Official Journal of Erciyes University Faculty of Medicine

DOI: 10.14744/cpr.2024.98502
J Clin Pract Res 2024;46(6):593–600

Scapula Morphometry and Types of Acromion

Keziban Bağcı,[1] Mehtap Nisari,[2] Emre Atay,[3] Cemalettin Bağcı,[4] Erdoğan Unur[2]

[1]Department of Medical Services and Techniques, Niğde Ömer Halisdemir University, Niğde Zübeyde Hanım Vocational School of Health Services, Niğde, Türkiye
[2]Department of Anatomy, Erciyes University Faculty of Medicine, Kayseri, Türkiye
[3]Department of Anatomy, Afyonkarahisar Health Sciences University Faculty of Medicine, Afyon, Türkiye
[4]Department of Food Processing, Niğde Ömer Halisdemir University, Bor Vocational School Higher Education, Niğde, Türkiye

ABSTRACT

Objective: This study aimed to evaluate the bone anatomy and morphometry of the scapula and to contribute to arthroscopic and surgical interventions for scapular or shoulder disorders.

Materials and Methods: Fifty dry scapula bones, used for educational purposes at Erciyes University Faculty of Medicine, Department of Anatomy, were included in the study. A digital caliper (Rico brand) with a precision of 0.1 mm was used for measurements. Statistical analysis of the data was conducted using the Statistical Package for the Social Sciences (SPSS) Statistics 24.0 program. Minimum and maximum values, as well as mean and standard deviation, were calculated for each measurement parameter.

Results: The following measurements were obtained: maximum scapula length, 141.2±13.4 mm; outer edge length, 122.6±11.1 mm; scapula width, 95.1±8.1 mm; spina scapula length, 128.0±10.7 mm; base length, 78.2±7.2 mm; acromion length, 43.2±7.1 mm; acromion width, 27.5±5.9 mm. The coracoacromial distance, which is a contributing factor in shoulder impingement syndrome, measured 36.6±6.7 mm. The distance between the acromion and the cavitas glenoidalis was measured at 27.6±5.1 mm. The anteroposterior diameter of the cavitas glenoidalis was 24.5±3 mm, and the maximum superior-inferior diameter was 34.9±3.3 mm. The depth of the cavitas glenoidalis was 4.5±2 mm, with a surface area of 631±139.053 mm^2. The distance between the processus coracoideus and the cavitas glenoidalis was 24.3±3.6 mm, and the length of the processus coracoideus was found to be 41.1±4.2 mm. The acromion shapes of the scapulae included in the study were classified as flat in 14 cases (28%), curved in 27 cases (54%), and hooked in nine cases (18%).

Conclusion: This study identified both similarities and differences in the measurement results.

Keywords: Acromion, impingement, morphometry, scapula, variation.

Cite this article as:
Bağcı K, Nisari M, Atay E, Bağcı C, Unur E. Scapula Morphometry and Types of Acromion. JClinPractRes2024;46(6):593–600.

Address for correspondence:
Keziban Bağcı.
Department of Medical Services and Techniques, Niğde Ömer Halisdemir University, Niğde Zübeyde Hanım Vocational School of Health Services, Niğde, Türkiye
Phone: +90 388 211 28 49
E-mail: kbagci@ohu.edu.tr

Submitted: 30.04.2024
Revised: 27.07.2024
Accepted: 06.11.2024
Available Online: 21.11.2024

Erciyes University Faculty of Medicine Publications -
Available online at www.jcpres.com

