Acromion – Anatomic Study of South Indian Dry Scapulae

Yogitha Ravindranath[1], Anusha Abraham[2], Davis John Thelekatt[3], Abel Thomas Oomen[3], Sister Johnsia[3]

ABSTRACT

Introduction: Various studies have reported the relative association of morphology of acromion and rotator cuff diseases. There is a strong genetic control over the variability in shape of the acromion. Considering this variability and the clinical relevance, the present study was aimed to document the quantitative measurements in South Indian acromions. Study objectives were to estimate the qualitative and quantitative parameters of the acromion among South Indian adult scapulae.

Material and Methods: An observational study was performed on acromion process of 130 scapulae. The acromion dimensions (maximum length, maximum width, maximum thickness, acromio-coracoid distance and acromio-glenoid distance) were measured using Vernier digital caliper. The prevalence of the type of acromion and the type of inferior surface of anterior third of acromion were also calculated.

Results: The mean acromial length was 40.97 ± 5.25mm, mean acromial width was 29.98 ± 4.44 mm, mean acromial thickness was 7.42 ± 1.31 mm, acromio-coracoid distance was 29.83 ± 4.74 mm and acromio-glenoid distance was 26.18 ± 3.14 mm. There was found to be significant difference in width, acromio-coracoid distance and acromio-glenoid distance between right and left sides. The prevalence of type of acromion was found to be: type I- 9.23%, type II- 89.23% and type III- 1.54%.

Conclusion: The morphometric data of acromion process and the types of acromion may be helpful for the orthopedicians during surgical repair around the shoulder joint.

Key words: Acromion, Morphology, Types, Rotator Cuff Disease

INTRODUCTION

Acromion is a flattened process presenting as an extension of dorsal surface of the spine of the scapula. Various studies have reported the relative association of morphology of acromion and rotator cuff disease[1-3]. The acromion process is associated with a variety of ailments in the shoulder joint[4]. One of the most important factors for the appearance of subacromial compression syndrome and rotator cuff ruptures is the morphology of acromion[5]. One of the causative factors for chronic shoulder pain is reported either due to rotator cuff injuries or the impingement syndrome. Etiological factors could vary from degenerative changes to variation in morphometry of the acromion. It is well known that the bony dimensions, shape, difference between sides and gender vary among human population. As reported by the anthropologists, variability in shape of the acromion may be influenced by epigenetic and developmental factors, and thus there is a strong genetic control over its overall form, such that variation within and between populations is being reported. Considering this variability and the clinical relevance, present study was aimed to document the quantitative measurements in South Indian acromions.

Study objectives were to estimate the qualitative and quantitative parameters of the acromion among South Indian adult scapulae.

MATERIAL AND METHODS

An observational study was performed on 130 (Right:53, Left:77) well preserved macerated adult acromion of unknown sex and definitive age, presumed to be of mixed South Indian origin from the collection of department of Anatomy, St John's Medical College, affiliated to Rajiv Gandhi University of Health Science, Bangalore, India. All acromions were inspected carefully and those damaged, fractured and showing pathological changes were excluded from the study.

The acromion was inspected for the types based upon the criterion suggested by Bigliani-Morrison-April classification. According to this method, the shape of the acromion was classified into three types: typeI (flat), type II (curved), type III (hooked)[1]. Inferior surface of anterior third of the acromion was also observed for roughness or smoothness in these types.

A total of five acromion dimensions were measured using Vernier digital caliper of MITUTOYO make and were expressed in millimetres. The variables and their measurement techniques were as follows:

Maximum Length (ML): The distance extending from anterior to posterior longitudinal axis of the acromion;

Maximum Width (MW): The distance between the medial and lateral borders of the acromion;

Maximum Thickness (MT): Measured from 1cm posterior to the anterior border and 1cm medial to the lateral border;

Acromio-coracoid distance (ACD): The distance measured from the tip of acromion to posterior border of coracoid;

Acromio-glenoid distance (AGD): The distance between supraglenoid tubercle and inferior surface of

[1]Professor, [2]Postgraduate student, [3]Undergraduate MBBS Students, Department of Anatomy, St. John's Medical College, Sarjapur Road, Bangalore- 560034, Karnataka, India

Corresponding author: Dr. Yogitha Ravindranath, Professor, Department of Anatomy, St. John's Medical College, Sarjapur road, Bangalore-560034, Karnataka, India

How to cite this article: Yogitha Ravindranath, Anusha Abraham, Davis John Thelekatt, Abel Thomas Oomen, Sister Johnsia. Acromion – anatomic study of south indian dry scapulae. International Journal of Contemporary Medical Research 2018;5(5):E11-E14.

