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The Glenoid Cavity: its morphology and clinical significance.

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Abstract

Introduction: Size and shape of the glenoid cavity (GC) of the scapula is directly related to the dislocation of shoulder joint and may affect the results of total shoulder arthroplasty and rotator cuff surgeries. Hence, we planned this study to note the percentage of normal and variable morphology of the glenoid cavity and discuss its clinical correlation in detail. **Methods:** A total of 123 dry human scapulae were included in the study. The maximum length and width of the scapula along with shape of the glenoid cavity were measured. Three measurements for every GC: maximal length, maximum width and transverse diameter at the level of glenoid notch was also observed. **Results:** Of the 123 scapula included, 64 belonged to right and 59 to left side. The maximum length and width of the GC was 38.78 ± 4.43 and 26.97± 3.79 cm respectively. The width of the GC at the level of glenoid notch was 20.2± 3.80 cm. The maximum length and width of the scapula was 136.43±13.31 and 99.14± 8.21 cm respectively. **Conclusions:** These exact measurements of the glenoid cavity will guide the surgeon in selection of appropriate prosthesis during shoulder arthroplasty.

Keywords: scapula, glenoid cavity, morphology, shoulder arthroplasty.

Introduction

Lateral border of the scapula terminates superiorly at glenoid cavity (GC) which articulates with the head of the humerus to form gleno-humeral joint.[1] The articular surface of GC is pear shaped, with its inferior half being 20% larger than the superior half.[2] The GC provides a vertical axis for the movement of the head of humerus during abduction and when the arm is raised to the shoulder height, the head slides into the smaller upper part of glenoid cavity which is deepened by glenoid labrum.[3] The variations in the shape and size of GC and attachment of glenoid labrum at the glenoid notch are important for normal functioning of this most freely movable joint of the human body.

In comma shaped glenoid cavity, the glenoid labrum is not firmly attached to the margins of GC. This arrangement simulates a labral tear, sublabrum foramen or Buford complex during arthroscopy. Sublabral foramen occurs when the antero-superior labrum is congenitally unattached to the adjacent glenoid and is present in almost 12% of individuals. The Buford complex consists of an absent anterosuperior labrum and a thick cord like middle glenohumeral ligament which originates from the superior labrum near the attachment of the long head of biceps tendon. It is present in about 1.5% of individuals.[4]

Hence, knowledge of exact dimensions of the scapula and GC are of fundamental importance in understanding the recurrent shoulder dislocation and patho-mechanics of rotator cuff disease.[1, 3] The parameters of GC are of great importance while planning for prosthetic sizing, positioning and design for total shoulder arthroplasty. Unfortunately, these procedures are not free from complications and the presence of anatomical variations such as bony defects of anterior or posterior rim of glenoid fossa has been reported to increase the risk of failure to achieve full congruency at this joint.[1, 2, 5-8] The purpose of this study is to investigate various morphologic features of scapula and shape of glenoid cavity in dry scapula.

Methods

Data was collected from 123 (64 right and 59 left) dry, unpaired scapula. The age and sex of the scapula were unknown. The scapula maintaining their normal anatomical features were included in the study. The specimens which were partially broken or had any deformity were excluded from the study.

The measurements of the scapula and the articular face of glenoid cavity were taken with the help of sliding vernier calliper with an accuracy of 1 mm, by keeping it directly on the bony surface. The measurements were taken thrice and the mean was taken in order to prevent any observational error.

Measurements of the scapula

The anatomical length of the scapula (i.e. the distance between the highest point of the superior angle and the lowest point of the inferior angle) and the anatomical width (distance from the centre of glenoid cavity to the midpoint between two lips of the spine of scapula) were determined (fig 1).

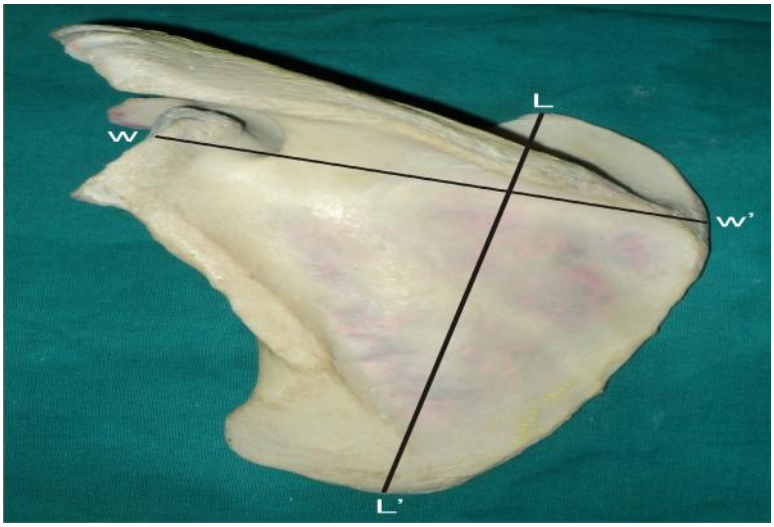

Fig 1. anatomical length and width of the scapula

Measurements of the Glenoid Cavity

a.The shape of the glenoid cavity was observed by lining the outer raised margin of GC (fig 2 a, b, c, d).

