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Original Research Article

MEASUREMENT AND ANALYSIS OF ANTHROPOMETRIC MEASUREMENTS OF THE HUMAN SCAPULA IN TELANGANA REGION, INDIA.

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ABSTRACT

Background: Several shoulder pathologies have an anatomical basis. The scapula presents several variations, based on race, sex, and region. The osteometric measurements and morphometric knowledge of the scapula is essential to understand and treat different shoulder disorders.

Objective: The aim of this study was to measure and record the osteometric data of the Human scapulae in Telangana region, India. The clinical importance of these parameters, comparison with anthropometric studies from other regions and review of literature are presented in this paper.

Materials and methods: 50 dry intact scapulae were examined. The maximum length and width of the scapula, angles of the scapula, measurements of the different parameters of glenoid, acromion, coracoid, spine of the scapula were taken .Statistical analysis of the recorded measurements was done and the results tabulated.

Results and Conclusion: The anthropometric measurements of the adult scapula in the Telangana region are reported in this paper. This data could be helpful to understand the normal anatomy, of scapula, play an important role in the management of different shoulder pathologies, rehabilitation of shoulder injuries, contribute to demographic studies, and assist in forensic cases.

KEY WORDS: Scapula, Glenoid Cavity, Acromion Process, Floating Shoulder.

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INTRODUCTION

The human scapula commonly known as shoulder blade is a triangular, flat, paired bone located on the postero-lateral aspect of thoracic wall. It consists of a body with subscapular fossa on the costal aspect, and supraspinous and infraspinous fossa on the dorsal aspect. It also has a triangular spine, its continuation the acromion process and the coracoid process. It has three angles superior, inferior, and lateral; the lateral angle is truncated and bears the glenoid cavity. Scapula gives attachment to various muscles which act on the gleno-humeral joint, stabilizing as well bringing about various movements at that joint [1].

The glenoid cavity is a component of the gleno-humeral joint. The vertical length and the maximum width of the glenoid cavity have been measured in this study. The anatomy of its articular surface plays an important role in maintaining the stability of the joint and variations can predispose to recurrent dislocations.

Gleno humeral arthritis can occur at this joint, and total shoulder arthroplasty done to treat this condition requires anatomic knowledge of the intact glenoid according to Anetzberger et al [2]. Variations in the normal anatomy of glenoid cavity should be considered while designing the glenoid component to prevent post-operative complications including loosening of the prosthetic component [2]. In acute trauma shoulder dislocations can be associated with glenoid fractures. According to Dirk et al [3] treatment of glenoid fractures requires the knowledge of glenoid anatomy and the glenoid inclination angle. The measurements of the glenoid can be measured using radiographs in the living. Bony Bankarts lesions, fracture in the antero-inferior part of the glenoid cavity, can lead to gleno-humeral instability. The surgeon requires precise knowledge of the glenoid to diagnose coexisting pathologies of the shoulder joint and in planning the treatment according to Grondin et al [4]. Rotator cuff tears can be due to trauma, or degenerative changes [5]. Glenoid anatomy plays an important role in the prognosis and treatment of the rotator cuff tears according to Pandeya et al [5].

According to Anetzberger et al [2] the length and width of the acromion process play an important role in the pathogenesis of impingement syndrome, leading to rotator cuff disease. They also reported that the length of the acromion has an effect on the acromio-glenoid distance and a shortening of this distance can predispose to impingement syndrome [2]. Surgery involving the shoulder joint and coraco-acromial arch requires precise knowledge of the osteometric parameters of acromion process. The length of the coracoid plays an important role in the surgical treatment of coracoid impingement syndrome according to David et al [6].

The suprascapular notch can be discrete, well defined, or present as a foramen. The superior transverse ligament bridges across the notch, the suprascapular artery passes above, and the suprascapular nerve and vein pass below this ligament. Anatomical variations of this notch are important in the pathogenesis of suprascapular nerve entrapment according to Jacob et al [7]. This can lead to atrophy of the supraspinatus and infraspinatus muscles and lead to disorders of movements at the shoulder joint.

The superior transverse diameter and maximal depth of the supra-scapular notch as defined by Polguj et al [8] are also measured in our study.