DOI: http://dx.doi.org/10.21276/ijcmr.2018.5.5.18

Measurements (mm) n=130	Right n=53 Mean ± SD	Left n=77 Mean ±SD	Total n=130 Mean ± SD	p value
Length of acromion	41.77 ± 4.82	40.43 ± 5.49	40.97 ± 5.25	0.15
Width of acromion	32.24 ± 3.88	28.42 ± 4.13	29.98 ± 4.44	<0.001
Thickness of acromion	7.51 ± 1.29	7.35 ± 1.33	7.42 ± 1.31	0.52
Acromio-coracoid Distance	31.08 ± 4.82	28.97 ± 4.52	29.83 ± 4.74	0.012
Acromio-glenoid distance	26.96 ± 2.95	25.65 ± 3.16	26.18 ±3.14	0.018

Table-1: Descriptive statistics of measured variables between right and left Acromion

Type	n	Prevalence [%]
I [flat]	12	9.23%
II [curved]	116	89.23%
III [hooked]	2	1.54%

Table-2: Descriptive statistics of prevalence of types of acromion

Type of inferior surface of anterior third	n	Prevalence [%]
Rough	100	76.92%
Smooth	30	23.08%

Table-3: Descriptive statistics of prevalence of type of inferior surface of anterior third of acromion

Measurements (mm) n=130	Intra-class correlation coefficient
Length of Acromion	0.999
Width of Acromion	0.996
Thickness of Acromion	0.999
Acromio-coracoid Distance	0.999
Acromio-glenoid distance	0.965

Table-4: Descriptive statistics of inter observer reliability calculated for 5 measurements and estimated by the intra-class correlation coefficient.

acromion.

To ensure the reliability of measurements, each of the 5 variables were measured independently by three authors and the average was calculated for analysis (table1,2).

STATISTICAL ANALYSYS

The data was analysed by using SPSS version 24 software. The mean and standard deviation were calculated separately for the 5 measurements of right and left acromion. The difference between the means of right and left acromion was determined by the independent sample *t* test. Statistical significance was set at 'p' < 0.05. The prevalence of the type of acromion and the type of inferior surface of anterior third of acromion were also calculated. Inter observer reliability was estimated for the 5 measurements by intra-class correlation coefficient.

RESULTS

There was found to be significant difference in width, acromio-coracoid distance and acromio-glenoid distance between the right and left sides. But there was found to be no significant difference in length and thickness between the right and left sides (Table 1).

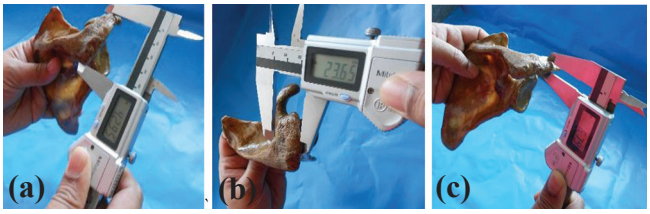

Figure-1: Method of measuring the length, width and thickness of acromion using digital Vernier caliper. a) Length of acromion-posterior view of right scapula; b) Width of acromion- superior view of right scapula; c) Thickness of acromion- posterior view of right scapula

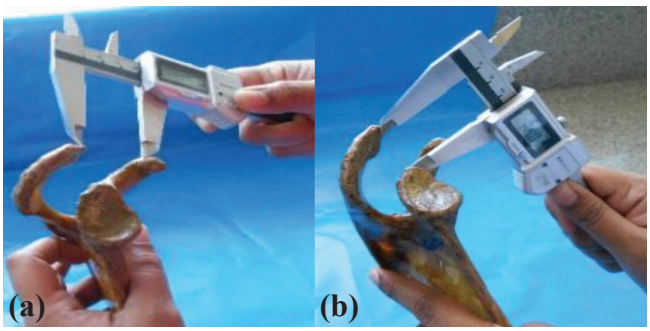

Figure-2: Method of measuring acromio-coracoid distance and acromio-glenoid distance using digital Vernier caliper. a) Acromio-coracoid distance: medial view of right scapula; b) Acromio-glenoid distance: medial view of right scapula