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

INTRODUCTION

The scapula, commonly known as the shoulder blade, is a triangular bone located on the posterior-outer side of the thorax between the second and seventh ribs. It has three margins (medial, lateral, and superior), three angles (superior, inferior, and lateral), and two surfaces (costal and posterior).[1] In addition to the bone's surface, angles, and margins, the three protrusions—the spinous process, acromion, and coracoid process—are also important attachment points for many muscles and ligaments. Clinical conditions affecting these structures may impair the biomechanics of the upper extremity.[2] The scapula, attached to the rib cage by muscles and membranes, contributes to the structure of complex joints such as the shoulder joint (glenohumeral joint), which has a wide range of motion.[1] Developmental anomalies, fractures, dislocations, arthritis, and tumors are common clinical conditions involving the shoulder joint and scapula. Understanding the detailed bone anatomy of the scapula is important for surgical or arthroscopic interventions involving the shoulder or scapula, such as total shoulder prosthesis (for prosthesis positioning), open reduction, and internal fixation in fractures related to these pathological conditions.[2,3] Additionally, knowledge of the morphometric features of the acromion, glenoid cavity, and coracoid process, and the subacromial space formed by these structures, is crucial for understanding the etiology of shoulder pain caused by rotator cuff compression.[2,4] The acromion, due to its relationship with the humeral head, is the most studied protrusion on the scapula as it is associated with various pathological conditions.[5] Most studies focus on the shape of the acromion, and two classification methods are commonly used. The first method, described by Edelson and Taitz,[6] categorizes acromion types based on the superior view: cobra (Type I), square (Type II), and intermediate type (Type III). The second classification, based on the inferior view and inclination of the acromion, was described by Bigliani et al.[7] and further developed by Koşar et al.,[8] categorizing acromion types as Type I (flat inferior surface), Type II (curved inferior surface), and Type III (hooked inferior surface). However, the classification by Bigliani[7] is more widely accepted. In a study using magnetic resonance imaging (MRI) in 1995, Vanarthos et al.[9] identified a fourth type of acromion, Type IV, which features a convex inferior surface, in addition to the three types previously described by Bigliani,[7] Vanathros, and Monu.[9] Understanding the types and frequency of acromion variations is important due to their association with shoulder pain symptoms.[10] Consequently, morphometric studies in this field are crucial in the diagnostic and treatment phases.[7–11] The aim of this study is to contribute to arthroscopic interventions and surgical treatments for scapular or shoulder disorders by providing detailed measurements of the scapula.

MATERIALS AND METHODS

This study included 50 healthy scapulae selected from a total of 76 dry scapula bones of unknown gender and age, used for educational purposes in the bone archives of the Anatomy Department at the Erciyes University Faculty of Medicine between May 1–30, 2017. Scapulae that were excessively damaged, broken, or fragmented were excluded from the study.

KEY MESSAGES

- Understanding the detailed anatomy and morphometry of the scapula is essential for guiding surgical procedures, prosthesis placement, and arthroscopic interventions.
- The depth and surface area of the glenoid fossa are crucial for selecting and positioning the appropriate prosthesis size in shoulder arthroplasty.
- Evaluating acromion types that predispose to subacromial impingement syndrome and rotator cuff tears is important.

A digital caliper (Rico brand) with a precision of 0.1 mm was used for measurements. The measurement parameters and reference ranges were based on the studies by Von Schroeder et al.,[3] Ohl et al.,[11] and Kabakçı et al.[12] Measurement parameters were categorized into five main groups: general measurements, spine of scapula measurements, acromion measurements, glenoid cavity measurements, and coracoid process measurements. A total of 15 measurements were made, and statistical analyses were conducted using the SPSS 24.0 program. The arithmetic mean, standard deviation (SD), and minimum–maximum values for all measurements were calculated.

General Measurements: Taken from the dorsal surface of the scapula (Fig. 1a).

G1: Scapula maximum length (the distance between the center of the superior angle and the lowest point of the inferior angle).

G2: Scapula outer border length (the distance between the inferior angle of the scapula and the inferior margin of the glenoid cavity).

G3: Scapula width (the distance between the attachment point of the spine of the scapula to the medial margin and the center of the posterior margin of the glenoid cavity).

Spine of Scapula Measurements:

S1: Spine of scapula length (the distance between the attachment point at the medial margin and the lateral margin of the acromion).

S2: Spine of scapula base length (the distance between the starting point of the spine of the scapula at the medial margin and the point where it is unattached to the dorsal surface) (Fig. 1b).

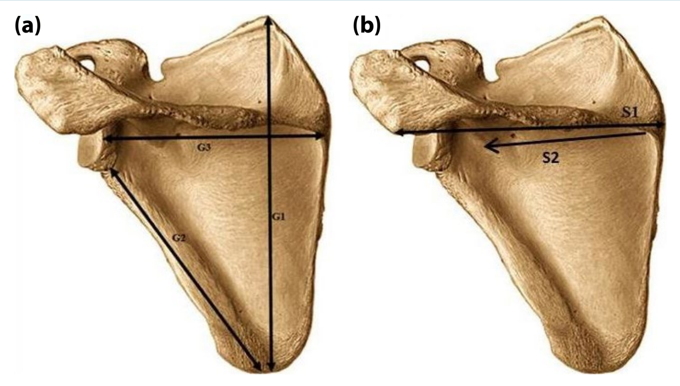

Figure 1. (a) Posterior view of the scapula (dorsal surface), showing general measurement. **(b)** Posterior view of the scapula (dorsal surface), showing spine of scapula measurement (S1, S2) parameters.

(G1, G2, G3) parameters. G1: Scapula maximum length. G2: Scapula outer border length. G3: Scapula width. S1: Spine of scapula length. S2: Spine of scapula base length.