The movements of the shoulder joint are influenced by the angles of the scapula which provide the adequate leverage for the shoulder muscles according to Sharma et al [9].

Floating shoulder is defined as ipsilateral fractures of the mid-shaft of the clavicle and the neck of the glenoid [10]. Glenopolar angle measures the obliquity of the glenoid articular surface in relation to the scapular body. Normal is 30^0 to 45^0.Gleno-polar and glenoid inclination angles are important while deciding on the treatment and prognosis of floating shoulder according to Kim et al [10]. Caudal dislocation of the glenoid is defined as a glenoid inclination angle of more than 20^0. Glenoid inclination angle has a role in shoulder arthroplasty according to Cofield et al [11].These angles can also be evaluated by radiographs. According to our knowledge these two angles evaluated in our study, are the first to be reported in the South Indian population.

All the components of the scapula have clinical relevance for which the knowledge of the normal anatomy is essential, the osteometric measurements of the different parameters of scapula are presented in this paper.

MATERIALS AND METHODS

50 intact and dry scapulae sourced from the bone banks of medical colleges in Telangana, South India, were studied. The age and gender of the bones was not known.

Inclusion criteria: Adult, intact scapulae with clear features.

Exclusion criteria: Broken or defective scapulae.

Of the fifty scapulae 24 belonged to the right side and 26 to the left side.

A sliding digital Vernier caliper and measuring scale were used for taking linear measurements. Angular measurements were taken using goniometer and protractor.

The following measurements of the scapula were taken:

Maximum scapular length (Figure 1. A): Distance from the superior angle to the inferior angle of scapula.

Maximum scapular width (Figure 1. B): The maximum transverse diameter between the medial border of the scapula, where the spine meets the body of the scapula, and the anterior lip of the glenoid.

Superior-Inferior glenoid diameter (Figure 1. C): Maximum distance measured from the inferior point on the glenoid margin to the most prominent point of the supraglenoid tubercle.

Anterior-Posterior glenoid diameter (Figure 1. D): maximum breadth of the articular margin of the glenoid cavity perpendicular to the glenoid cavity height.

Acromion Maximum length (Figure 2. G): is the distance between tip and midpoint of posterior border of acromion process.

Acromion Maximum breadth (Figure 2. H): is the distance between the lateral and medial borders at the midpoint of the acromion process.

Length of the coracoid process (Figure 3. I): Measured form the base to the tip of the coracoid process.

Projection length of scapular spine (Figure 3. L): measured from the medial edge of the scapula to the lateral edge of the acromion process.

The Acromio-Coracoid distance (Figure 2. E): is the distance between the tip of acromion and tip of the coracoid processes.

The Acromio-Glenoidal distance (Figure 2. F): is the distance between tip of acromion process and supraglenoid tubercle.

Supra-scapular notch Superior transverse diameter (Figure 3. J): The maximum value of the horizontal measurements taken in the horizontal plane between the corners of the suprascapular notch on the superior border of the scapulae.

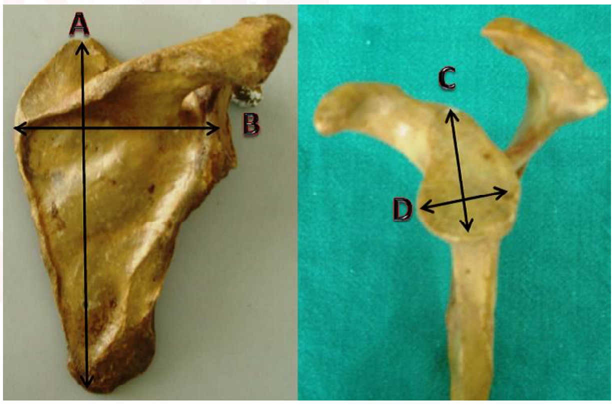
Supra-scapular notch Maximal depth(Figure 3.K): The maximum value of the longitudinal measurements taken in the vertical plane from an imaginary line between the superior corners of the notch to the deepest point of the suprascapular notch.

