



MORPHOMETRIC ANALYSIS OF FULLY OSSIFIED CLAVICLE BONES IN NORTH INDIAN POPULATION

Anatomy

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ABSTRACT

The clavicle is considered to be an important bone while dealing with sex difference in skeletal material. Clavicle possesses sex, side, activity, laterality and occupation dependent osteological variations in its features and these factors need to be considered while carrying out forensic anthropological or clinical (orthopedic or anatomical) examination using this bone. Clavicle has an additional forensic advantage of being having extended growth period sufficient to indent additional identifying features in it. The present study included 84 fully ossified clavicle bones (42 right sided and 42 left sided) of unknown sex and age. Parameters maximum length, acromial breadth and height of clavicle, sternal breadth and height of clavicles were studied. All measurements were taken with the help of vernier caliper and measured in mm. The maximum length of clavicles, height and width of clavicles of sternal end of clavicle were found higher in left sided clavicle while height and width of acromial end of clavicles were found higher in right sided clavicles. These variations could be due to racial, genetic or mechanical factors. The orthopaedic surgeons should consider these variations as it will be useful during the surgical correction procedures of clavicle fractures.

KEYWORDS

Acromial end, Clavicle, Sternal end, Variations

INTRODUCTION:

Variations in the morphology and measurements of clavicle has been a subject of interest for the researchers. These measurements help to determine the age, gender and stature of an individual. The clavicle is a modified long bone which lies horizontally at the root of the neck. It is subcutaneous bone which has a sternal and an acromial end. The shaft of clavicle is curved with convexity forwards in its medial 2/3rd and concavity forwards in its lateral 1/3rd.¹

Fractures of the clavicle are most common and 70-80% are occurs at the middle third of the shaft of bone. Fractures of clavicles account for 2-5% in adults, 10-15% in children and for 44-66% of all shoulder fractures. Variations in the size and dimensions of clavicle bone are very important in clinical cases of fracture-fixation of internal or external medullary devices as well as in forensic and anthropological purposes for identification of sex of an individual and for medico-legal purposes.²

Usually, the right sided long bones in human beings are longer and larger than those left sided. The weight and length of right sided clavicles was also found heavier and longer than left sided clavicles.³

MATERIALS AND METHODS:

The present observational study was carried out in the department of Anatomy, Rama Medical College, Hapur, UP. The present study included 84 fully ossified clavicle bones (42 right sided and 42 left sided) of unknown sex and age. The bones were dried, macerated, cleaned and observed for any physical deformity.

Bones were excluded which were having any type of deformity, damaged and gross pathological abnormality. Parameters maximum length, acromial breadth and height of clavicle, sternal breadth and height of clavicles were studied. All measurements were taken with the help of vernier caliper and measured in mm.

1. Maximum length: is the maximum distance between the two ends of the clavicle. (Fig 1)
2. Acromial breath of clavicle: is the maximum width of acromial end of the clavicle. (Fig 2)
3. Acromial height of clavicle: is the maximum of acromial end of clavicle. (Fig 2)
4. Sternal breadth of clavicle: is the maximum width of the sternal end of clavicle. (Fig 3)
5. Sternal height of clavicle: is the maximum height of the sternal end of the clavicle. (Fig 3)
6. Presence of articular facet at conoid tubercle (Fig 4)

All the data was recorded in the Microsoft excel sheet and analysis of data was done by SPSS software version 21.0 and p-value ≤ 0.05 was considered as statistically significant.



Figure 1: Measurements of maximum length of clavicle.



Figure 2: Measurements Of Acromial Breath And Acromial Width Of Clavicle.



Figure 3: Measurements Of Sternal Width And Sternal Height Of Clavicles.



Figure 4: Presence of articular facet in conoid tubercle.

RESULTS:

A total of 84 dried and cleaned adult clavicles of unknown sex were studied by measuring their length, height and width of acromial end, height and width of sternal end and presence of articular facet on the conoid tubercle of the clavicles.

Table 1: Showing comparison of maximum length of both sided clavicles.

