

Morphometry of Acromion Process of Scapula with Respect to Gender

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Abstract

Background: Of the wide spectrum of musculoskeletal disorders affecting the shoulder, subacromial impingement syndrome is considered to be quite common. The main objective of the present study is to evaluate the morphometry of acromion and to measure other parameters like acromioclavicular distance (ACD) and acromioglennoid distance (AGD).

Materials And Method: Study was conducted on 100 male and 100 female adult scapulae. Length and breadth of the acromion, ACD, and AGD were measured using vernier callipers. Measured parameters were tabulated and analysed for statistical significance.

Results: Acromial length, acromial breadth, ACD and AGD varied significantly with sex. Positive correlation was observed between above parameters in male scapulae, whereas positive correlation was seen only between ACD & AGD among female scapulae.

Conclusion: The studied parameters could be help during diagnoses and treatment of shoulder pathologies. They can also be used for forensic and anthropological purposes for determining gender, ethnicity

Keywords: *Acromion, Impingement syndrome, Rotator cuff tears, Acromioclavicular distance, acromioglennoid distance.*

Introduction

The most common causes of pain and disability in the upper limb are inflammation of rotator cuff tendons and rotator cuff tears that relates to the structure of the acromion¹.

Scapula, large flat triangular bone has three processes—spine, coracoid, and acromion. Medial aspect of acromion gives attachment to coracoacromial

ligament, while the other end of the ligament is attached to coracoid process. These three structures form coracoacromial arch. Tendon of biceps, subacromial bursa, rotator cuff tendons and proximal humerus travel beneath this arch. Subacromial space is defined by the undersurface of anterior third of acromion, coracoacromial ligament and the acromioclavicular joint above and head of the humerus below. Various factors contribute in narrowing of subacromial space which can lead subacromial impingement syndrome (SAIS)².

Subacromial impingement syndrome is the most common disorder of shoulder accounting for 44-65% of all the complaints of shoulder pain. Chronic impingement of rotator cuff can result in inflammation of tendons, subacromial bursitis and eventually rupture of tendons³. Anterior acromioplasty is the surgical treatment of choice for impingement syndrome which

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includes removal anterior third of acromion and release of coracoacromial ligament². Anatomy of acromion and related structures is important in successful interpretation of shoulder images and carrying out of surgical procedures in pathologies associated with joint⁴.

Present study was undertaken to study the morphometry of acromion parameters which influences the subacromial space like length & breadth of acromion, ACD and AGD in male and female scapulae.

Materials and Method

Study was done on 100 male and 100 female dry human scapulae of different people collected from department of Anatomy, KIMS, Bangalore. Only adult scapulae with all ossification centres fused were included, damaged scapulae were excluded from the study. Sexing of the scapulae was done using maximum transverse diameter measured by Vernier callipers. Scapulae with transverse diameter more than 105cm were grouped into male scapulae and those with less than 91 cm into female scapulae^{5,6,7}. After grouping, in each scapulae following measurements were taken using Vernier's callipers.

1. Anteroposterior length of the acromion along longitudinal axis (Length) - L ph-1
2. Distance between the medial and lateral border of the acromion at the midpoint of insertion of acromio clavicular ligament (breadth) - B ph-2
3. Acromio coracoid distance ACD - distance between acromion and coracoid process along an imaginary line representing the midpoint of coracoacromial ligament.ph-3
4. Acromio glenoid distance AGD - distance between inferior surface of acromion and supraglenoid tubercle. Ph-4

Inferior surface of acromion was examined to see whether it is rough or smooth. Each measurement was taken twice and then average was considered to reduce the bias errors. The data obtained is tabulated and statistical analyses were done using Statistical Package for Social Sciences (SPSS) software. Descriptive statistics like percentage, mean and standard deviation were used to analyse the data. The inferential statistics is done using Chi square test, Student't' test and Pearson's correlation test. Microsoft word and excel were used to generate graphs and tables. Values of male and female subjects were compared. The results are considered statistically

significant when $p < 0.05$ and highly significant when $p \leq 0.001$.