Gleno-polar angle (Figure 4. M): Angle measured between a line connecting the most cranial with the most caudal point of the glenoid cavity and a line connecting the most cranial point of the glenoid cavity with the most caudal point of the scapular body.

Glenoid inclination angle (Figure 5. N): Angle measured between a line drawn perpendicular to the line connecting the most cranial with the most caudal point of the glenoid cavity and a line drawn perpendicular to the tangent along the medial border of the scapula.

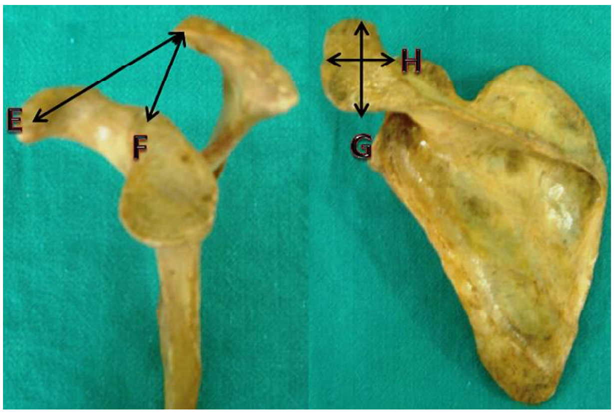
The measurements were taken thrice by the same author in order to avoid errors. The data was analyzed using SPSS version 17.0.

Fig. 1: Osteometric measurements of scapula.



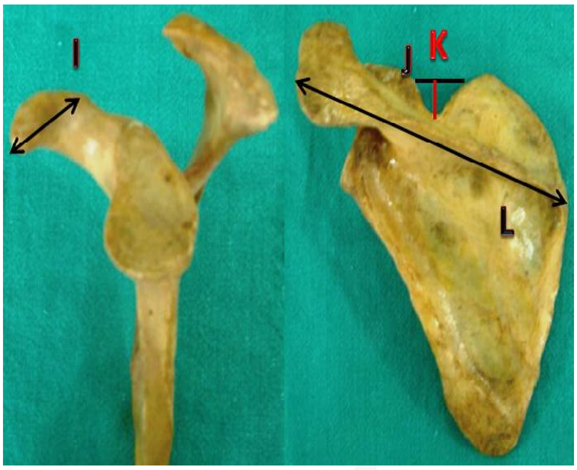
A- Maximum scapular length, B- Maximum scapular width, C- Superior-Inferior glenoid diameter, D- Anterior-Posterior glenoid diameter.

Fig. 2: Osteometric measurements of scapula (contd).



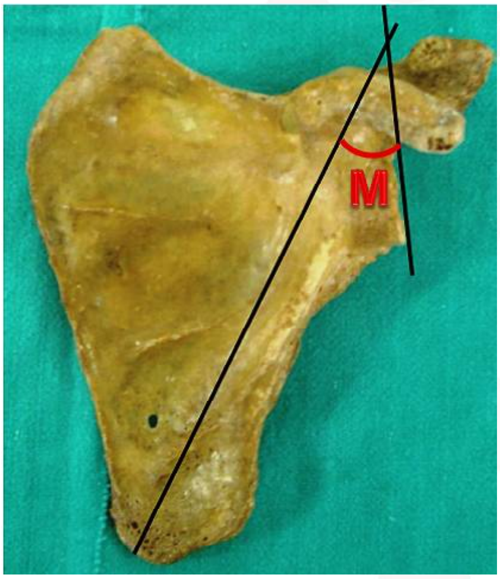
E- The Acromio-coracoid distance, F- Acromio-Glenoidal distance, G- Acromion Maximum length, H- Acromion Maximum breadth.

Fig. 3: Osteometric measurements of scapula (contd).



