Original Article

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Osteometric Analysis of Clavicular Facet of the Acromion Process and Degenerative Changes of the Acromion

Anatomy Section

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ABSTRACT

Introduction: Osteometric evaluation of the acromion process and related structures contribute a lot for the pathomechanics of impingement syndrome and instability of the acromioclavicular joint.

Aim: To determine the morphometry of the clavicular facet of the acromion process and to observe some of the morphological degenerative changes in the acromion process.

Materials and Methods: The present observational study was conducted on 110 adult dry scapulae of both sexes from the Department of Anatomy, SGT University, Gurugram, Haryana, India. The clavicular facet on the acromion process was studied for different parameters like length and width along with the distance of the facet from the tip of the acromion process by a digital vernier caliper. Morphological features of the acromion suggestive of degeneration were also examined by visual inspection like presence of spur or facet, consistency and regularity of undersurface of the acromion and the shape of the tip of the acromion process were also determined. Data obtained from the observation was tabulated and statistical analysis was performed.

Results: The average values of each parameter were: length of the facet 10.32 mm and 10.06 mm on right and left side respectively; width 6.52 mm and 5.69 mm on right and left side and distance 9.39 mm on the right and 8.24 mm on the left side. The percentages of the shape of tip of the acromion process was mostly cobra shaped 44.54% followed by square tip 33.63% and least was intermediate type 21.8%. It was also noted that the degenerative change like spur or facet were present among 28.2% scapulae in the anterior third of the acromion and the undersurface of acromion was mostly rough with a consistency of thick acromion process.

Conclusion: Osteometric analysis and morphological evaluation will act as a baseline data for the clinicians especially orthopaedic surgeons as it will be of great help for them to diagnose the cases and to perform operative procedure of acromioclavicular joint instability.

Keywords: Acromial facet, Acromial degeneration, Acromioclavicular joint, Morphology

INTRODUCTION

The scapula, is a flat triangular bone present on the posterolateral aspect of the thoracic wall extending from 2nd to 7th ribs [1]. The bone is predisposed to fracture, dislocation, tumours, developmental annotations and many pathological conditions which make an impact on the proper functioning of the shoulder joint [2]. The bone consists of dorsal and costal surfaces with three angles and two prominent processes; coracoid, the long spinous process and the acromion process which is in the continuation of spine of the scapula [3]. It is one of the major components of the pectoral girdle, carrying an important role in the movements of the upper extremity. Among the two processes, the acromion projecting forward, contributes to the formation of coracoacromial arch having numerous morphological variations [3]. In the medial border of the acromion process, there is a facet present to articulate with the distal part of the clavicle to form the acromioclavicular joint which is a diarthrodial joint enclosed by a capsule with intra articular synovium and an articular cartilage in it [4]. It was observed that the average size of the joint surface among adult population is almost 9 mm vertically and 19 mm antero-posterior side and the width range from 1 to 3 mm, both the measurements are variable in relation to age and sexes [5].

The acromioclavicular and coracoclavicular ligaments are the two responsible for the proper functioning and stability of acromio clavicular joint by sheering forces and translating resistance at the time of combined movement with glenohumeral articulation [6]. Most of the time, among athlete injuries of the shoulder affects the acromioclavicular joint but newer advances in biomechanics of the joint helped in the treatment modalities to restore proper activities [7]. So, acromial morphology a potential source of symptoms occurring in shoulder joint pathologies was described long back by Hamilton FH [8]. Neer CS, finally stated the cause and association of acromial morphology with rotator cuff abnormalities [9]. The most popular classification of acromial morphology was given by Bigliani LU et al., they describe the acromion process as flat; curved and hooked types and also concluded a higher incidence of hooked acromion was one of the predisposing factor for rotator cuff tears [10]. The site of impingement was noticed as it occurs against the anterior one third of acromion or coracoacromial ligament; at times the inferior aspect of acromioclavicular joint [10,11]. It has been described by Ogata S and Uthoff HK that spur can also develop in the substance of coracoacromial ligament which can be factor for the impingement [12]. Finally, degenerative changes of the acromion can occur because of longstanding shoulder pathologies [13].