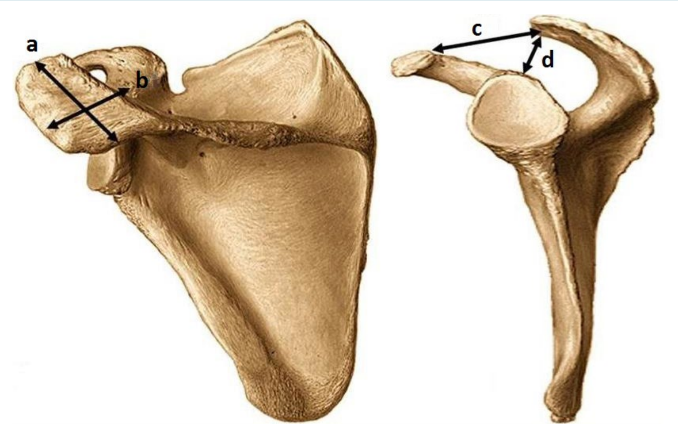

Figure 2. Posterior view of the scapula (dorsal surface) showing acromion measurement (2a, 2b, 2c, 2d) parameters.

2a: Acromion length. 2b: Acromion width. 2c: Coracoacromial distance. 2d: Distance between acromion and glenoid cavity.

Acromion Measurements:

2a: Acromion length (anteroposterior maximum length of the acromion).

2b: Acromion width (the distance between the inner end of the clavicular facet and the outer margin of the acromion).

2c: Coracoacromial distance (the distance between the midpoint of the end of the acromion and the end of the coracoid process).

2d: Distance between the acromion and glenoid cavity (the distance between the tip of the acromion and the posterior margin of the glenoid cavity) (Fig. 2).

Glenoid Cavity Measurements:

3a: Glenoid cavity anteroposterior diameter.

3b: Glenoid cavity maximum superior-inferior diameter (the distance between the most prominent point of the supraglenoid tubercle and the inferior margin of the glenoid cavity).

3c: Glenoid cavity depth (the length of a line drawn between the highest and lowest points of the long axis of the glenoid cavity and a line drawn at 90 degrees from the deepest point of the glenoid cavity to this line).

3d: Surface area of the glenoid cavity (50 dry scapula bones were photographed with a Nikon E5700 camera, and the Image J program was used for area measurements (https://imagej.nih.gov/ij/downland html).

Surface Area Measurement Stages: A transparent ruler was placed on the glenoid cavity, and a photo was taken. The images obtained were transferred to a computer, and calibration was adjusted between the original image and the photo to ensure accurate measurements. The photo intended for calibration was opened with the ImageJ program. In the photo, an original 10 mm distance on millimeter paper was measured using the Straight Line tool. Appropriate calibration was then applied through the Analyze > Set Scale > Known Distance menu in the ImageJ program. The calibration result was determined manually with the Wand Tool feature of ImageJ, and the results were obtained in millimeters (Fig. 3).

Coracoid Process Measurements:

4a: Distance between the coracoid process and glenoid cavity (the distance between the end of the coracoid process and the supraglenoid tubercle).

4b: Coracoid process length (the distance between the suprascapular notch and the end of the coracoid process) (Fig. 4).

Acromion Types: In the visual morphological classification of the scapula, the acromion is categorized into three types based on the inclination of the inferior surface, as described by Bigliani et al.[7] and stated by Koşar et al:[8] Type I (flat inferior surface), Type II (curved inferior surface), and Type III (hooked inferior surface) (Fig. 5a–c). However, the classification by Bigliani[7] is more widely accepted. In a study using MRI in 1995, Vanathros and Monu[9] described a fourth type of acromion, Type IV, with a convex inferior surface, in addition to the three different types previously defined by Bigliani.[7] The acromions of the scapulae included in this study were evaluated based on the inclination of the inferior surface.

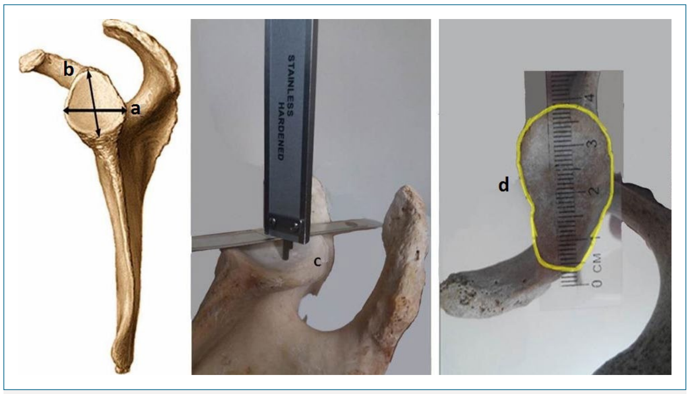

Figure 3. Lateral view of the scapula, showing glenoid cavity measurement (3a, 3b, 3c, 3d) parameters.