Photograph 1: Measuring length of Acromion



Photograph 2: Measuring breadth of Acromion



Photograph 3: Measuring ACD



Photograph 4: Measuring AGD

Results

Among 100 male scapulae 64 had rough undersurface and the rest had smooth undersurface. Among 100 female scapulae 41 had rough undersurface while rest of them (59) had smooth undersurface. Statistically significant association was observed between gender and nature undersurface of acromion (table 1).

Table 1: Percentage of male and scapulae with rough & smooth acromion undersurface (*denotes significant association)

Under Surface	Male		Female		χ^2	P-Value
	N	%	n	%		
Rough	64	64%	41	41%	10.607	0.001*
Smooth	36	36%	59	59%		
Total	100	100%	100	100%		

Mean length of acromion was 4.6cm (45.94mm) in male scapulae and 3.9 cm (38.99mm) in female scapulae. Mean breadth of acromion was 2.5cm (25.58mm), 2.3cm (23.09) in male and female scapulae respectively. Both parameters showed statistically significant difference with $p < 0.001$. In male scapulae mean ACD was 2.8cm (28.61 mm) and AGD was 2.7cm (27.5mm), while in female scapulae they were 2.6cm (26.55mm) and 2.6cm (26.01mm) respectively. ACD and AGD showed statistically significant difference in male and female scapulae ($p = 0.001$). All the measured parameters were higher in male scapulae compared to female.

Table 2: Comparison of different parameters of acromion between male and female scapulae

Parameter	Gender	Range (mm)	Mean	SD	SE of Mean	Mean Difference	T	P-Value
L	Male	35.0-56.48	45.94	4.09	0.41	6.950	10.305	$< 0.001^*$
	Female	23.0-5.0	38.99	5.36	0.54			
B	Male	19.8-34.0	25.58	2.80	0.28	2.496	5.451	$< 0.001^*$
	Female	17.0-46.8	23.09	3.62	0.36			
ACD	Male	17.16-38.6	28.61	4.27	0.43	2.062	3.254	0.001*
	Female	9.0-37.0	26.55	4.69	0.47			
AGD	Male	17.0-38.8	27.50	3.33	0.33	1.496	3.251	0.001*
	Female	16.5-38.8	26.01	3.18	0.32			

Pearson’s correlation equation was applied for all measured acromial parameters among male and female scapulae. There was significant correlation among length & breadth, ACD & AGD among male scapulae ($p < 0.001$) (table 3).

Table 3: Correlation between different parameters in male scapulae

Correlations		L	B	ACD	AGD
L	r	1	0.441	-0.066	-0.026
	P-Value	---	$< 0.001^*$	0.517	0.795
B	r	0.441	1	0.059	0.127
	P-Value	$< 0.001^*$	---	0.559	0.208
ACD	r	-0.066	0.059	1	0.412
	P-Value	0.517	0.559	---	$< 0.001^*$
AGD	r	-0.026	0.127	0.412	1
	P-Value	0.795	0.208	$< 0.001^*$	---

Among female scapulae significant correlation was seen only between ACD & AGD (table 4).

Table 4: Correlation between different parameters in female scapulae

Correlations		a APL	b TD	ACD	AGD
L	r	1	0.192	-0.165	0.175
	P-Value	---	0.056	0.101	0.081
B	r	0.192	1	-0.005	-0.171
	P-Value	0.056	---	0.959	0.090
ACD	r	-0.165	-0.005	1	0.340
	P-Value	0.101	0.959	---	0.001*
AGD	r	0.175	-0.171	0.340	1
	P-Value	0.081	0.090	0.001*	---

Discussion

With the evolution of bipedal gait and more distal migration of deltoid insertion, scapula has shown enormous evolutionary changes. From being broad and short in pronograde man to long and slender in orthograde man, it has undergone various changes like broad and down sloping acromion, narrow coracoacromial arch and more laterally oriented glenoid cavity. All the above parameters contribute in compromising subacromial space.⁸