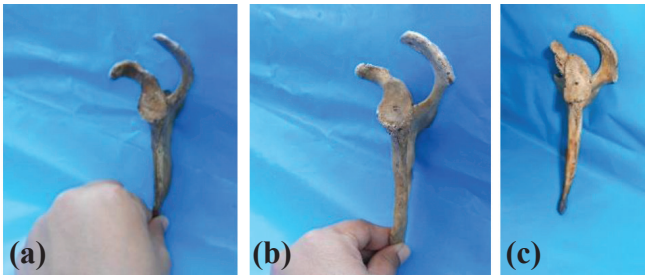

Figure-3: Showing the types of acromion. a) Type I [flat] acromion - medial view of left scapula; b) Type II [curved] acromion -medial view of left scapula; c) Type III [hooked] acromion - medial view of left scapula

The prevalence of type II acromion was found to be the highest and type III acromion the least (Table 2, figure 3).

The prevalence of rough type of inferior surface of anterior third of acromion was found to be more than 3 times that of smooth type (table-3).

The intraclass correlation coefficient for all the 5 measurements indicate that the data measured by the 3 different observers are in absolute agreement.

DISCUSSION

In the present study, the mean acromial length was found to be 40.97 ± 5.25mm, mean acromial width was 29.98 ± 4.44 mm, mean acromial thickness was 7.42 ± 1.31 mm, acromio-coracoid distance was 29.83 ± 4.74 mm and acromio-glenoid distance was 26.18 ± 3.14 mm. There was found to be significant difference in width, acromio-coracoid distance and acromio-glenoid distance between right and left sides. This difference can be attributed to differences in handedness, occupation or racial differences.

The prevalence of type of acromion in the present study was found to be: type I (flat)- 9.23%, type II (curved) - 89.23% and type III (hooked) - 1.54%. The most prevalent type is type II. The prevalence of type of acromion can depend on occupation, age or population. The prevalence of smooth type of inferior surface of anterior third of acromion was found to be 23.08% and rough type was 76.92%, which is more than 3 times that of smooth type. This can be again attributed to difference in occupation, age or gender.

David et al in 1995, did a clinical review on 56 shoulders. The acromial structure was seen on the plain film and MRI film. The shoulders were classified as acromial type I (flat), type II (curved), or type III (hooked). On plain radiographs 89% of type III acromions had tearing of the rotator cuff, but the association between acromial type and the presence of rotator cuff tearing as determined on magnetic resonance imaging was less significant. This proves that MRI had no additional benefit over plain radiographs for determining acromial type[3].

In 1996, Gregory et al did a study in 420 scapulae. The length, anterior width and anterior thickness of the acromion were measured with digital calipers, examined visually, and evaluated radiographically. Distribution of acromial morphologic types were type I (flat)- 32%, type II (curved)- 42% and type III (hooked)- 26%. Mean acromial dimensions in men were: length - 48.5 mm, anterior width - 19.5 mm and anterior thickness - 7.7 mm. Mean dimensions in women were: length - 40.6 mm, anterior width - 18.4 mm and anterior thickness - 6.7 mm. The acromial length in women and the thickness in both genders were comparable to our present study. The other parameters were not comparable with our study probably due to the method of study, population differences or racial differences[6].

Mako Hirano et al in 2002 have stated that the status of the rotator cuff and the shape of the acromion is visulaised by Magnetic resonance imaging. Among a group of 91 shoulders with rotator cuff tears, type 1 was found to be 36.3%, type II -24.2% and type III- 39.6%. Comparison of the incidence of each acromial shape between groups of specimens with and without rotator cuff tears revealed no significant differences. The difference in the prevalence of types of acromion compared to the present study can due to the difference in methodology or ethnic and racial differences[7].

In 2006, Nigar et al did a study in Turkish population. They classified 90 dry bones of the scapula, according to morphological types of acromion- Type I was seen in 11%, type II in 66% and type III 23% of the specimens. For the radiological evaluation, the postero-anterior and the lateral shoulder radiographs of 90 consecutive adult patients with normal findings were used. The distribution of the acromial morphologic types seen in radiograph according to slope was type I (flat) 10%, type II (curved) 73%, type III (hooked) 17%. The proportion of type I acromion found using both methods is similar to our present study. The proportion of other types differ from our study mostly due to population differences[8].