3a: Glenoid cavity anteroposterior diameter. 3b: Glenoid cavity maximum superior-inferior diameter. 3c: Glenoid cavity depth. 3d: Glenoid cavity surface area.

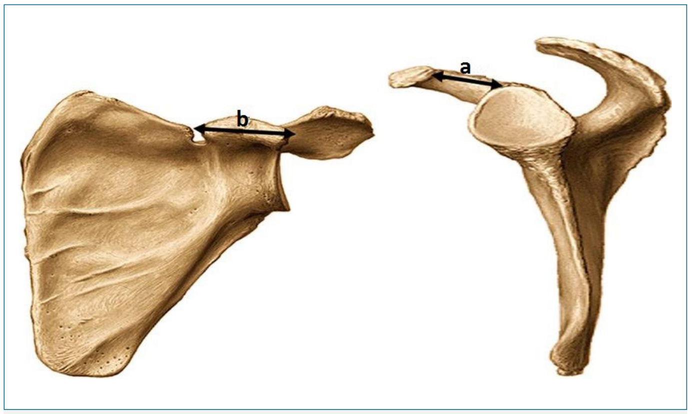

Figure 4. Coracoid process parameters (4a, 4b).

4a: Distance between coracoid process and glenoid cavity. 4b: Coracoid process length.

Statistical Analysis

The data obtained were analyzed statistically. The conformity of the data to a normal distribution was assessed using the Shapiro-Wilk test. Statistical analysis of the data was conducted using the Statistical Package for the Social Sciences (SPSS) Statistics 24.0 program. Minimum and maximum values, as well as the mean and standard deviation, were calculated for each measurement parameter.

RESULTS

The arithmetic mean, standard deviation, and minimum-maximum values of the scapula measurement parameters are presented in Table 1.

The measurement parameters and arithmetic means of the general measurements of the scapula, expressed as G1, G2, and G3, were found to be:

- Maximum length of the scapula: 141.2±13.4 mm (Fig. 1a, G1);
- Scapula outer border length: 122.6±11.1 mm (Fig. 1a, G2);
- Scapula width: 95.1±8.1 mm (Fig. 1a, G3).

The measurement parameters and arithmetic means of the spine of the scapula were as follows:

- Spine of scapula length: 128.0±10.7 mm (Fig. 1b, S1);
- Spine of scapula base length: 78.2±7.2 mm (Fig. 1b, S2).

The acromion measurements were as follows:

- Acromion length: 43.2±7.1 mm (Fig. 2a);
- Acromion width: 27.5±5.9 mm (Fig. 2b);
- Coracoacromial distance 36.6±6.7 mm (Fig. 2c);

Distance between the acromion and glenoid cavity 27.6±5.1 mm (Fig. 2d).

The glenoid cavity measurements were as follows:

- Glenoid cavity anteroposterior diameter: 24.5±3 mm (Fig. 3a);
- Glenoid cavity maximum superior-inferior diameter: 34.9±3.3 mm (Fig. 3b);
- Glenoid cavity depth: 4.5±2 mm (Fig. 3c);
- Surface area of the glenoid cavity: 631±139.053 mm^2 (Fig. 3d).

The measurements for the coracoid process were as follows:

- Distance between the coracoid process and glenoid cavity: 24.3±3.6 mm (Fig. 4a);
- Coracoid process length: 41.046±4.2 mm (Fig. 4b, Table 1).

Results of Acromion Types: The acromion of 50 scapulae included in the study was evaluated in three groups based on inferior surface inclination (Fig. 5a–c). When examining the inferior views of the acromion in these 50 scapulae, 14 (28%) were found to have a flat surface, 27 (54%) a curved surface, and nine (18%) a hooked inferior surface (Table 2).

DISCUSSION

Understanding the anatomy of the scapula is crucial during the preoperative period. However, identifying the borders of certain bones can be challenging; statistical approaches based on subject-specific parametric models are used to address this issue.[11] Numerous studies on scapula morphometry and acromion types have been published, employing various methods, including computed tomography (CT),[13,14] MRI,[10] 3D analysis,[11] and dry bones.[2,12,15–17] In the present study, dry scapula bones used for educational purposes in anatomy laboratories were measured, focusing on the dimensions of basic structures, and acromion types were evaluated.

Figure 5. Acromion types detected in the study (a–c).

5A: Type I: flat inferior surface. 5B: Type II: curved inferior surface. 5C: Type III: hooked inferior surface.

