

The glenoid with its variable anatomy, minimal bone stock and inherent instability makes addressing the glenoid one the most difficult procedures in orthopedics [4]. Variations in the size and shape of the glenoid cavity would be helpful for orthopaedic surgeons to decide proper size of the glenoid component in the shoulder arthroplasty and better understanding of the shoulder pathology [5]. Total shoulder

arthroplasty is a common treatment for glenohumeral arthritis, but glenoid loosening, causing postoperative pain, limitation of function and potentially, the need for revision surgery, is one of the most common failure modes of total shoulder arthroplasty [6].

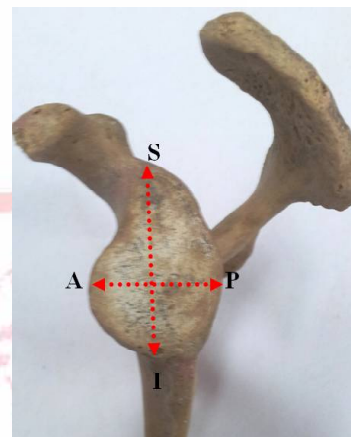
The knowledge of the normal anatomical features and variations in shape and size of the glenoid fossa are required for better understanding of shoulder joint arthroplasty. The present study was done to determine and analyze the morphological types and diameters of the glenoid fossa in adult Egyptian scapulae to improve the efficacy and minimize the failure rates in shoulder arthroplasty particularly those involving the glenoid component of the shoulder joint.

## MATERIALS AND METHODS

In this study, sixty eight adult Egyptian dry unpaired scapulae (38 right and 30 left) were collected from Anatomy Department, Faculty of Medicine, Zagazig University. The selected specimens were of unknown age and sex and did not show any evidence of deformity or pathology. The superior-inferior and the anterior-posterior diameters of glenoid fossa were measured and the glenoid index was calculated as previously described [7]: The superior-inferior glenoid diameter represented the maximum distance from the inferior point on the glenoid margin to the most prominent point of the supraglenoid tubercle and the anterior-posterior glenoid diameter represented the maximum breadth of the articular margin of the glenoid cavity perpendicular to the height of glenoid cavity (fig.1). The glenoid index was calculated through the following equation:  $\text{glenoid width/glenoid length} \times 100\%$ . All measurements were taken to the nearest millimeter using the Vernier sliding caliper which is accurate to 0.1 millimeter. Microsoft office excel 2007 computer program was used to calculate the range, mean, standard deviation of both glenoid diameters and the glenoid index. The slightly raised rim of the glenoid fossa in each scapula was used to define the border of the fossa. The presence or absence of a glenoid notch was used in classifying shape of the

glenoid fossa as previously described [3] into three types; pear-shaped or inverted comma-shape in presence of a glenoid notch or oval in notch absence. The pear shaped has indistinct glenoid notch and the inverted comma shaped has a distinct notch (fig.2). The number and incidence of each type in the studied scapulae was registered and tabulated.

**Fig. 1:** Measurement of the superior-inferior (SI) glenoid diameter and anterior -posterior glenoid diameter (AP).



**Fig. 2:** The glenoid notch (Thick arrow) in the anterior margin of the glenoid fossa divides the glenoid fossa into three shape types: a) Oval-shaped (no notch), b) Pear-shaped (indistinct notch) and c) Inverted comma-shaped (distinct notch).



## RESULTS

The average superior - inferior (SI) diameter of the glenoid fossa on the right and left scapulae was  $3.31 \pm 0.39$  (2.58 – 3.95) and  $2.87 \pm 0.41$  (1.97 – 3.72) centimeters respectively. The average anterior - posterior (AP) diameter of the glenoid fossa on the right and left scapulae was  $2.44 \pm 0.44$  (1.69 – 3.12) and  $2.21 \pm 0.44$  (1.3 – 3.1) centimeters respectively. The average glenoid index (GI) of the right and left scapulae was  $73.67 \pm 9.08\%$  (55.49 – 91.03%) and  $76.71 \pm 8.37\%$  (62.83 – 91.08%) respectively (table 1).

**Table 1:** The superior- inferior (SI) diameter, the anterior-posterior (AP) diameter in centimeters and the calculated glenoid index (GI) in percent (%) of the glenoid fossa in the studied scapulae.

