



Morphometric analysis of fully ossified clavicle bones in North Indian Population: A Study

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ABSTRACT

The clavicle bone is an essential anatomical structure that plays a crucial role in shoulder girdle function, as it serves as an attachment site for various muscles and ligaments. The clavicle bone is also important in forensic medicine, as it is frequently used for age and sex estimation. The aim of this study is to perform a morphometric analysis of fully ossified clavicle bones in the North Indian population and compare our findings with previous studies. The clavicle is considered to be an important bone when dealing with sex differences in skeletal material. The present study included 84 fully ossified clavicle bones (42 right-sided and 42 left-sided) of unknown sex and age. Parameters like maximum length, acromial breadth and height, and sternal breadth and height of clavicles were studied. All measurements were taken with the help of a vernier caliper and measured in mm. The maximum length, height, and width of the sternal end of the clavicle were found to be higher in the left-sided clavicle, while the height and width of the acromial end of the clavicles were found to be higher in the right-sided clavicles. These variations could be due to racial, genetic, or mechanical factors. These findings may be helpful to orthopedic surgeons involved in the surgical correction procedures of clavicle fractures.

Introduction

Variations in the morphology and measurements of the clavicle have been a subject of interest for researchers. These measurements help determine the age, gender, and stature of an individual. The clavicle is a modified long bone that lies horizontally at the root of the neck. It is a subcutaneous bone that has a sternal and an acromial end.

The shaft of the clavicle is curved with convexity forwards in its medial 2/3rd and concavity forwards in its lateral 1/3rd. It transfers part of the weight of the upper limb to the axial skeleton (1). Fractures of the clavicle are the most common, and 70-80% occur at the middle third of the shaft of the bone. Clavicle fractures account for 2-5% in adults, 10-15% in children, and 44-66% of all shoulder fractures. Variations in the size and dimensions of the clavicle bone

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are very important in clinical cases of fracture-fixation of internal or external medullary devices, as well as in forensic and anthropological purposes for the identification of the 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 on the left side. The weight and length of right-sided clavicles were also found to be heavier and longer than left-sided clavicles (3). The aim of this study is to perform a morphometric analysis of fully ossified clavicle bones in the North Indian population and compare our findings with previous studies.

Materials and Methods

The present observational study was carried out in the Department of Anatomy at our institute. The study included 84 fully ossified clavicle bones (42 right-sided and 42 left-sided) of unknown sex and age. The bones were dried, macerated, and cleaned. Bones with any type of deformity, damage, or gross pathological abnormality were excluded. The parameters studied were maximum length, acromial breadth and height of the clavicle, and sternal breadth and height of the clavicles. All measurements were taken using a vernier caliper and recorded in millimeters.

Maximum length is the maximum distance between the two ends of the clavicle (Fig 1).

Acromial breadth of the clavicle is the maximum width of the acromial end (Fig 2).

Acromial height of the clavicle is the maximum height of the acromial end (Fig 3).

Sternal breadth of the clavicle is the maximum width of the sternal end (Fig 4).

Sternal height of the clavicle is the maximum height of the sternal end (Fig 5).

Presence of an articular facet at the conoid tubercle (Fig 6).

All the data were recorded in Microsoft Excel and analyzed using SPSS software version 21.0. A p-value ≤ 0.05 was considered statistically significant.

Results

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

Discussion

Maximum Length of clavicle (ML)

It was observed in the present study that the mean length of the left clavicle (141.54 ± 1.094 mm) is more than the right clavicle (138.85 ± 1.075 mm). This finding is in line with the findings observed by previous authors [3, 4, 5, and

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 of the maximum length of clavicles was found to be higher in left-sided clavicles (14.15) in comparison to right-sided clavicles (13.88). A statistically significant difference was observed in left-sided clavicles. In total clavicles, the maximum length of clavicles was found to be 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 shows that the mean value of right-sided clavicles (10.96) was observed to be higher in comparison to left-sided clavicles (10.74). No statistically significant difference was found. A statistically significant difference was observed in total clavicles ($p=0.001$).

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 the sternal end of clavicles were observed to be higher in the left-sided clavicles (21.51) compared to the right-sided clavicles (21.13), and no statistically significant difference was observed. A significant difference was observed in the total clavicles ($p=0.001$).

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.

6], but it is in contrast with others [7] who observed that right limb bones are usually longer.

While comparing the work of other authors regarding the mean length of the clavicle, it was seen that the length of the clavicle was not the same in different populations and races. In the present study, the mean length of the clavicles in the right clavicles was 138.85 ± 1.075 mm, and in the left-sided clavicles, it was 141.54 ± 1.094 mm, which was less than the findings of previous authors [5, 8, 9]. The mean length of the present study was found to be similar to the findings of an American study [10]

and higher than that of Sudha [2]. The present study also supports the previous study that the maximum length of the clavicle in males was found to be greater than in female clavicles. The average length of the clavicle in the north Indian population was less when compared to the English, Nepalese, American White & Negroes, and the French. Another 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.