Table 1. Morphometric measurements of the scapula (mm) (n=50)

Parameter	Mean±SD	Min–Max
G1	141.20±13.40	112.40–174.30
G2	122.60±11.10	94.70–156.50
G3	95.10±8.10	76.60–112.00
S1	128.04±10.70	97.70–150.00
S2	78.02±7.20	63.10–94.90
2a	43.20±7.10	22.00–60.00
2b	27.50±5.90	18.10–45.20
2c	36.60±6.70	21.20–51.20
2d	27.60±5.10	16.40–39.30
3a	24.50±3.00	17.30–29.90
3b	34.90±3.30	27.50–40.00
3c	4.50±2.00	1.75–9.00
3d	631.00±139.05	266.05–1089.50
4a	24.30±3.60	18.80–31.80
4b	41.05±4.20	32.90–48.60

Arithmetic mean, standard deviation, minimum, and maximum values of morphometric measurements (n=50).

Table 2. Acromion types according to inclination (n=50)

Acromion inclination	n	%
5a. Type I (flat)	14	28
5b. Type II (curved)	27	54
5c. Type III (hooked)	9	18

Three measurements were made in our study regarding the general structure of the scapula (G1, G2, G3). Scapula length and scapula width, known to be among parameters used in gender determination, were shown as G1 and G3 in our study.[14]

The mean maximum scapula length (G1) was found to be 141.2 mm (min: 112.4 mm, max: 174.3 mm) in our study. In the literature, mean scapula length measurements have been reported as 14.08 cm, 141.5 mm, 155 mm, 141 mm, 147 mm, 160.4 mm in men, 140.1 mm in women, and 153.9 mm in other studies.[2,3,11–13,16,18] Similarities and differences are evident when comparing these studies.

The mean scapula outer border length (G2) was found to be 122.6±11 mm (min: 94.7 mm, max: 156.5 mm) in our study. Polguj et al.[19] reported this distance as 137.9 mm (min: 120.1 mm, max: 153 mm). We believe that the difference between our results and those of Polguj et al.[19] are due to racial differences or measurement techniques.

The mean result for the G2 measurement was reported as 126.2 mm by Taşer and Başaloğlu,[2] and as 122.5 mm by Kabakçı et al.[12] We believe that the similarity between these results and those of our study is due to the fact that the scapulae studied belong to the same population.

The mean scapula width (G3) was found to be 95.1±8.1 mm (min: 76.6 mm, max: 112.0 mm) in our study. In the literature, mean scapula width has been reported as 90 mm in women, and as 102 mm, 96.7 mm, 102.2 mm, 103 mm, 105 mm, 109.6 mm, and 98.5 mm in men.[2,11–13,16,18,20] The value closest to ours, 96.7 mm, was reported by Taşer and Başaloğlu.[2] While some of the other values are lower than ours, others are higher. When studies in the literature are taken into consideration, it is observed that these measurements differ from data presented in studies conducted in some populations. This suggests that scapula morphometric measurements vary across different races. These differences may be due to factors such as age, gender, and race.

The mean spine of scapula length (S1) was found to be 128 mm in our study. In the literature, mean S1 measurements have been reported as 124 mm in women and as 140 mm, 133 mm, 128.7 mm, 134 mm, and 141.5 mm in men.[2,3,18–20]

The mean spine of scapula base length (S2) was found to be 78.2 mm in our study. Previous studies report this measurement as 69 mm in women and as 74 mm and 78.4 mm in men.[2,20]

Differences can be observed when comparing our study's data with those in other studies, and when measurement reference ranges are considered, these differences are considered normal.

Four measurements were conducted for the acromion, which plays a role in shoulder impingement syndrome, following the parameters used by Koşar et al.,[8] specifically acromion length (2a), acromion width (2b), coracoacromial distance (2c), and distance between the acromion and glenoid cavity (2d).

In the literature, mean acromion length measurements have been reported as 48 mm, 46.7 mm, 47.5 mm, 47 mm, 43.4 mm, and 46.6 mm in the right scapula; 45.5 mm in the left scapula; 44.52 mm in the right scapula; 45.13 mm in the left scapula; and 36.21 mm.[3,8,11,18,21,22] In our study, the mean acromion length (2a) was measured as 43.2 mm.

The mean acromion width (2b) was measured as 27.5±5.9 mm in our study. In the literature, mean acromion length has been reported as 26.63 mm in the right scapula and 27.23 mm in the left scapula, as well as 24.5 mm, 23 mm, 22.0 mm, 28.34 mm in the right scapula, and 28.31 mm in the left scapula.[2,11,18,21,22]

It can be seen that the data on acromion length and width in previous studies are largely consistent with the findings in our study. We believe that the minor differences observed are due to factors such as race, gender, or the methods used.