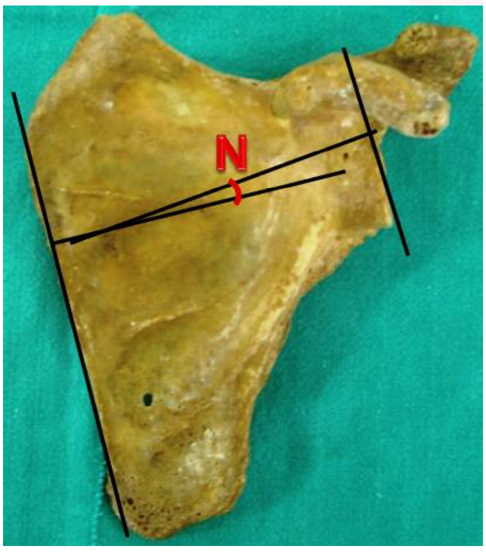
I- Length of the coracoid process, J- Supra-scapular notch Superior transverse diameter, K- Supra-scapular notch Maximal depth, L- Projection length of scapular spine.

Fig. 4: Gleno-polar angle.



M- Gleno-polar angle.

Fig. 5: Glenoid inclination angle.



N- Glenoid inclination angle.

RESULTS AND DISCUSSION

Scapula has few, but important anatomical variations which have significant relevance in understanding different shoulder pathologies, and the anthropometric measurements are useful in treating different disorders of the shoulder joint and also designing the shoulder implants.

The highest value of the scapula length, 155mm, was reported by Polguj et al al [8]. In our present study it was141.49mm, while another study among the Indians by Kavitha et al [12] revealed a higher value of 145.1mm. Wael Amin et al [13] reported the Scapula length as 151.16mm among the Egyptians. Paraskevas et al [14] recorded a value of 147.6mm among the Greeks. The lowest value of 131.1mm was reported among the Thais by Sitha et al [15].

Kavitha et al [12] recorded the scapular width as 105.5mm among Indians, which was higher than our observed value of 98.69mm. Wael Amin et al [13] recorded the scapular width as 107.22mm in Egyptians. Sitha et al [15] reported 95.7mm among the Thais, and Paraskevas et al [14] recorded 101.9mm among the Greeks. These different values could be due to racial, ethnic, and regional variations. This data can be used for demographic studies, comparative studies among different population groups and forensic cases.

The glenoid measurements are important to design the glenoid component of the shoulder joint in shoulder arthoplasty according to Anetzberger et al [2]. In the present study it was found that the Superior-Inferior glenoid diameter was 36.85mm,Kavitha et al[12] recorded 35mm, Mamatha et al[16] reported values of 33.67mm on right side and 33.92mm on the left side, which was lower than our measurements but closer to the values of 33.6mm as reported by Sitha et al[15] among the Thais. The highest value was reported by Wael Amin et al [13] 38.95mm in Egyptians. Treatment of glenoid fractures [3], rotator cuff tears [5], bony Bankarts lesion [4] require precise knowledge of glenoid anatomy.

Anterior-Posterior glenoid diameter as reported by Kavitha et al[12] 6.6mm,and Mamatha et al[16] Right side 20.1mm, Left side 19.6mm, was much lower than our recorded value of 25.07mm. Among the Egyptians it was 28.15mm [13], Thais 25.6mm [15]. Coskun et al [17] recorded a value of 24.6mm among the Turks. Understanding of anterior glenoid anatomy is important in the evaluation and management of shoulder joint instability [5], [4], [3].

The length and width of the acromion is of paramount importance in the management of rotator cuff tears and impingement syndrome according to Anetzberger et al [2].The acromion was longer in the Egyptians, 52.81mm, as reported by Wael Amin et al [13] and shortest value of 40mm was observed among the Thais [15]. Singh et al [18] recorded a value of 46.1mm, the same as reported by Paraskevas et al [14] among the Greeks, which was higher than our measured value of 43.22mm.

The widest dimensions of the acromion process, 32.05mm, were reported among the Egyptians [13] and among the Greeks it was observed to be the narrowest, 22.3mm [14]. Singh et al [18] reported the width of the acromion as 23.2mm which was closer to our value of 24.64mm and Sitha et al [15] reported a value of 23.9mm among the Thais.

Kavitha et al [12] reported coracoid length as 41mm, closer to our finding of 39.04mm. In Thais the observed value was 37.8mm [15], and in Turks 19.4mm [17]. Knowledge of coracoid length is important while planning for a coracoid osteotomy in the management of coracoid impingement syndrome according to David et al [6].

We found the projection length of scapular spine to be123.35mm which was much lower than the values reported by Polguj et al [8] 132mm, 134mm.