Parameter		Range	Mean	Standard deviation
SI	Right	2.58 – 3.95 cm	3.31cm	0.39
	Left	1.97 – 3.72 cm	2.87 cm	0.41
AP	Right	1.69 – 3.12 cm	2.44 cm	0.44
	Left	1.3 – 3.1 cm	2.21cm	0.44
GI	Right	55.49 – 91.03 %	73.67%	9.08
	Left	62.83 – 91.08%	76.71%	8.37

The border of the glenoid fossa was marked by the slightly raised rim in each fossa and the presence or absence of a glenoid notch was noted. The glenoid notch was found along the anterior margin of the fossa in 52 (76.47%); 29 out of 38 (76.32%) and 23 out of 30 (76.67%) were right and left respectively. The glenoid notch was absent in 16 (23.53%); 9 out of 38 (23.68%) and 7 out of 30 (23.33%) were right and left respectively (table 2). In presence of a glenoid notch, 31(45.59%) were classified as pear shaped due to an indistinct notch and 21(30.88%) were classified inverted comma shaped due to a distinct notch. The pear shaped glenoid fossa was found in 17 out 38 (44.74%) right and in 14 out 30 (46.67%) left, whereas the inverted comma shaped glenoid fossa was found in 12 out of 38 (31.58%) right and 9 out

**Table 2:** The incidence of the glenoid notch in the anterior margin of glenoid fossa in the studied scapulae.

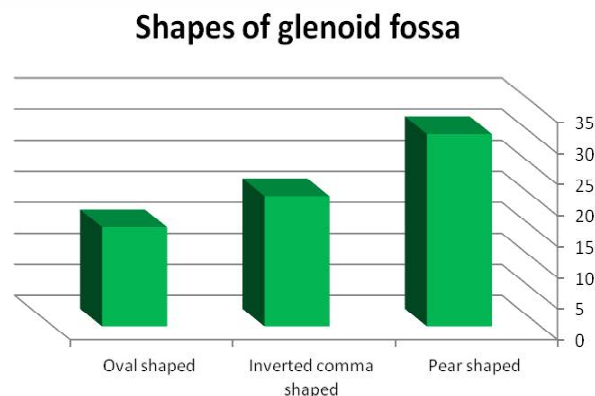
Glenoid notch	Incidence (%)		
	Total	Right	Left
Found	52 (76.47%)	29 (76.32%)	23 (76.67%)
Absent	16 (23.53%)	9 (23.68%)	7 (23.33%)
Total	68 (100%)	38 (100%)	30 (100%)

**Table 3:** The morphological types of the glenoid fossa and their incidence in the studied scapulae.

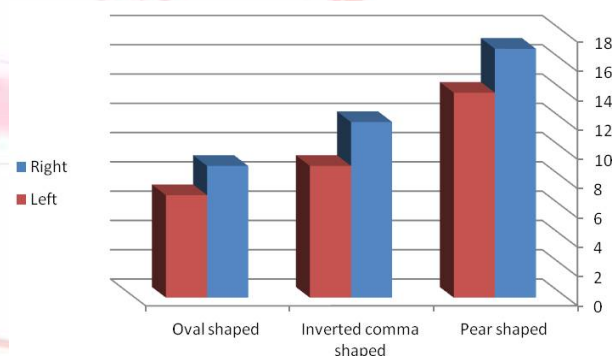
Glenoid shape	Incidence (%)		
	Total	Right	Left
Pear -shaped	31 (45.59%)	17 (44.74%)	14 (46.67%)
Inverted comma -shaped	21 (30.88%)	12 (31.58%)	9 (30%)
Oval -shaped	16 (23.53%)	9 (23.68%)	7 (23.33%)
Total	68 (100%)	38 (100%)	30 (100%)

30 (30%) left. In absence of a glenoid notch, 16 (23.53%) were classified as oval shaped ; 9 out of 38 (23.68%) right and 7 out of 30 (23.33%) left (table 3 and fig. 3 & 4 ).

**Fig. 3:** Incidence of morphological types of glenoid fossa in the studied scapulae.



**Fig 4:** Incidence of morphological types of glenoid fossa in the right and left scapulae.



### DISCUSSION

The present study was done to determine and analyze the morphological types and diameters of the glenoid fossa in adult Egyptian scapulae . In the present study, the average superior - inferior diameter of the glenoid fossa on the right and left scapulae was 3.31 ± 0.39 and 2.87 ± 0.41 centimeters respectively. This finding indicated that the right glenoid values were slightly higher than the left values. In contrast, slightly higher values, particularly on left side, were reported by Mamatha et al [8] in unpaired Indian scapulae. The previous authors described an average superior - inferior glenoid diameter of 33.67 ± 2.82 and 33.92 ± 2.87 millimeters in right and left sides respectively. Moreover, Coskun et al [9] in Turkish population, reported a mean vertical length of the glenoid cavity of 36.3 ± 3 mm, which is much more higher. However, Churchill et al [10] described in scapular bones from combined white and black

rates of the United States of America, a glenoid length of  $37.5 \pm 2.2$  mm and  $32.6 \pm 1.8$  mm in the male and the female respectively. The findings of latter authors, apart from the lower value in females, are higher than those of the present study (table 4).

**Table 4:** The observed superior-inferior (SI) diameter of the glenoid fossa in the present study compared to other studies.