The mean coracoacromial distance (2c) was found to be 36.6±6.7 mm in our study. In the literature, mean coracoacromial distance measurements have been reported as 29.2 mm, 31.7 mm, 28 mm; 26.63 mm in the right scapula and 39.39 mm in the left scapula; 90.7 mm in men; 77.6 mm in women; 34.59 mm in the right scapula and 37.46 mm in the left scapula; and 30.48 mm.[2,8,18,20–23]

The mean distance between the acromion and glenoid cavity (2d) was measured as 27.6±5.1 mm in our study. This distance was reported as 21 mm by Taşer and Başaloğlu,[2] 31 mm in right scapula and 31.97 mm in the left scapula by Mansur et al.,[21] and 18.5 mm by Aydemir et al.,[18] and as 32.31 mm in the right scapula and 33.18 mm in the left scapula by Akhtar et al.[22] When all these values are reviewed, it is suggested that the differences are due to variations in measurement technique, racial differences, and differences in measurement reference points.

It has been reported that understanding the shape and dimensions of the glenoid cavity is crucial for managing rotator cuff disease, shoulder dislocation, and the design and fitting of prostheses for total shoulder arthroplasty, as noted by Gosavi et al.[24] Considering the importance of the glenoid cavity, we conducted four measurements in this study: anteroposterior diameter (3a), superior-inferior diameter (3b), depth (3c), and surface area (3d) of the glenoid cavity.

When examining the results for the anteroposterior diameter of the glenoid cavity, the smallest reported value was 23.2 mm, while the highest was 29.00 mm.[3,25] These values have been reported as 23.2 mm, 23.11 mm, 23.70 mm, 24 mm, 26 mm, 25.9 mm, 29 mm, and as 24.4 mm, 25.5 mm, 25.1 mm, and 24.6 mm in studies conducted on the Turkish population.[2,3,11,12,16,18,24–28] In our study, the mean glenoid cavity transverse length (3a) was measured as 24.5±3 mm.

The mean superior-inferior (length) diameter values of the glenoid cavity, expressed as (3b) in our study, have been reported as 33.79 mm, 34.59 mm, and 36 mm in some studies, while other studies report values of 36 mm and 35.3 mm. In studies conducted on the Turkish population, the 3b value was reported as 34.8 mm, 36.8 mm, 36.3 mm, and 36.3 mm.[2,3,11–13,16,25–27] In our study, the mean superior-inferior glenoid length was found to be 34.9±3.3 mm. Differences in measurements could be attributed to factors such as age, race, gender, and measurement techniques.

Calculating both the depth and surface area of the glenoid cavity may be useful when selecting and positioning the appropriate size prosthesis in shoulder arthroplasty. In our study, the mean glenoid cavity depth, expressed as 3c, was found to be 4.5±2 mm. A limited number of results were found in the literature regarding depth. In a 2017 study, Keleş[13]reported this depth as 0.45 cm in men and 0.38 cm in women. It can be seen that the study results of this study are consistent with those of our study.

The surface area of the glenoid cavity, expressed as 3d, was determined to be 631±139.053 mm^2 (6.31 cm^2) on average in our study. In a study by Prescher and Klümpe,[29] the area of the cavitas glenoidalis was stated to be 9.87 cm^2 in men and 7.18 cm^2 in women. Similarly, as reported by Prescher and Klümpe[29] found the area of the cavitas glenoidalis to be an average of 6.3 cm^2 in their study.

In our study, the mean distance between the coracoid process and glenoid cavity (4a) was found to be 24.3±3.6 mm. Sabancıoğulları et al.[30] reported this distance as 17.6 mm, while Kabakçı et al.[12] reported it as 2 cm. While the results of our study were similar to those of Kabakçı et al.,[12] they differed from those of Sabancıoğulları et al.[30] We believe that this difference is due to variations in measurement reference points.

In our study, the mean length of the coracoid process, referred to as 4b, was measured as 41.1±4.2 mm. Previous studies have reported this measurement as 31 mm by Albino et al.,[16] 32 mm by Von Schroeder et al.,[3] 41.5 mm by Sabancıoğulları et al.,[30] 42.1 mm by Aydemir et al.,[18] and 48.8 mm by Ohl et al.[11] In a study conducted by Manal et al.[31] to examine ethnic differences in coracoid process morphometry in Asian populations, the measurement was reported as 43.3 mm on average in the Indian population, 42.2 mm in the Chinese population, 39.1 mm in the Myanmarese population, and 15.59 mm by Koca et al.[23] When various measurement results are considered, it is likely that variations arise from differences in measurement ranges, age, gender, ethnic groups, and study methods.

When study results on scapula morphometry are considered in the literature, it is found that measurement results show both similarities and differences. Generally, these differences are attributed to factors such as age, race, gender, as well as the materials and methods used.