The Acromio-Coracoid distance in the Egyptians [13] 31.34mm, was similar to our findings of 31.85mm. Singh et al[18] recorded the acromio-coracoid distance as 28.5mm, which was very close to that reported in Greeks[14] 28.1mm, and the lowest value of 14.8mm was reported among the Thais[15].

Cezayir et al [19] reported the highest Acromio-Glenoidal distance of 30.06mm, while the lowest was among the Thais [15] 18.1mm, and the Greeks [14] 17.7mm. Singh et al [18] .

Table 1: Measurements of scapular parameters.

Measurements Of Scapulae (mm)	Mean	Standard Deviation	Minimum	Maximum
Maximum scapular length	141.49	9.74	118.18	159.31
Maximum scapular width	98.69	6.98	82.7	111.51
Superior-Inferior glenoid diameter	36.85	3.17	29.1	43.97
Anterior-Posterior glenoid diameter	25.07	2.55	19.72	32.66
Acromion Maximum length	43.22	5.75	31.49	53.83
Acromion Maximum breadth	24.64	2.89	18.86	32.34
Length of the coracoid process	39.04	4.16	30.77	50.74
Projection length of scapular spine	123.35	7.88	105.53	136.72
Acromio-Coracoid distance	31.85	4.4	16.57	42.74
Acromio-Glenoidal distance	24.46	3.68	18.46	32.29
Supra-scapular notch Superior transverse diameter	9.07	2.76	2.55	14.84
Supra-scapular notch Maximal depth	5.47	2.07	2.88	10.37

Table 2: Measurements of scapular angles.

Measurements Of Scapulae (Degree)	Mean	Standard Deviation	Minimum	Maximum
Superior Angle	91.7	2.69	86	97
Inferior angle	37.66	4.4	28	44
Lateral angle	55.1	3.75	46	63
Gleno-polar angle	34.34	4.63	22	44
Glenoid inclination angle	11.58	2.02	9	18

findings of 27.0mm were close to that in the Egyptians [13] 27.39mm. In the present study our findings were 24.46mm. The acromio coracoid and acromio-glenoid distances have a role in rotator cuff lesions, and impingement syndromes affecting the shoulder and play an important role in their management [2].

Suprascapular nerve entrapment can occur due to anatomical variations of suprascapular notch according to Jacob et al [7]. Superior transverse diameter of the suprascapular notch measured 9.07mm, and the maximal depth was 5.47mm in our study. Suprascapular nerve entrapment sometimes occurs in volley ball players, and in people doing sudden overhead activities. A smaller supra scapular notch could predispose for suprascapular nerve entrapment more than a larger notch according to Rengachary et al [20].

In the current study we also recorded the measurements of the Superior Angle 91.70^0, Inferior angle 37.66^{0,} and Lateral angle 55.10^0.Sharma et al [9] reported values of 100.83^0, 63.62^0, 61.72^0 for the superior, inferior, and lateral angles respectively. These angles are important in the biomechanics of shoulder joint movements [9].

Glenoid inclination angle in our present study was 11.58^0. According to Hughes et al [21] an increase in the glenoid inclination angle is associated with full-thickness rotator cuff tears. We found the gleno-polar angle to be 34.34^0. These two angles are important in the diagnosis and management of floating shoulder [10], [11].

A summary of the measurements of the different parameters of the scapula, the mean, standard deviation, minimum and maximum values have been tabulated in Table 1, and Table 2.

CONCLUSION

The precise measurements of various parameters of the scapula in the Telangana region, India have been summarized and presented in this paper. Comparision with studies in people from different regions, revealed variations in the osteometric values of the scapula, the basis of which could be attributed to racial and ethnic differences. Knowledge of the normal osteometric values and variations of scapula is important for medical practitioners to understand, treat different shoulder joint disorders, and help in designing implants for the shoulder joint in Telangana region. Glenopolar and glenoid inclination angles in the south Indian population are evaluated and presented for the first time in our paper. This data can also be used for demographic studies, assist in forensic cases, and rehabilitation of players who sustained sports injuries.

Conflicts of Interests: None

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