

## Morphologic Evaluation of the Glenoid Cavity on Dry Scapula

### Cavitas Glenoidalis Morfolojisinin Kuru Kemikler Üzerinde İncelenmesi

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#### ABSTRACT

**Aim:** The aim of this study was to determine the notch and shape variations of the glenoid cavity (GC), to emphasize its clinical importance, and compare it with the previous studies.

**Material and Methods:** This study was performed with 157 (78 right sides, 79 left sides) adult Anatolian dry scapulae. The GCs were typed as oval, pear, and inverted comma shaped and noted the number of GC notch.

**Results:** The most common GC shape was found as the pear shaped with 63 (80.8%) at the right side, 49 (62%) at the left side, and 112 (71.4%) in total. The second most common GC shape was found as oval shaped with 13 (16.6%) at the right side, 28 (35.5%) at the left side, and 41 (26.1%) in total. The glenoid notch was found at the right side, left side, and totally; 28 (35.9%), 19 (24.1%), and 47 (29.9%), respectively. All of the inverted comma shaped GCs had distinct glenoid notch, while the oval shaped GCs not. The pear shaped GCs had indistinct glenoid notch or no glenoid notch. The glenoid notch was found at the right side, left side, and totally on the pear shaped GC; 26 (41.3%), 17 (34.7%), and 43 (38.4%), respectively.

**Conclusion:** Pear shaped GC was found as the most (71.4%) common shape in this study. Forty-seven (29.9%) of the scapulae had a glenoid notch. The notch and shape variations of the GC are important and this study will contribute to anatomists, orthopedists, and radiologists from this perspective.

**Keywords:** Scapula; glenoid cavity; notch; shape.

#### ÖZ

**Amaç:** Bu çalışmanın amacı, cavitas glenoidalis (CG) çentik ve şekil varyasyonlarını ortaya koymak, klinik önemini vurgulamak ve daha önceki çalışmalarla karşılaştırmaktır.

**Gereç ve Yöntemler:** Bu çalışma, erişkin Anadolu popülasyonuna ait 157 (78 sağ taraf, 79 sol taraf) kuru scapula ile yapıldı. CG'ler oval, armut ve ters virgül şeklinde tiplendirildi ve CG çentik sayısı not edildi.

**Bulgular:** En sık görülen CG şekli, sağ tarafta 63 (%80,8), sol tarafta 49 (%62) ve toplamda 112 (%71,4) ile armut şeklinde CG olarak bulundu. İkinci sıklıktaki CG şekli ise sağ tarafta 13 (%16,6), sol tarafta 28 (%35,5) ve toplamda 41 (%26,1) ile oval şekilli CG olarak bulundu. Glenoid çentik sağ taraf, sol taraf ve toplamda sırası ile 28 (%35,9), 19 (%24,1) ve 47 (%29,9) olarak tespit edildi. Ters virgül şekilli CG'lerin tamamında belirgin glenoid çentik varken oval şekilli CG'lerde ise yoktu. Armut şekilli CG'lerde belli belirsiz glenoid çentik vardı veya hiç glenoid çentik yoktu. Armut şekilli CG'de glenoid çentik sağ taraf, sol taraf ve toplamda sırası ile 26 (%41,3), 17 (%34,7) ve 43 (%38,4) olarak tespit edildi.

**Sonuç:** Bu çalışmada en sık (%71,4) armut şekilli CG bulunmuştur. Scapularların 47 (%29,9) tanesinde glenoid çentik vardı. CG'nin çentik ve şekil varyasyonları önemlidir ve bu çalışmanın anatomistler, ortopedistler ve radyologlara bu açıdan katkıda bulunacağı düşünülmektedir.

**Anahtar kelimeler:** Scapula; cavitas glenoidalis; çentik; şekil.

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## INTRODUCTION

The scapula is a flat, triangular bone located between the 2<sup>nd</sup> to 7<sup>th</sup> ribs at the posterolateral to the thorax wall. The glenoid cavity (GC), which is the upper end of the lateral border of the scapula, articulates with the head of the humerus (1). The articular surface of the GC is covered with hyaline cartilage and the borders of the joint surface are the attachment points for the glenoid labrum (2). The glenoid labrum is a fibrocartilaginous structure and increases the depth of the articular surface (3). GC has a notch at the anterosuperior border of the articular surface and this notch affects the shape of the GC (4). If the notch is distinct, it is classified as inverted comma shaped, otherwise it is oval shaped, if it is indistinct, it is classified as pear shaped GC (3,4). GC shape differences may also differ between populations and studies performed within the same population (5).

The aim of this study was to determine the notch and shape variations in the Turkish population and compare them with the previous studies.