In 2014, Musa et al conducted a study in 73 patients. This study was conducted on patients without any shoulder disease. Images were obtained from the patients whose scapulae could be imaged completely through multidetector computed tomography (MDCT). Totally 146 scapulae, including 73 right and 73 left scapulae were examined. The acromial width, acromial length and acromio-coracoid distance were measured and compared between both sides. There was no significant difference between right and left sides unlike our study. Also the percentage of different types of acromion was found to be: type I [flat]-37%, type II [curved]- 48.7% and type III [hooked]-13.7% which is also much different from our study. These differences can be attributed to handedness, genetic variation or racial differences. Also, our study was based on dry bones which may also have led to the differences[5].

Wael Amin and Mona Hassan in 2015 did a study on 160 scapulae of Egyptian population. Morphological shapes and types of acromion were evaluated. The length, breadth and thickness of the acromion process and the acromio-coracoid and acromio-glenoid distances were measured. The maximum breadth [32.05±3.88 mm], thickness [9.06±2.68mm], acromio-coracoid distance [31.34±3.64mm] and acromio-glenoid distance [27.39±3.01mm] were found to be similar to our study. Also, the inferior surface of acromion was smooth in 86.88% and rough in 13.12% of acromion. The percentage of types of acromion was found to be type I- 26.88%, type II- 45.62% and type III- 15%. The major cause of difference between the above measurements and the measurements of the present study is most likely to be due to the population differences[9].

In another study conducted by Rohini and Manoranjitham [2016], 105 scapulae were taken [52 right and 53 left] and morphological types of acromion process were found. These were: type I (flat)- 40.95%, type II (curved)-48.57% and type III (hooked)-10.47%. Type II was found to be more frequent than type I or type III. This is similar to our study even though the prevalence percentage was much different[10].

In a study conducted by Vinay and Sheela in South Indian population in 2017, 164 dry adult scapulae were taken. The mean acromial length was 42.47 ± 4.68 mm, the mean acromial width was 26.57 ± 3.28 mm, the mean acromio-coracoid distance was 34.05 ± 4.94 mm and the average acromio-glenoid distance was 30.05 ± 4.08 mm. The length of the acromion [42.47 ± 4.68 mm] measured was found to be similar to our study, which was also done in South Indian population. The prevalence of type of acromion was also

assessed - type I (flat) was seen in 37.1%, type II (curved) in 47.5% and type III (hooked) in 15.2%, which were not comparable with our study and the reason can be attributed to genetic factors, age or occupation. An independent student's t-test was used to compare quantitative variables. Statistical significance was set at 0.05. There was no significant difference in length, maximum width, acromio-coracoid and acromio-glenoid distance between right and left sides which is not similar to our study which can be attributed to the handedness in all likelihood[4].

The acromial type according to Bigliani was not associated with any particular cuff lesion[11].

Robert etal in 1993 found an association between the morphology of the acromion and the occurrence of rotator cuff tear. The authors studied acromial morphology on magnetic resonance images of a control population (47 shoulders), of patients with isolated impingement (30 shoulders), and of patients with full-thickness rotator cuff tears (34 shoulders) to assess the association of acromial shape with disorders of the rotator cuff. Acromions were classified as flat (type 1), smoothly curved (type 2), or hooked (type 3) and patients with rotator cuff tear and impingement were found to have a significantly increased prevalence of type 3 acromions[12].

The limitation of the study was that there could be manual errors during measurement of the acromion. Also, there could be variation in measurements of acromion according to age, race, population, occupation or genetic variations, which makes it difficult for comparison. Moreover, the present study was done on dry bones which may be of less accuracy compared to radiologically assisted methods.

CONCLUSION

The morphometric data of acromion process and types of acromion may be helpful to the orthopedician during surgical repair around the shoulder joint.

ACKNOWLEDGEMENT

Authors would like to thank the staff of department of Anatomy, St John's Medical College for their unconditional support and help during the study period. We would also like to thank Mr. John Michael Raj, Lecturer, Department of Biostatistics, St John's Medical college. No financial support was provided for this study from any source.

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Source of Support: Nil; **Conflict of Interest:** None

Submitted: 22-04-2018; **Accepted:** 25-05-2018; **Published:** 07-06-2018