Data	Right clavicles (mm)	Left clavicles(mm)	Total clavicles (mm)
No. of bones	42	42	84
Mean	138.85	141.54	140.2
Standard deviation	1.057	1.094	1.08
Mode	13.20	15.0	15.00
Median	13.9000	14.10	14.00
Range	11.20-16.20	11.30-16.90	11.20 – 16.9
P- value	0.04		0.001

In this table, the mean value of maximum length of clavicles was found higher in left sided clavicles (141.54mm) in comparison to right sided clavicles (138.85mm). There was statistically significant difference was observed in left sided clavicles. In total clavicles, maximum length of clavicles was found statistically significant (p=0.001).

Table 2: Showing comparison of maximum height of acromial end of both sided clavicles.

Data	Right clavicles (mm)	Left clavicles (mm)	Total clavicles (mm)
No. of bones	42	42	84
Mean	10.96	10.74	10.85
Standard deviation	1.75	1.68	1.71
Mode	9.50	9.30	10.86
Median	10.51	10.78	10.57
Range	7.59-15.62	6.78-16.80	6.78-16.80
P- value	0.359		0.001

This table showed that the mean values of right-sided clavicles (10.96mm) were observed higher in comparison to left sided clavicles (10.74mm). No statistically significant difference was found. In total clavicles, statistically significant difference was observed (p=0.001).

Table 3: Showing comparison maximum width of acromial end of clavicles.

Data	Right clavicles (mm)	Left clavicles (mm)	Total clavicles (mm)
No. of bones	42	42	84
Mean	24.50	21.97	23.23
Standard deviation	3.93	4.17	4.22
Mode	24.70	23.59	21.18
Median	24.46	21.08	23.35
Range	17.31 - 33.78	15.76 - 34.42	15.76 – 34.42
P- value	0.001		0.001

On comparison between right and left clavicles, the mean values width of acromial end of right sided clavicles were found to be higher than left sided clavicles and statistically significant difference was observed in right sided clavicles (p=0.001). In total clavicles, the mean value of width of acromial end of clavicles, statistically significant difference was found (p=0.001).

Table 4: Showing comparison of maximum height of sternal end of both sided clavicles.

Data	Right clavicles	Left clavicles	Total clavicles
No. of bones	42	42	84
Mean	21.13	21.51	21.32
Standard deviation	3.12	2.89	3.00
Mode	20.03	20.53	20.03
Median	21.13	21.19	21.17
Range	14.22-28.21	15.27-29.01	14.22-29.01
P- value	0.462		0.001

The mean values of the height of sternal end of clavicles was observed higher in left sided clavicles (21.51) in comparison to right-sided clavicles (21.13) and no statistically significant difference was observed. In total clavicles, there was significant difference was observed (p=0.001).

Table 5: Showing comparison of maximum width of sternal end of both sided clavicles.

Data	Right clavicles	Left clavicles	Total clavicles
No. of bones	42	42	84
Mean	20.93	21.05	20.99
Standard deviation	3.10	3.31	3.19
Mode	19.38	20.46	19.38
Median	20.58	21.22	20.71
Range	15.27-26.61	14.86-29.49	14.86-29.49
P- value	0.819		0.001

The mean values of the width of sternal end of clavicles was observed higher in left sided clavicles (21.05) in comparison to right-sided clavicles (20.93) and no statistically significant difference was observed. In total clavicles, there was significant difference was observed (p=0.001).

Table: 6 Showing the presence of articular facet on the conoid tubercle (CCJ).

Parameter	Right-sided (42)	Left-sided (42)	Total (84)
Presence of no. of facets for CCJ	2	2	4
Frequency	4.76%	4.76%	4.76%

Out of 84 clavicles, only in 4 (4.76%) clavicles had articular facet for CCJ on conoid tubercle. Out of 4 facets, 2 were present on right sided clavicles and 2 were present in left sided clavicles.