In 1972 Neer described impingement syndrome, according to him the anterior inferior part of acromion is the principal site of the disease. Even anterior acromial spur, one of the etiologies of impingement syndrome are due to acquired ossification of coracoacromial ligament, which is inserted to the inferior surface of anterior third of acromion⁹. In our study among 200 scapulae 105 (52.5%) had rough undersurface while 95 (47.5%) had smooth undersurface. In the literature Paraskevas reported rough undersurfaced acromion in 51 (57%) and smooth undersurfaced acromion in 37(42%) studied scapulae¹⁰. In other two studies done on Indian population Singh et al and Gupta et al found the undersurface of acromion to be rough in 57(44%) and 45 (90%) scapulae respectively, whereas the undersurface of acromion was smooth in 72 (55.8%) & 5 (10%) respectively^{11,12}.

Morphometry of acromion is an important factor implicated in the impingement syndrome of shoulder joint¹³. In our study mean acromion length recorded was 42.46mm which is agreement with all other studies like Paraskevas et al(46mm), Mansur et al (46mm), Sushmitha et al (41mm), Musa et al (45.85mm) except a study done on Chile population by Collipal et al where they reported length of acromion to be 65.8mm^{10,13,14,15,16}. Mean breadth of acromion reported in our study was 24.33mm and it is in agreement with that of other studies like Paraskevas et al (22.3 mm), Mansur et al (26.9 mm), Sushmitha et al (21.8mm), Musa et al (23mm) and Collipal (24.5mm)^{10,13,14,15,16}. In the literature acromio coracoid distance showed wide spectrum of measurement 15.48mm (Musa et al) – 39.6mm(Collipal et al^{15,16}. In our study ACD was 27.58mm which is in consistent with one more Indian study where they found it 28.4mm¹⁴. Lowest AGD was recorded by Parakevas (17.7mm) and highest by Mansur et al (31.9mm). In our study mean AGD was found to be 26.75mm, which is again in consistent with that recoreded by Sushmitha et al (26.2mm)¹⁴.

In the literature there are various studies regarding comparison of acromion morphometry in right and left scapulae but there are very few studies which throws light on sexual dimorphism of acromion morphometry (table 5).

Table 5: Comparison of acromion parameters with other studies with respect to gender

Study	Length		Breadth		ACD		AGD	
	Male	Female	Male	Female	Male	Female	Male	Female
Nicholson ⁹	48.5	40.6	19.5	18.5	-	-	-	-
Paras ¹⁰	48.3	43.9	22.6	22	28.9	27.3	17.9	17.5
Von Schroeder ¹⁷	50.7	43.6	22.9	20.4	28.7	24.6	16.1	14.9
Present Study	45.9	38.9	25.5	23	28.6	26.5	27.5	26

The mean value of length of acromion in both male and female scapulae is less compared to other studies^{9,10,17}. But higher values are recorded for the breadth of the male scapulae compared to other studies^{9,10,17}. Acromio coracoid distance is almost in agreement with values recorded in previous studies^{10,17}. Higher values are recorded for acromioglennoid distances for both male and female scapulae compared to other studies^{10,17}. Higher values of ACD & AGD enables the subacromial structures to glide smoothly within the subacromial space. These differences in the measured parameter among various studies could be because of study sample, different specimens and method followed.

There are many studies in the literature about the types of acromion and its morphometry. Few authors have correlated the acromion morphology of right and left scapulae. But there are very limited studies which throws light on sexual dimorphism of acromion morphometry. In this aspect our study stands unique in which we have compared the length, breadth, ACD & AGD among male and female scapulae and there is statistically significant difference of the above parameters with respect gender. Knowledge of morphometry of acromion and significant difference with respect to gender helps clinicians in diagnosing and planning for the treatment of subacromial pathologies. Morphometry of acromion process is also of interest to the anthropologist while studying about bipedal gait & evolution of erect posture in man.¹⁴

Conclusion

Morphometric parameters of acromion and its sexual dimorphism is quite important in diagnosing and treatment of subacromial pathologies. Morphometric analysis of acromion provides an additional knowledge for better understanding of shoulder disorders and treatment especially while planning acromioplasty.

Conflict of Interest: None

Financial Assistance: Nil

Ethical Clearance: As the study involved only dry scapulae, it was exempted.

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