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ORIGINAL ARTICLE

Determination of Dimensions of Glenoid Cavity from other Scapular Parameters

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ABSTRACT
Background: Different pathological conditions are associated with the anatomical variations in glenoid cavity. For getting insights into these variations the anthropometric parameters knowledge is highly required.
Objective: The purpose of the study was the determination of the anthropometric relationship present between the left and right side of the glenoid cavity of the scapula and the application of the obtained knowledge in the forensic medicine.
Place and Duration: In the department of anatomy, Multan Medical and Dental College and Bacha Khan Medical Complex Swabi for six months duration, from January 2021 to June 2021.
Material and Methods: The data of 190 patients included in the study, was collected from the anatomy department of our institute. The sample was withdrawn from the non-deformed and well macerated scapulae bone of the 190 patients. The calibrated sliding digital caliper was used to measure the anthropometric parameters of glenoid cavity. The glenoid height, width and index were calculated by SPSS software.
Results: The 34.8±4.0 (R=38 ± 4.98 and L=27.9-46.78) and 24.9 ±3.90 (R=27.2 ± 3.43 and L=20.1- 36) was the calculated mean standard deviation of Maximum glenoid height (MGH) and Maximum glenoid width (MGW) respectively. The statistically significant and greater values of MGH and MGW on the right side were obtained by using ANOVA and t-test. While calculated values of glenoid Index (GI) was smaller on the right side as compared to the left.
Conclusion: The kinanthropological applications of the scapula are indicated by the study that which side can be more commonly used. This study provides with in-depth knowledge of biological profiling and develops better understanding required during reconstruction of the damaged skeleton.
Keywords: Glenoid cavity, Maximum glenoid height (MGH), Maximum glenoid width (MGW).

INTRODUCTION
Glenoid cavity is also known as glenoid fossa. It is a shallow articular surface. It is present on the lateral side of the scapula. The Glenoid cavity has a longer vertical diameter. The most commonly dislocated joint of the body is the shoulder joint[1-2]. For total shoulder arthroplasty knowledge of glenoid components is necessary. The glenoid cavity has varying morphology. The glenoid fossa and coracoid process are involved in the dimensions of the scapula.

During trauma the dislocations of joints with fractures are highly observed. According to the shape of the glenoid cavity described by the anatomist, it is pear-shaped or teardrop and others described it as inverted comma shape. The prosthetic designers and orthopedic surgeon really look forward to understanding the anatomy of the glenoid cavity[3-4].

This diversity has given origin to the different anthropometric parameters for glenoid shape description. The anterior, posterior and inferior borders of the glenoid cavity are used to locate the center of the glenoid cavity[5-6]. At this center the tubercle of Assaki commonly also known as bare area is present. It is the thickest part of the subchondral bone of the glenoid cavity.

Shoulder instability has been observed in the 2% population of the world. This is the leading musculoskeletal disease of today's community[7]. It is necessary to deeply study the glenoid fossa variations for developing complete understanding of glenohumeral osteoarthritis, shoulder dislocation and rotator cuff disease. The glenohumeral joint (GHJ) is the one of the highly mobile joints in the Homo sapiens. The knowledge about glenoid fossa will help to improve the stability of the GHJ. It is also useful for the selection of the therapy for dislocated shoulder joints[8-9].

The consistent use of one limb compared to the others is defined as the handedness. In this the one limb remains dominant over the other one. The glenoid labrum aids the stability of the glenoid fossa by providing it with variable types of movements[10]. The morphology of the glenoid labrum is highly affected by the presence of a notch in the glenoid rim. The ossification rate and scapular development process vary in the different organisms.

The study was designed to evaluate the anthropometric parameters of scapula mainly focusing on the glenoid cavity[11-12]. The anthropometric parameters that play an important role in defining the skeletal remain handedness. These anthropometric variations also open new doors for the practical explanation of handedness[13].

MATERIAL AND METHODS
The data of 190 patients having non-deformed macerated scapula bone taken from the teaching hospital of our institute were included in the study. The right side glenoid cavity was observed in 82 patients while the other 108 had left side glenoid cavity. According to the exclusion criteria the deformed and poorly macerated bones were excluded from the study. The inclusion criteria was not dependent on the bone pairing. The samples were collected from different anatomy museums. Different universities contributed to the study and provided the sample. The standing clamp was used to tightly hold the scapula. The lateral side of the glenoid cavity was anteriorly facing the clamp.

The Campobasso protocol was used for the collection of the data. The anthropometric parameters were calculated by using calibrated sliding digital calipers. It was calibrated to 0.00 mm. SPSS was used for the statistical calculation of the parameters. The Maximum glenoid height MGH, Maximum glenoid width MGW and glenoid index GI was calculated by SPSS software. T-test and ANOVA was used for obtaining statistical significant values. For lowering the error rates, the twice readings were calculated.