DISCUSSION:**Maximum Length of clavicle (ML):**

While doing comparison of the work of other authors regarding the mean length of clavicle, it was seen that the length of clavicle was not same in different population and races. In the present study, the mean length of clavicles in right clavicles was 138.85±1.075mm and in left sided clavicles was 141.54±1.094mm which was less than the findings of Olivier G et al⁴, Terry RJ (Negros) et al⁵, Terry RJ et al (Whites)⁶, Parsons FG et al⁷. The mean length of present study was found to be similar to Singh S et al (Whites USA)⁸ and higher than Sudha R et al². The present study also supports the previous study that the maximum length of clavicle in males was found greater than in female clavicles. The average length of the clavicle in north Indian population was less when compared to the English, Nepalese, American White & Negroes and the French. Auerbach and Ruff states that the racial and genetic differences play a great role in the variations of the features of the clavicle. Other explanation offered for the patterns of bilateral asymmetry among clavicles is the role of mechanical forces. The length of the clavicle as recorded by different workers in western countries and in India was given in Table 1 and 2.

Table 1 Comparison of maximum length of clavicle of present study with western studies.

Population	Total bones examined	Right Max. length (in mm)		Left Max. length (in mm)	
		Male	Female	Male	Female
English (Parsons FG) ⁷	100 (50 M & 50 F)	152	138	154	139
U. S. A Negroes (Terry RJ) ⁵	100 (50 M & 50 F)	153.30±0.83	140.98±0.76	155.86±0.92	141.78±0.03
French (Olivier G) ⁴	170 (110 M & 60 F)	154.20	137.90	155.00	138.70
U. S. A. Whites (Terry RJ) ⁶	50	152.90±0.88		154.10±0.91	
U. S. A. Whites (Singh S) ⁸	230	151.40	133.68	153.37	134.84
Haque Mk et al ³	257	143.21±11.13		145.53±11.04	
Present study (North Indian population)	84 (42 R & 42 L)	138.85±1.07		141.54±1.09	

Table 2: Comparison of maximum length of clavicle of present

study with different zones of India

Population	Total bones examined	Right Max. length (in mm)		Left Max. length (in mm)	
		Male	Female	Male	Female
Amritsar zone (Jit I et al) ⁹	348 (236M & 112F)	145.58±8.60	130.36±9.11	147.59±9.25	129.80±1.77
Chandigarh zone (Jit I et al) ¹⁰	360 (280 M & 80 F)	148.00±8.60	132.40±8.40	149.80±8.40	134.00±8.10
Chandigarh zone (Kaur H et al) ¹¹	1000 (748 M & 252 F)	149.40±8.91	134.53±9.68	151.14±8.72	136.21±9.64
Varanasi zone (Singh et al) ¹²	97	141.49±8.22	125.78±7.50	144.18±8.01	127.77±8.09
Present study (North Indian population)	84 (42 R & 42 L)	138.85±1.07		141.54±1.09	

The mean values of acromial height of clavicles were similar to the findings of Padeyappanavar (2012)¹² and Suryawanshi AK et al (2015)¹³ while not similar to Patil AB (1996)¹⁴. The findings of the width of acromial end of present study was observed similar to Dongen RU (1963)¹⁵ while dislike to Patil AB (1996)¹⁴ and Padeyappanavar (2012)¹². Coracoclavicular joint (CCJ) is most commonly found in the Gorilla and Gibbon but in human beings, it is rare. The incidence of CCJ joint in the present research was similar to the findings of Jaluvka (1956)¹⁶ and Das SS et al (2016)¹⁷ while incidence of CCJ was not similar to the finding of Mariano et al (2013)¹⁸, Nehme et al (2004)¹⁹, Gumina et al (2002)²⁰. It was described in 1861. previous studies suggested that the presence of CCJ may be occurred due to geographical migration, not due to environment, genetic or evolutionary factors.

CONCLUSION:

Presence of CCJ predispose to degenerative changes of the sternoclavicular and acromioclavicular joints. The knowledge of this joint is important for surgeons and orthopedicians for identifying the cause of undiagnosed shoulder pain and steps which followed for managing and treating this condition. The present study will be helpful for orthopedic surgeons for correct surgical procedures of clavicle fractures. These parameters are also useful for the forensic experts in medico-legal issues and for anthropologists to study evolution of human beings and migration of races.

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