Study	SI diameter
Mamatha et al [8]	Right $33.67 \pm 2.82$ mm
	Left $33.92 \pm 2.87$ mm
Churchill et al [10]	Male $37.5 \pm 2.2$ mm
	Female $32.6 \pm 1.8$ mm
Coskun et al [9]	Mean $36.3 \pm 3$ mm
Present study	Right $3.31 \pm 0.39$ cm
	Left $2.87 \pm 0.41$ cm

In the present study, the average anterior - posterior diameter of the glenoid fossa on the right and left scapulae was  $2.44 \pm 0.44$  and  $2.21 \pm 0.44$  centimeters respectively. This finding indicated that the right glenoid values were slightly broader than the left values. In the study of Mamatha et al [8], the glenoid was similarly broader on the right side, however, the average anterior - posterior diameter was  $23.35 \pm 2.04$  mm and was  $23.02 \pm 2.30$  mm on the right and left sides respectively, which are narrower on the right and broader on the left than the values described in the present study. On the other hand, Churchill et al [10] described a glenoid width of  $27.8 \pm 1.6$  mm and  $23.6 \pm 1.5$  mm in male and female scapulae respectively. In the latter study, glenoid width in female, although slightly wider than the value on the left side, is slightly narrower than that on right side in the present study. On contrary, the male glenoid

**Table 5:** The observed anterior-posterior (AP) diameters of the glenoid fossa in the present study compared to other studies.

Study	AP diameter
Mamatha et al [8]	Right $23.35 \pm 2.04$ mm
	Left $23.02 \pm 2.30$ mm
Churchill et al [10]	Male $27.8 \pm 1.6$ mm
	Female $23.6 \pm 1.5$ mm
Coskun et al [9]	Mean $24.6 \pm 2.5$ mm
Present study	Right $2.44 \pm 0.44$ cm
	Left $2.21 \pm 0.44$ cm

width observed by Churchill et al [10] is much wider than values observed on both sides of the present study. Moreover, Coskun et al [9] reported a mean transverse length of the glenoid cavity of  $24.6 \pm 2.5$  mm, which is very close to the observed value on the right side, but wider than that on the left side of the present study (table 5).

In the present study, the average glenoid index of the right and left scapulae was  $73.67 \pm 9.08$  % and  $76.71 \pm 8.37$  % respectively (table 1). In contrast to this study, Polguy et al [7] described a glenoid index of  $72.3 \pm 5.8$  % in scapulae with longer maximal depth of supra-scapular notch and  $72.4 \pm 5.3$  % in scapulae with longer superior transverse diameter of supra-scapular notch, which are lower than that observed in the present study.

In the present study, the glenoid notch was found along the anterior margin of the fossa in 76.47% and absent in 23.53% of the studied scapulae (table 2). In absence of a glenoid notch the glenoid fossa was classified as oval shaped, whereas in presence of a glenoid notch, 45.59% were classified as pear shaped due to an indistinct notch and 30.88% were classified as inverted comma shaped due to a distinct notch (table 3). Mamatha et al [8] described in scapulae of Indian origin, a distinct glenoid notch in 34% and 33% on the right and left sides respectively, and glenoids were inverted comma-shaped. An indistinct glenoid notch was observed in 46% and 43% on the right and left sides respectively, and glenoids were pear-shaped. Thus, the percentage of glenoids with the glenoid notch, that is, both indistinct and distinct was 80% on the right side and 76% on the left side. In 20% on the right side and 24 % on the left side, glenoids did not show any notch and were oval in shape. The observations of the previous authors are close to the values described in the present study. On the other hand, Prescher and Klumpen [3], in the scapulae of German individuals, described a notch in 55% and gave rise to a pear shaped cavity and absence of the notch in 45% and the shape was oval, which are totally different from those of the present study. In contrast, Coskun et al [9] reported values that are the reverse to the results of the present study; these authors described

absence of glenoid notch in 72% of Turkish scapulae and the glenoid cavity was oval shaped, whereas in 28% the notch was well expressed and the glenoid cavity was pear-shaped. However, in addition to the use of glenoid notch in the morphological classification of glenoid fossa, the presence of a distinct glenoid notch plays a role in shoulder joint stability. Prescher and Klumpen [3] reported that if a distinct notch exists, the glenoid labrum is not attached to bone at the notch and is therefore liable to be sheared off (Bankart lesion). This type of lesion is normally the result of a traumatic anterior shoulder dislocation [11]. In the present study, 30.88% of glenoid fossae were classified as inverted comma shaped due to the presence of a distinct notch indicating that about one third of Egyptians are liable to Bankart lesion.

In conclusion, the documented morphological types and diameters of glenoid fossa in this study would be very beneficial to decide proper size of the glenoid component in shoulder arthroplasty performed to Egyptians. Moreover, approximately one third of Egyptians are liable to Bankart lesion.

**Conflicts of Interests: None**

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