Table 2: Comparison of maximum length of clavicle of present study with different zones of India

The mean values of acromial height of clavicles were similar to the findings of Padeyappanavar [11] and Suryawanshi [12], while differing from Patil [13]. The findings of the width of the acromial end of the present study were observed to be similar to Dongen [14], while differing from Patil [13] and Padeyappanavar [11]. The 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 [15] and Das [16], while the incidence of CCJ was not similar to the findings of Mariano [17], Nehme [18], and Gumina [19]. Previous studies also suggested that the presence of CCJ may occur due to geographical migration, not due to environmental, genetic, or evolutionary factors.

Conclusion

The presence of a CCJ predisposes to degenerative changes in the sternoclavicular and acromioclavicular joints. The knowledge of these joints is important for surgeons and orthopedicians to identify the cause of undiagnosed shoulder pain and the steps to follow in managing and treating this condition. The morphometric study of the clavicle in the present study will be helpful for orthopedic surgeons during treatment procedures for clavicle fractures. These parameters are also useful for forensic experts in medico-legal issues and for anthropologists studying the evolution of human beings and the migration of races.

Conflict of interest

None declared

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Ethical approval

Taken

Reference

Standring S. Gray's Anatomy. The anatomical basis of clinical practice. 41st ed. London: Elsevier Churchill Livingstone; 2016. p. 799.

- Sudha R. Study of clavicle: Length and curvatures in South Indian population. *Natl J Clin Anat*. 2011 Feb;3(4):198-202.
- Haque MK, Mansur DI, Ashwin K, Karki R, Sharma K, Shakya RK. Morphometric analysis of clavicle in Nepalese population. *Kathmandu Univ Med J*. 2011;9(3):193-7.
- Kaur H, Harjeet, Sahni D, Jit I. Length and curves of the clavicle in Northwest Indians. *J Anat Soc India*. 2002;51(2):199-209.
- Parsons FG. On the proportions and characteristics of the modern English clavicle. *J Anat*. 2011;51:71-93.
- Jit I, Singh S. Estimation of stature from clavicles. *Indian J Med Res*. 2011;44(1):137-55.
- Singh S, Gangrade KC. The sexing of adult clavicles: Demarking points for Varanasi zone. *J Anat Soc India*. 2011;17:89-100.
- Olivier G. Anthropologie de la clavicule; XIII, conclusions générales. *Bull Mem Soc Anthropol Paris*. 2011;7(5):404-47.
- Terry RJ. The clavicle of American Negro. *Am J Phys Anthropol*. 2011;16(3):351-80.
- Singh S. Sexing of American clavicles. *J Anat Soc India*. 2011;18:25.
- Padeyappanavar KV, Bhusareddi PS. Sex determination of adult human clavicles by various anthropometric measurements. *Anatomica Karnataka*. 2011;6(2):56-61.
- Suryawanshi AK, Puranic MG, Mudiraj NR. Morphometric analysis and sex determination of adult human clavicles in Maharashtra region. *Int J Recent Trends Sci Technol*. 2015;15(2):333-8.
- Patil AB. Sexual dimorphism in adult human clavicles. [dissertation]. 2011.
- Dongen RV. The shoulder girdle and humerus of the Australian Aborigine. *Am J Phys Anthropol*. 1963;21(4):469-88.
- Jaluvka V. Articulatio coracoclavicularis. *Cesk Morfol*. 2011;4:99.
- Das SS, Mahajan A, Vasudeva N. Morphometric study of clavicular facet of coracoclavicular joint in adult Indian population. *J Clin Diagn Res*. 2016;10(4):8-11.
- Mariano DS, Vasquez B, Suazo I. Clavicular facet of the coracoclavicular joint: Analysis in modern skeletons of the Mapuche indigenous individuals. *J Anat Soc India*. 2014;63(1):19-23.
- Nehme A, Tricoire JL, Giordano G, Chiron P, Rouge D, Puget J. Coracoclavicular joints. Reflections upon incidence, pathophysiology, and etiology of the different forms. *Surg Radiol Anat*. 2004 Feb;26(1):33-8.
- Gumina S, Salvatore M, De Santis R, Postacchini F, Orsina L. Coracoclavicular joint: Osteologic study of 1020 human clavicles. *J Anat*. 2002 Dec;201(6):513-9.
- Jit I, Sahni D. Sexing the North Indian clavicles. *J Anat Soc India*. 2011;32(2):61-72.