RESULTS
There were total 190 patients taken for this study. 82 of them had a right sided glenoid cavity and the remaining 108 had left sided glenoid cavity. The maximum and minimum height and width of the glenoid cavity was found and tabulated. The significance of the results was measured by using T test and variance analysis to see either the data found is statistically significant or not. The values obtained are shown in the table form. You can see that the mean

of the standard deviation was observed and the range value was studied it came to be from 27-46mm for the right side glenoid cavity and in case of left side cavity the range came out to be from 29-44 the range was almost same in both the cases. Moreover, the width analysis was also carried out and the mean of standard deviation in case of right and left glenoid cavity is 27 and 25.2 respectively. The glenoid index for the right side was 0.78 and for the left side it was 0.071.

Table 1: Features of glenoid cavity of the scapula

Characteristics	Right side =82 mean± standard dev	Range from minimum to maximum	Left= 108 mean ± standard dev	Range	Total =190 mean ± standard dev	Range from minimum to maximum
Max height of glenoid in mm	38 ± 4.98	27.9-46.78	36.77 ± 3.45	29.12 - 44.7	34.8±4.0	29.1-45.2
Max width of glenoid in mm	27.2 ± 3.43	20.1- 36	25.2 ±4.2	16.98-35.1	24.9 ±3.90	18.12-36
Glenoid index	0.78 ± 0.045	0.66-0.90	0.071 ± 0.056	0.56-0.89	0.76±0.066	0.53-0.9

Table 2: Study of statistical significance of the median angle

Features compared	Side of cavity	Test carried out for variance (f, significance)	T test	P value	Mean	Standard error	Inference
Maximum height of the glenoid cavity	R L	2.0,0.156	2.54	0.0148**	1.56	0.587	S
Maximum width of cavity	R L	1.41,0.234	3.55	0.002**	1.879	0.543	S
Glenoid index	R L	2.56,0.172	2.87	0.007**	0.034	0.0078	S

The analysis of the variance and significance was also carried out as shown in table 2. And the results were found to be statistically significant.

DISCUSSION

As per studies carried out by Larson and Alemseged et.al there are two ways by which glenoid fossa size can be measured. The length and width of the fossa can help decide the size of the glenoid fossa. So if the weight or the body stature of the patient is unknown then it can help decide the size of glenoid fossa. Kreiehoff also worked on this topic and found that the orientation or the dimension of the glenoid cavity can be estimated by measuring the angle the glenoid cavity makes with the scapular spine[14-15]. Also one more way to calculate the dimension of the glenoid cavity is to measure the angle between glenoid cavity and lateral border and also it can be measured by finding the angle between median border and glenoid cavity.

The Glenoid cavity acts like a static point in the area of the scapular region so it helps to make detections related to the changes that are produced relative to the glenoid cavity. Osteological convention was described by Buikstra and Ubelaker and it provided information regarding the measurement of the glenoid cavity[16]. They stated that the important thing is to measure the left side of the skeletal muscle but if it is damaged or it has some injury then the right can also be measured. But if there is no injury to the left side then left should be measured and right can be estimated according to the left side[17].

The pairwise relation between right and left glenoid cavity should be carried out in the scapula, mays and Steele region. If you want to know about the headedness, then directional asymmetry is the way to do it. In this study the structural variance between some of the features of the right and left glenoid cavity was measured that can have a strong impact on the anatomy of scapula[18].

As per studies carried out by Gray et.al the majority of the changes in the scapula are related to the headedness. Hopppa along with his colleagues stated that mean variance between right and the left side is due to the asymmetry of the skeletal muscles they did studies on human skeletal growth and found some other interesting facts as well. The headedness can be defined as either use of one hand more than the other by the person or the skill being predominantly present in any one hand more than the other. Both biological and environmental factors play a role in determining such factors. The glenoid cavity is a socket that is shallow from inside. The articular fossa is giving a head for the humerus to reside[19].

The shape of the glenoid cavity is one important aspect as it gives stability to the whole structure. And because of this the humerus can move in a range of movements. The rate of ossifications is different for different individuals. Different people can have different sorts of ossifications and some people can never have ossification as there is maximum fusion of the acromial region to the scapula therefore they suffer from a condition called acromiale[20].

Campobasso et.al made use of all the seven parameters which included length, width, and the relationship between acromion and coracoid process. All the parameters were calculated to find the regression formulae in order to measure scapula features. Campobasso et.al along with his fellows found that the most used formula that can help find regression to predict or propose the height, width, length of the glenoid cavity for female and male members. These studies hold so much importance as they can help find the height of the glenoid cavity in case of forensic investigations by looking at the incomplete bones and the regions of the fragments[21].

The determination of orientation of the glenoid cavity suggests that there is a high rate of variations that exist between left and right side of the glenoid cavity. It plays an important role in determining the handedness of the person.

The anthropometric estimation of the range of differences or variations that are found between the right and the left side of the scapula can help tell us about the handedness in people as well. The brain controls the handedness based on the changes between the left and the right glenoid cavity. So the use of the left and right glenoid cavity plays an important role in deciding the handedness of the person. However, in order to further validate the glenoid cavity attributes playing a role in deciding handedness there is need of further studies as well[22].

CONCLUSION

The determination of orientation of the glenoid cavity from other parameters was carried out and it was found that there is a high rate of variations that exist between left and right side of the glenoid cavity and it plays an important role in determining the handedness of the person.

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