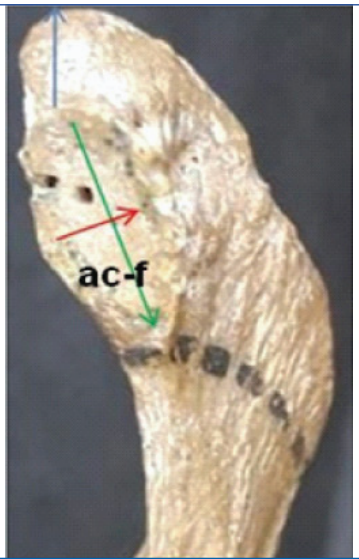
Among different varieties of degenerative changes of the acromion, the spur or facet degeneration, roughness of the undersurface of acromion, extremely thickened acromion these are the commonly seen stated by Edelson JG and Taitz C [14]. But, they mentioned the acromioclavicular degeneration was usually a separate entity from the spur or facet degeneration of the acromion process. The size and slope of the acromial facet of acromioclavicular facet was also variable [15]. Knowing the clinical and applied aspect of the acromioclavicular facet and degeneration of acromion process, the present osteometric evaluation along with degenerative changes of the acromion process have been conducted as there is a paucity of literature regarding these variables among Indian population. It is expected that, these baseline data will help the clinicians to

diagnose the case and to decide for better surgical interventions for the patients.

MATERIALS AND METHODS

The current observational study was performed on 110 completely ossified dry scapulae of unknown sexes collected from the osteology museum Department of Anatomy, Faculty of Medicine and Health Sciences, SGT University, Gurugram , Haryana, India, over a period of one and half year (since October 2018). The exact age of the specimens was not known, but were estimated as the mature adult individuals (the specimens were anonymised, randomly coded and de-linked from any identity sources, ICMR National guidelines for biomedical and health research involving human participants, ICMR, 2017, sec 5, Box 5.2).

Each of the scapulae were examined for the general anatomical features and among 110 scapulae, 43 were found to be of right side and 67 scapulae were considered as left sided bones. We have conducted osteometry for the articular facet for the clavicle in the acromion process where the vertical and transverse diameters of the facet along with distance of the anterior most point of the facet to the tip of the acromion process were measured. All the morphometric parameters were measured by the help of an electronic digital vernier caliper (accurate up to 0.01 mm; 0-150 mm; Metric/ imperial dual reading). The landmark for the length; width and distance of the facet to the acromion were as follows: length of the facet was measured from the anterior most part of the facet up to the posterior end vertically; width was measured transversely from the medial to the lateral border of the facet at the middle of it; distance between the anterior most point of the facet to the tip of the acromion process were also measured. The landmark for all the morphometric parameters has been displayed in the [Table/Fig-1].



[Table/Fig-1]: Measurements of the clavicular facet of acromion. ac-f = clavicular facet for the acromion; Three different arrows; vertical green = for the length, horizontal red = for the width and oblique blue arrow= distance of anterior most point of ac-f to the tip of the acromion.

Morphological evaluation of acromion processes was also conducted which suggested as the degeneration of the acromion by subjective evaluation. All the scapulae were examined to determine the shape of the tip of the acromion process (square tip; cobra shaped or intermediate), any evidence of osteophytic spur formation or facet presentation with their location and the undersurface of the acromion was studied for the smooth or rough appearance according to Edelson JG and Taitz C [14]. The acromion processes of all scapulae were also examined for the consistency, whether thick or a thin acromion by visual observation [14]. For each morphological feature, number of the specimen and their percentages were calculated for both the sides. Photography was done for the proper documentation and is exhibited in the results.

STATISTICAL ANALYSIS

All the measurements were taken twice and the average was taken of the study to reduce the error. Data obtained from the observation was tabulated and analysed using Statistical Package for the Social Sciences (SPSS) version 21 software. Maximum, minimum, mean and standard deviation for the morphometric parameters was calculated and the data compared on both sides; F-value and p-value both were also mentioned; p-value less than 0.05 (≤0.05) was considered as significant.