## MATERIAL AND METHODS

This study was performed at the Department of Anatomy, Faculty of Medicine, Hacettepe University, and Department of Anatomy, Faculty of Medicine, Ankara University with 157 adult Anatolian dry scapulae (78 right sides, 79 left sides). The scapula with trauma, pathological condition, and osteoporotic appearance were not included in the study. The ages and genders of scapula were unknown. The GCs were typed as oval, pear, and inverted comma shaped and noted the number of GC notch. These morphologic features were evaluated by three anatomists and the glenoid cavity shape and notch variations were decided together according to studies by Singh R., and Saha and Vasudeva (6,7). If the notch is distinct or pronounced, GC was classified as an inverted comma, otherwise, it was oval, if it is indistinct, it is classified as pear shaped. Ethics approval was taken from the Hacettepe University ethics committee (Date: 15/03/2022, number: 2022/05-44).

### Statistical Analysis

Statistical analyzes were performed using SPSS version 23. Qualitative results were expressed as numbers (%). Side and notch, side and shape of GC were given using crosstabs. The chi-square test was used to determine whether there was a statistical difference between the right and left sides. In cases where the chi-square test assumptions could not be met, it was compared with Fisher's exact test. A p value below 0.05 was considered statistically significant.

## RESULTS

The most common GC shape was found as the pear shaped with 63 (80.8%) at the right side, 49 (62%) at the left side, and 112 (71.4%) in total. The second most common GC shape was found as oval shaped with 13 (16.6%) at the right side, 28 (35.5%) at the left side, and 41 (26.1%) in total (Figure 1). The least common GC shape was found as inverted comma shaped with 2 (2.6%) at the right side, 2 (2.5%) at the left side, and 4 (2.5%) in total (Figure 2). There was a statistically significant difference between the sides in terms of the shape of the GC ( $p=0.023$ ). Post-hoc procedures and Bonferroni correction for the significance



**Figure 1.** Oval shaped glenoid cavity



**Figure 2.** Inverted comma shaped glenoid cavity, the red arrow indicates the notch

limit were applied to determine which group caused this difference ( $0.05/3=0.017$ ). The chi-square test was applied separately and it was determined that the difference was caused by oval shaped and pear shaped GC ( $p=0.007$  and  $p=0.009$ , respectively). The glenoid notch was found at the right side, left side, and totally; 28 (35.9%), 19 (24.1%), and 47 (29.9%), respectively. No glenoid notch was found at the right side, left side, and totally; 50 (64.1%), 60 (75.9%), and 110 (70.1%), respectively. There was no statistical difference between the side and the presence of a notch ( $p=0.105$ ).

All of the inverted comma shaped GC had a distinct glenoid notch. All of the oval shaped GC had no glenoid notch. The glenoid notch was found at the right side, left side, and all of the pear-shaped GC; 26 (41.3%), 17 (34.7%), and 43 (38.4%), respectively (Figure 3). No glenoid notch was found at the right side, left side, and all of the pear-shaped GC; 37 (58.7%), 32 (65.3%), and 69 (61.6%), respectively (Figure 4). No significant difference was found between the right and left sides for the notch formation of pear shaped GCs ( $p=0.478$ ). The shape and notch morphology of the GC were summarized in Table 1 and Table 2.



**Figure 3.** Pear shaped glenoid cavity with a notch, the red arrow indicates the indistinct notch



**Figure 4.** Pear shaped glenoid cavity with no notch

**Table 1.** Shape and notch variations of glenoid cavity

	Right (n=78)	Left (n=79)	P	Total (n=157)
<b>Shape, n (%)</b>				
Oval	13 (16.6)	28 (35.5)		41 (26.1)
Pear	63 (80.8)	49 (62.0)	<b>0.023</b>	112 (71.4)
Inverted comma	2 (2.6)	2 (2.5)		4 (2.5)
<b>Notch, n (%)</b>				
Yes	28 (35.9)	19 (24.1)	0.105	47 (29.9)
No	50 (64.1)	60 (75.9)		110 (70.1)

**Table 2.** Notch variations at pear shaped glenoid cavity

	Right (n=63)	Left (n=49)	P	Total (n=112)
<b>Notch, n (%)</b>				
Yes	26 (41.3)	17 (34.7)	0.478	43 (38.4)
No	37 (58.7)	32 (65.3)		69 (61.6)

**DISCUSSION**

The morphology of the glenoid cavity may differ depending on the populations living in different geographies. In the studies of Prescher and Klumpen (3), and Coskun et al. (8), the glenoid notch was found on 129 (54.7%) and 26 (28.9%) of the scapula, respectively, and they classified them as pear shaped GC. The glenoid notch was not found and they classified them as oval shaped GC. In this study, while 4 (2.5%) of GCs were inverted comma shaped and all of them had distinct glenoid notch; 41 (26.1%) of GCs had no glenoid notch and they were classified as oval shaped. Unlike the studies by Prescher and Klumpen (3), and Coskun et al. (8), in this study, pear shaped GCs were classified as two types according to notch formation and 43 (38.4%) of them had an indistinct glenoid notch, 69 (61.6%) of them had no glenoid notch.

In accordance with the study of Yadav et al. (9), no statistically significant difference was found between notch formation and side in this study.