Due to its relationship with the humeral head, the acromion is the most frequently studied protrusion on the scapula, as it is associated with various pathological conditions, as noted by Ergöz.[5] Most studies focus on the shape of the acromion. In studies on acromion types, Koşar et al.[8] found the following distribution: 50.66% Type I (flat), 41.33% Type II (curved), and 8% Type III (hooked). Another study reported the distribution as 23% Type I (flat), 63% Type II (curved), and 14% Type III (hooked). In a study conducted by Edelson and Taitz[6] on 200 scapulae, the acromion types were 22% Type I (flat), 62% Type II (curved), and 16% Type III (hooked). Aydemir et al.,[18] in a study on 31 scapulae, reported acromion types as 45.2% Type I (flat), 32.2% Type II (curved), and 22.6% Type III (hooked). The results from Coşkun et al.[26] showed 10% Type I (flat), 73% Type II (curved), and 17% Type III (hooked). Akhtar et al.[22] reported a distribution of 53.34% Type II (curved) and 18.33% Type III (hooked). In a study by Vanarthos et al.[9] on 30 scapulae, the percentage of Type IV (convex) acromion was found to be 13%, higher than the average reported in previous studies. In their study titled "Distribution of Acromion Types in Turkish Society and Subacromial Distances" Duymuş et al.[10] evaluated 100 shoulder MRI images retrospectively and reported the acromion types as 47% Type I (flat), 24% Type II (curved), 20% Type III (hooked), and 9% Type IV (convex). Koca et al.[23] reported the distribution of acromion types as 21% Type I (flat), 62% Type II (curved), and 17% Type III (hooked). Across various studies, the data regarding acromion types linked to shoulder symptoms and their percentages vary significantly. The acromion types of 50 dry scapulae used in our study were examined, and the results showed 28% Type I (flat), 54% Type II (curved), and 18% Type III (hooked).

CONCLUSION

In this study, similarities and differences were observed in the measurement results. We believe that the findings we obtained will assist clinicians in all types of surgical and arthroscopic interventions involving the shoulder and scapula.

Ethics Committee Approval: The Erciyes University Clinical Research Ethics Committee granted approval for this study (date: 11.02.2015, number: 261).

Author Contributions: Concept – KB, MN, EA, CB, EU; Design – KB, MN, EA, CB, EU; Supervision – KB, MN, EA, CB, EU; Resource – KB, EU, MN; Materials – KB, EU; Data Collection and/or Processing – KB, MN, EA, CB, EU; Analysis and/or Interpretation – KB, CB, EU; Literature Search – KB, MN; Writing – KB, EU; Critical Reviews – KB, MN, EA, CB, EU.

Conflict of Interest: The authors have no conflict of interest to declare.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Use of AI for Writing Assistance: Not declared.

Financial Disclosure: The authors declared that this study has received no financial support.

Peer-review: Externally peer-reviewed.

REFERENCES

1. Arifoğlu Y. Anatomy in All Aspects. 3rd edition, Istanbul: Istanbul Medical Bookstores; 2021.
2. Taşer FA, Başaloğlu H. Morphometric measurements of the scapula. Aegean Med J 2003; 42(2): 73-80.
3. Von Schroeder, Herbert P, Kuiper SD, Botte MJ. Osseos anatomi of the scapula. Clin Orthop Relat Res 2001; (383): 131-9.
4. Karabulut M. Investigation of the Effectiveness of Laser in the Conservative Treatment of Subacromial Impingement Syndrome, (Specialist Thesis), Republic of Turkey Ministry of Health Istanbul 70. Yıl Physical Therapy and Rehabilitation Training and Research Hospital 3rd Clinic, Istanbul, 2006; 2-8.
5. Ergöz E. Comparison of the Effectiveness of Physical Therapy and Corticosteroid Injection into the Supacromial Space in Patients with Shoulder Rotator Cuff Partial Rupture, (Specialist Thesis), Republic of Turkey Ministry of Health Şişli Etfal Training and Research Hospital, Istanbul,

2000.