RESULTS

In the current study, 110 scapulae were evaluated for the morphometric parameters of the facet present on the acromion as well as some morphological degenerative features of the acromion process. The morphometric evaluation of the acromial facet is shown in [Table/Fig-2-4]. The position of the clavicular facet on acromion was inferiorly facing among most of the scapulae; only a few scapulae were showing an overriding acromioclavicular facet.

Length of acromial facet	No.	Min.	Max.	Mean±SD	F-value	p-value
Right side	43	5.56	19.96	10.32±2.68	0.28	0.59
Left side	67	5.34	17.21	10.06 ±2.32		

[Table/Fig-2]: Length of clavicular facet of acromion among right and left sided scapulae (p≤0.05).

Width of acromial facet	No.	Min	Max	Mean±SD	F-value	p-value
Right side	43	3.74	9.46	6.52±1.54	9.12	0.003
Left side	67	2.4	8.18	5.69±1.29		

[Table/Fig-3]: Width of clavicular facet of acromion on both sides (p ≤0.05).

Distance of clavicular facet of acromion to the tip of the acromion	No.	Min	Max	Mean±SD	F-value	p-value
Right side acromion facet.	43	4.13	16.62	9.39 ± 2.54	6.47	0.01
Left side acromion facet.	67	4.03	13.08	8.24 ± 2.18		

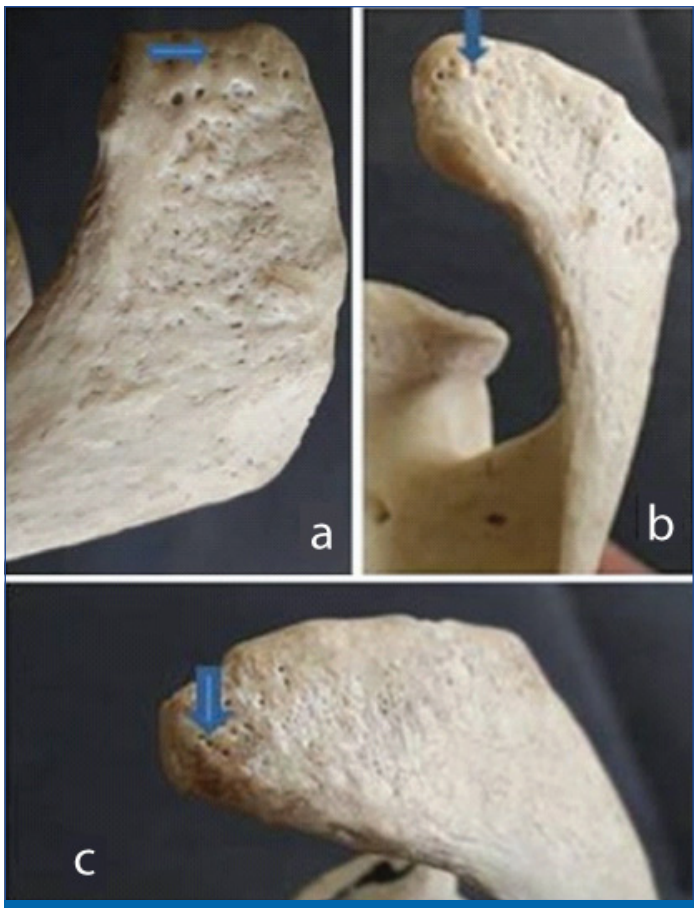
[Table/Fig-4]: Distance of clavicular facet of acromion to tip acromion on both sides of scapulae; (p ≤0.05).

Among the 110 scapulae, maximum frequency was observed for the cobra shaped tip of the acromion process which was 44.54% followed by the square tip acromion 33.6% and intermediate type was the least 21.8%. Cobra shaped tip of the acromion process was mostly seen on the right sided bone but the frequency for square shaped and intermediate type of acromion were most commonly visible in the left side of the scapulae; the frequency distribution of all the three different types of tip of the acromion process on both sides has been shown in [Table/Fig-5] and photographs for three types of acromion process is displayed in [Table/Fig-6].