b.Length (superior-inferior diameter) was taken from most prominent point on the supraglenoid tubercle to the inferior margin of GC (fig 3 L1).

c.Width (antero-posterior diameter) was measured at two level (fig 3);

i. the maximum width of GC (fig 3 W1)

ii.the width at the level of glenoid notch (fig 3 W2)

The mean and standard deviation of various dimensions were calculated.

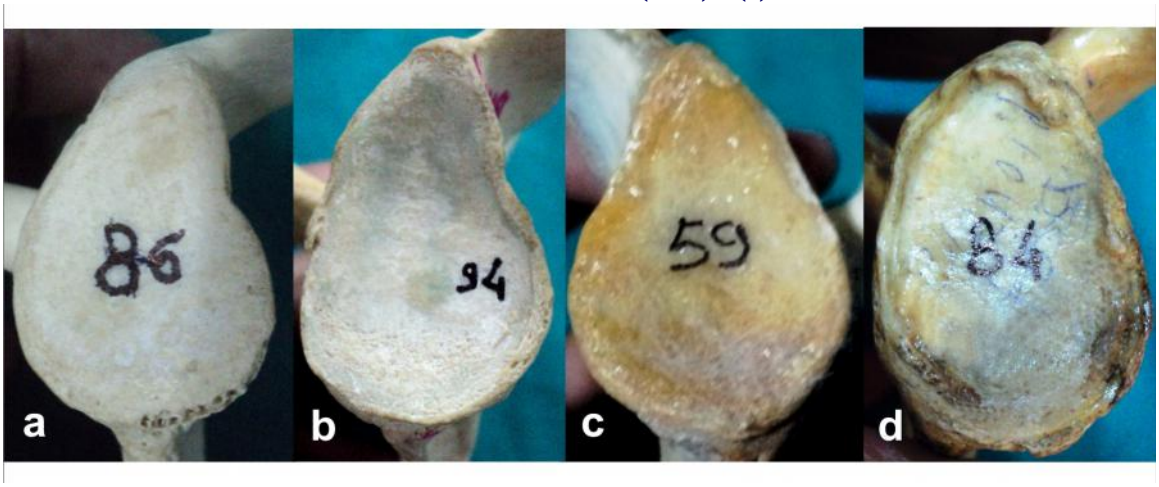

Fig 2. shape of the glenoid cavity

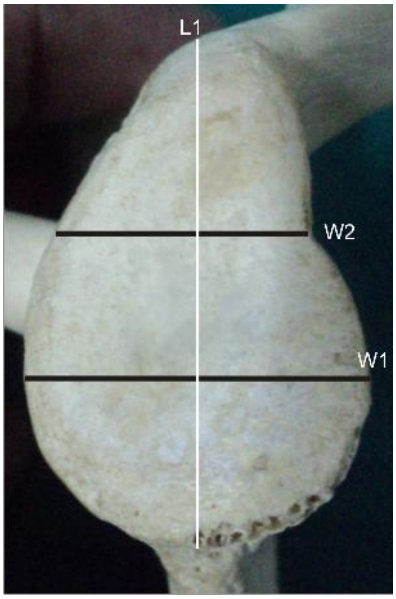

Fig 1. Length and breadth of the supraglenoid tubercle to the inferior margin of GC

Results

Of the 123 scapula included, 64 belonged to right and 59 to left side. The shape of the GC was found as inverted comma, pear, triangular and oval. The most common shape observed was of pear shaped GC in 69 (56.09%) of 123 scapula. 43 (34.95%) were of inverted comma shape, 8 (6.5%) of oval shape and 3 (2.4%) were triangular.

We propose that the shape of glenoid cavity can be classified into five categories depending upon presence of notch along its margins (fig 2; a, b, c, d) .

Type 1: the anterior margin shows a well defined deep notch in its upper one third (inverted comma shaped).

Type 2: the anterior margin shows a less evident notch in its upper one third (pear shaped).

Type 3: both, the anterior and posterior margins of glenoid cavity are indented with evident notches.

Type 4: notch is absent along the margins of glenoid cavity.

Type 5: a variation from the above mentioned morphology of glenoid cavity.