In studies in which the shape of the GC was typed in populations living in different geographies, Prescher and Klumpen (3), Rajendra et al. (5), Singh R. (6), Saha and Vasudeva (7), Chaijaroonkhanarak et al. (10), Mamatha et al. (11), Akhtar et al. (12), Dhindsa and Singh (13), and this study, pear shaped GC was found the most common shape at the right and left sides. In contrast to these studies, side difference was found in the study of Yadav et al. (9), and the most inverted comma shaped GC was found at the right side and the most pear shaped GC at the left side. While no significant difference was found between the side for the shape of GC in the studies of Dhindsa and Singh (13), and Saha and Vasudeva (7), a significant difference was found between the right and left sides for oval shaped and pear shaped GC in this study.

Considering the studies performed on the Turkish population, while the most oval shaped GC was detected by Coskun et al. (8), in this study, the pear shaped GC was found the most. In the study of Cirpan and Güvençer (14), notch variation of the GC was evaluated in detail and they classified notch variation into 5 types (type 0, type 1a, type 1b, type 2a, and type 2b).

The notch in shallow concave form (type 1a) was found at 24 (38.1) of 63 scapulae, mostly. In this study, notch formation was evaluated as more superficial, distinct, indistinct, or absent compared to the study of Cirpan and Güvençer (14). The studies performed for GC shape and notch variations were summarized in Table 3.

The scapula with distinct glenoid notches, the labrum often does not attach to the glenoidal joint border at the part where the notch is, making the glenohumeral joint more prone to dislocations (3). The adhesions of the labrum in the notch are important for the normal function of the glenohumeral joint. In the inverted comma shaped GC, the labrum does not adhere firmly to the joint face, this arrangement simulates the complex of labral tear, sublabral foramen, and Buford complex at arthroscopy (15). Frazer reports that the position of the notch shows the junction line of the scapular part of the GC and coracoid process (16).

The tendon of the subscapularis muscle crosses the joint at the level of the notch, it is thought that the tendon causes bone atrophy at the anterior border of the joint and causes notch formation (3). Knowledge of the normal anatomy and variations of the joint shape is important for understanding the mechanics of the shoulder joint. This information is important for orthopedic surgeons in shoulder arthroplasty, glenohumeral joint instability, and rotator cuff tear management (13).

### CONCLUSION

The pear-shaped GC was found as the most (71.4%) common shape in this study. Forty-seven (29.9%) of the scapula had a distinct glenoid notch. Knowledge of the notch and shape variations of the GC is important and this study will contribute to anatomists, orthopedists, and radiologists from this perspective.

**Table 3.** Studies on the shape and notch variations at glenoid cavity in the literature

Study	Population	Sample size	Side	Oval	Pear	Inverted comma	Notch (+)
Prescher and Klumpen (3)	Germany	236 (118 M, 118 F)	-	107 (45.3)	129 (54.7)	-	129 (54.7)
Rajendra et al. (5)	India	123 (64 R, 59 L)	-	8 (6.5)	69 (56.1)	43 (35.0)	69 (56.1)
Singh R. (6)	India	172 (91 R, 81 L)	R L	26 (28.6) 25 (30.9)	45 (49.4) 41 (50.6)	20 (22.0) 15 (18.5)	-
Saha and Vasudeva (7)	India	260 (127 R, 133 L)	R L	42 (33.1) 34 (25.6)	51 (40.2) 62 (46.6)	34 (26.8) 37 (27.8)	187 (71.9)
Coskun et al. (8)	Turkey	90 (44 R, 46 L)	-	64 (71.1)	26 (28.9)	-	26 (28.9)
Yadav et al. (9)	India	66 (30 R, 36 L)	R L	4 (13.3) 6 (16.7)	6 (20.0) 16 (44.4)	20 (66.7) 14 (38.9)	-
Chaijaroonkhanarak et al. (10)	Thailand	264 (166 M, 98 F)	-	18 (6.8)	184 (69.7)	62 (23.5)	-
Mamatha et al. (11)	India	202 (98 R, 104 L)	R L	20 (20.4) 25 (24.0)	45 (45.9) 45 (43.3)	33 (33.7) 34 (32.7)	-
Akhtar et al. (12)	India	228 (126 R, 102 L)	R L	17 (13.5) 14 (13.7)	65 (51.6) 50 (49.0)	44 (34.9) 38 (37.3)	-
Dhindsa and Singh (13)	India	80 (41 R, 39 L)	R L	9 (21.9) 7 (17.9)	20 (48.8) 18 (46.2)	12 (29.3) 14 (35.9)	-
This study	Turkey	157 (78 R, 79 L)	R L	13 (16.6) 28 (35.5)	63 (80.8) 49 (62.0)	2 (2.6) 2 (2.5)	47 (29.9)

M: male, F: female, R: right, L: left

**Ethics Committee Approval:** The study was approved by the Ethics Committee of Hacettepe University Faculty of Medicine (15.03.2022, 05-44).

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