Side of the scapula	Total number of specimen	Shape of tip of the acromial process					
		Square tip		Cobra shaped		Intermediate	
	n	n	%	n	%	n	%
Right side	43	10	23.25	28	65.11	5	11.6
Left side	67	27	40.29	21	31.3	19	28.35
Both sided scapulae	110	37	33.63	49	44.54	24	21.8

[Table/Fig-5]: Frequency distribution of scapulae according to the shape of tip of the acromial process.

In the present study, acromion process was studied to determine whether the undersurface was rough or smooth; it was observed by visual inspection that the frequency for the rough undersurface of acromion was 64.5% which was higher than smooth undersurface which was only 35.4% and both were observed more among the left sided scapulae which has been documented in [Table/Fig-7].



[Table/Fig-6]: Morphological variations of the tip of the acromion process by blue arrows for all the scapulae: a) acromion with a quadrangular shaped tip; b) acromion with a cobra shaped tip; c) intermediate tip acromion process.

Undersurface of the acromion process	Number of the scapulae		Right sided scapulae		Left sided scapulae	
	n	%	n	%	n	%
Rough	71	64.5	27	38.02	44	61.9
Smooth	39	35.4	16	41.02	23	58.9
Total	110		43		67	

[Table/Fig-7]: The distribution of rough or smooth under surface of acromion process on both sides of scapulae.

In the present observation, spur or facet type degeneration was noticed acromion process and it was among 28.2% scapulae; mostly in the left sided specimen. All were visible in the anterior one third of acromion process with a higher frequency of facet type degeneration as compared to spur formation has been exhibited in the [Table/Fig-8] and the images have been displayed in [Table/Fig-9]. It was noticed that facet and spur formation were mostly observed among the acromion process having a rough undersurface.

Type of degeneration	Number of the scapulae		Right sided scapulae		Left sided scapulae	
	n	%	n	%	n	%
Spur	14	45.2	5	35.7	9	64.2
Facet	17	54.8	7	41.1	10	58.8
Total scapulae with degenerative changes	31	28.2	12	38.7	19	61.3

[Table/Fig-8]: Frequency distribution of spur and facet type of degeneration at the anterior one third of acromion process.

Apart from all the mentioned morphological changes of the acromion process, it was observed that the consistency of the acromion by subjective evaluation and it was thick among 62.7% of the scapulae and thin acromion was only 37.2% which has been presented in [Table/Fig-10] and the image of a thick acromion process is shown in [Table/Fig-11].

[Table/Fig-9]: a) Facet degeneration marked by the red arrow on the rough undersurface of the acromion; and b) Spur type of degeneration is visible in the acromion pointed by red arrow and the acromioclavicular facet; has been marked in blue arrow. Both the degenerative changes are visible in the anterior one third of the acromion process

Acromial consistency	Number of the scapulae		Right sided scapulae		Left sided scapulae	
	n	%	n	%	n	%
Thick acromion	69	62.7	29	42.03	40	57.9
Thin acromion	41	37.2	14	34.1	27	65.8
Total no of scapulae	110		43		67	

[Table/Fig-10]: Distribution of scapulae according to the acromial consistency on both sides.

[Table/Fig-11]: A very thick acromion process with an overriding acromioclavicular facet (pointed by the blue arrow).

DISCUSSION

Shape of the acromion process is highly variable and has been mentioned in previous studies. Among all, Bigliani LU et al., had given the most popular classification and described the acromion as flat; curved followed by the hooked type which was also mentioned as the influence degenerative process of the acromion [10,16,17]. Neer CS, established the influence of various shapes of acromion with shoulder pathologies especially impingement syndrome [18]. This association is most commonly observed in orthopaedic examination for the mentioned pathology [19]. In one of our previous study, we also have concluded a strong relationship of acromial morphology with rotator cuff pathologies [20]. We have also classified the acromial slope by objective evaluation and the morphometric parameters of acromion with related structures among Indian population [21,22]. Most recently in 2018, the acromial variability and dimensions were determined

among Turkish population [23] but, it was noticed that, there is a paucity of literature regarding the various dimensions; location and degenerative changes of the clavicular facet of acromion as well as anterior acromial degenerative changes. Though, the facet is very close to the tip of the acromion process, so degenerative changes can be seen in both these structures which bear lots of clinical relevance. Very few researches have been undertaken for the morphometric evaluation of the clavicular facet of the acromion among Indian population which has been tabulated in [Table/Fig-12] [24,25].