The maximum length varied from 107-164 cm and width of the scapula range from 78-117 cm. The length (L1), maximum width (W1) and width at the level of notch (W2) of glenoid cavity are shown in figure 2 and described in Table 1 and 2.

Table1: Various morphometrical measurements of Glenoid cavity (Fig 3)

Various parameters of glenoid cavity	Range (cm)	Right (n=64) Average with SD (cm)	Left (n=59) Average with SD (cm)
Max Length (L1)	28-53	38.78 ± 4.43	40.30 ± 5.12
Max Width (W1)	17-37	26.47 ± 3.79	27.85 ± 3.86
Width at the level of Glenoid Notch (W2)	14-23	20.28 ± 3.80	21.28 ± 4.33

Table 2: Measurements of Scapula (Fig 1)

Measurements of Scapula	Range (cm)	Right (n=64) (cm)	Left (n-=59) (cm)
Length of Scapula	107-164	136.43 ± 13.31	140.27 ± 13.20
Width of Scapula	78-117	99.14 ± 8.27	102.13 ± 9.99

Discussion

A precise knowledge of normal and variational anatomy of the scapula is of great importance, in order to avoid complications when procedures are performed via open, arthroscopic, or arthroscopically assisted method adjoining shoulder region as well as for obtaining accurate congruency of the glenohumeral joint after total shoulder arthroplasty.[1, 2, 5] Recently, Poppen et al emphasized that abnormal morphology of the glenoid is associated with severe full thickness tears. [5, 6, 8] Luis RF found the maximum length of GC as 31.17 mm whereas in current study we observed this as 40.30 mm. There is significant difference in the size in different part of world as shown in Table 3. The length of GC is an important factor which should be appropriately matched with the size of prosthesis during total shoulder arthroplasty in order to achieve full congruency.[1, 6, 8, 9] Previous studies done on matched cadaveric pairs that only a little variance exists between men and women, but the differences between races are considerable.[5]

Table 3: Comparison of the length (supero-inferior diameter) of glenoid cavity by various authors.

S.no	Authors	Year	No. of Scapula	Supero-inferior diameter(mm)
1.	Iannotti et al	1992	140	39 ± 3.5
2.	Churchill et al	2001	Male-200 Female-144	37.5 ± 2.2 32.6 ± 1.8
3.	Luis Rios Frutos	2002	Male-65 Female-38	36.08 ± 2.0 31.17± 1.7
4.	Mamatha et al	2009	Right-98 Left- 104	33.67 ±2.82 33.92 ± 2.87
5.	Present study	2013	Right-64 Left-59	38.78 ±4.43 40.30 ± 5.12

Table 4: Percentage of distinct notch at Glenoid Cavity: comparison between different countries.

S.no.	Authors	Country	Specimens Studied	Distinct notch present	No notch observed
1.	Prescher A. And Klumpen T.	Germany	236	129 (55%)	107 (45%)
2.	Mamatha et al	India	202	68 (34%)	42(24%)
3.	Maman et al	Brazil	200	161 (79.5%)	39 (19.5%)
4.	Present Study	India	123	69 (56.09%)	8 (6.4%)

Poppen and Walker correlated well the morphology of GC with its function and explained the process of abduction in detail. They mentioned that the head of the humerus slides upward when the arm is elevated, and the lower part of the glenoid receives the humeral head when the arm is lowered. This suggests that the lower larger part of the glenoid cavity is suitable for the head when the arm is lowered and is therefore easily rotated in front of the trunk, while the upper small portion is suitable when the arm is elevated and range of movement is confined at the side of the trunk.[7, 8]

The shape of glenoid cavity is directly related to dislocation at shoulder joint. Presher and Klumper stated that the glenoid labrum in the area of the notch is not fixed to bony margins of glenoid cavity but bridges the notch itself. Many a times a small recess of the joint cavity projects between the glenoid labrum and the anterior margin of GC. Such an attachment of glenoid labrum makes the shoulder joint less resistant to dislocating forces and labral tear and avulsions usually occur at the anterior margin of the GC.[10] In the current study, 56% of specimens were having a deep notch which suggests that in cases of shoulder dislocation, this kind of pathology should be searched for and repaired for good congruency. We propose that the oval shaped GC (fig 2d) are the most stable type as the glenoid labrum is attached all along the borders of glenoid cavity whereas triangular shaped glenoid cavity i.e. type 3 (fig 2c) is more vulnerable for shoulder dislocations as the glenoid labrum is not attached to anterior as well as posterior margins of GC. We found this in 2 (1.62%) cases (fig 2 c) and till now only Coskun et al reported this kind of shape of GC but they did not mentioned the percentage of prevalence.

We conclude that the shape and size of glenoid cavity do not only vary in races but also in same population (table 4). Hence, this information is valuable for the surgeons during operations around shoulder joint.

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