6. Edelson JG, Taitz C. Anatomy of the coraco-acromial arch. Relation to degeneration of the acromion. J Bone Joint Surg Br 1992; 74(4): 589-94.
7. Bigliani LU, Morrison DS, April EW. The morphology of the acromion and its relationship to rotator cuff tears. Orthop Trans 1986; 10: 228.
8. Koşar Mİ, Sabancıoğuları V, Erdil FH, Çimen M, Aycak K. Acromion types and morphometric evaluation. C.Ü Faculty of Med J 2006; 28(1): 16-20.
9. Vanathros WJ, Monu JU. Type 4 acromion: a new classification. Contemp Orthop 1995; 30(3): 227-9.
10. Duymuş M, Asal N, Bozkurt A, Orman G, Yeşilkaya Y, Yılmaz Ö. Distribution of acromion types and subacromial distances in symptomatic patients: MRI findings. Kafkas J Sci 2012; 2(2): 60-5.
11. Ohl X, Billuart F, Lagacé PY, Gagey O, Hagemeister N, Skalli W. 3D morphometric analysis of 43 scapulae. Surg Radiol Anat 2012; 34(5): 447-53.
12. Kabakçı AG, Polat S, Yücel AH. Morphometric analysis and clinical significance of the scapula. Çukurova Med J 2019; 44(3): 788-93.
13. Keleş A. Morphometric Analysis of Cavitas Glenoidalis with Multidetector CT. (Master's Thesis), Necmettin Erbakan University, Institute of Health Sciences, 2017; 27-32.
14. Ülkir M. Examination of scapula morphmetry and gender relationship with computed tomography. (Specialization thesis), Hacettepe University, Institute of Health Sciences, 2021.
15. Ebraheim NA, Xu R, Haman SP, Miedler JD, Yeasting RA. Quantitative anatomy of the scapula. Am J Orthop (Belle Mead NJ) 2000; 29(4): 287-92.
16. Albino P, Carbone S, Candela V, Arceri V, Vestri AR, Gumina S. Morphometry of the suprascapular notch: correlation with scapular dimensions and clinical relevance. BMC Musculoskelet Disord 2013; 14: 172.
17. Clavert P, Jouanlanne M, Koch G. Validation of the inter-individual variability of the lateral offset of the acromion. Surg Radiol Anat 2019; 41(6): 693-7.
18. Aydemir AN, Yücens M, Onur Ş. Morphometric evaluation of scapula samples and anatomical variation. Antropology 2020; (39): 57-9.
19. Polguj M, Majos A, Waszczykowski M, Fabiś J, Stefańczyk L, Podgórski M, et al. A computed tomography study on the correlation between the morphometry of the suprascapular notch and anthropometric measurements of the scapula. Folia Morphol (Warsz) 2016; 75(1): 87-92.
20. Oliveria Costa AC, Feitosa de Albuquerque PP, de Albuquerque PV, de Albuquerque PV, Ribeiro de Oliveira BD, Lima de Albuquerque YM, et al. Morphometric analysis of the scapula and their differences between females and males. Int J Morphol 2016; 34(3): 1164-8.
21. Mansur DI, Khanal K, Haque MK, Sharma K. Morphometry of acromion process of human scapulae and its clinical importance amongst nepalese populastion. Kathmandu University Med J 2012; 10(2): 33-6.
22. Akhtar MJ, Kumar S, Chandan CB, Kumar P, Kumar B, Sinha RR, et al. Morphometry and morphology of the acromion process and its implications in subacromial impingement syndrome. Cureus 2023; 15(8): e44329.
23. Koca R, Fazlıogulları Z, Aydın BK, Durmaz MS, Karabulut AK, Ünver Doğan N. Acromion types and morphometric evaluation of painful shoulders. Folia Morphol (Warsz) 2022; 81(4): 991-7.
24. Gosavi SN, Jadhav S, Garud RS. Morphometric study of scapular glenoid cavityin Indian population. J Dental Med Scie 2014; 13(9): 67-9.
25. Mamatha T, Pai SR, Murlimanju BV, Kalthur SG, Pai MM, Kumar B. Morphology of glenoid cavity. Online J Health Allied Scs 2011; 10(3): 1-4.
26. Coskun N, Karaali K, Cevikol C, Demirel BM, Sindel M. Anatomical basics and variations of the scapula in Turkish adults. Saudi Med J 2006; 27(9): 1320-5.
27. Rajput HB, Vyas KK, Shroff BD. A study of morphological patterns of the glenoid cavity of scapula. National J Med Res 2012; 2(4): 504-7.
28. Dhindsa GS, Singh Z. A study of morphology of glenoid cavity. J Evolution Med Dental Scien 2014; 3(25): 7036-43.
29. Prescher A, Klümpen TH. Dose the area of glenoid cavity of the scapula Show sexual dimorphism. J Anat 1995; 186: 223-6.
30. Sabancıoğulları V, Koşar Mİ, Erdil FH, Çimen M, Aycan K, Kalkan K. Processus coracoideus morphometry. Erciyes Med J 2007; 29(5): 387-92.
31. Manal F, Pike-See C, Ahmad U, Nasir MN, San AA, Abdul Rahim E, et al. Anatomic variation in morphometry human coracoid process among asian population. Hindawi BioMed Res Int 2017; 2017: 6307019.