It has been well stated that, the distance of clavicular facet up to the tip of the acromion was studied only in present study; will be a reference data base useful for the clinicians. As per as the length and width concern, present study results is little different as the dimensions are a little less as compared to other research work. In present study, the mean values were higher at the right side than the left irrespective to gender which was similar in both the above research though the study was on different group of population.

The morphology of acromial slope was described in the literature [10,20,21] but the shape of the tip of the acromion process was less documented. The comparative anatomical distribution of different shapes of tip of the acromial process has been described in [Table/Fig-13] [14,23,26-28].

In most of the studies, there is higher frequency of intermediate type of tip of the acromion process which is different from present study result. Among the Indian population, the cobra shaped tip of acromion is the most frequent followed by square type and a least percentage has been observed for the intermediate type. The frequency of cobra shaped acromion was almost similar as study done by Boyan N et al., among Turkish population [23].

To the best of our knowledge, very few studies have been conducted for the degenerative changes of the acromion except the study performed by Edelson JG and Taitz C [14] where these degenerative changes of acromion process were observed. Similarly in present study , we have also examined the morphological features among Indian population but the sample size was different. In present study, the undersurface of most of the scapular acromion processes were rough with thicker consistency along with the presence of spur or facet degeneration projecting towards the inferior aspect of the acromion in the its anterior one third; this results were as in consonance with the study done by Edelson JG and Taitz C [14]. But, present study result was different from Nasr El-Din WA and Mohammed Ali MH, result as they observed a higher frequency of scapulae with smooth undersurface among Egyptian population [28].

Authors	Year	Sample size	Population		Parameters (in mm)		
					Length (mm)	Width (mm)	Distance of facet from the tip of acromion (mm)
Gosavi S et al., [24]	2015	127	Indian (Maharashtra)		13.81	7.69	-
Singroha R et al., [25]	2018	100	Indian (Rohtak)		13.82	7.33	-
Present study	2020	110	Indian (Gurugram)	Right	10.32	6.52	9.39
				Left	10.06	5.69	8.24

[Table/Fig-12]: The comparative analysis of morphometric evaluation of clavicular facet of acromion process among Indian population [24,25].

Authors	Year	Population	No of sample	Frequency of the shape of the tip of the acromion process (%)		
				Square type (%)	Cobra shaped (%)	Intermediate (%)
Edelson JG and Taitz C [14]	1992	Israel	280	22	33	45
Boyan N et al., [23]	2018	Turkey	73	7.5	45	47
Nigar C et al., [26]	2006	Turkish	90	13	31	56
Mansur DI et al., [27]	2012	Nepal	68	52		
Amin W et al., [28]	2015	Egypt	160	31	15	53
Present study	2020	Indian	110	33.6	44.5	21.8

[Table/Fig-13]: Frequency distribution of different shapes of tip of the acromial process among different population group [14,23,26-28].

Limitation(s)

In the current study, morphometric evaluation and morphological features of acromion process was performed irrespective to the gender which can be added later by performing the study in relation to sex differentiation. Moreover, the number of dry specimens can be increased for the further project.

CONCLUSION(S)

Morphometric parameters for the clavicular facet of the acromion process carry a vital role for the treatment of acromioclavicular joint instability especially for the sports medicine specialist. Degenerative changes of acromioclavicular facet can be a potential source for acromioclavicular joint instability and rotator cuff pathologies. So, both morphometric evaluation and degenerative morphological changes of acromioclavicular facet have a great influence in the pathogenesis and treatment of shoulder impingement syndrome.

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