Section: Anatomy

Original Research Article

SEXUAL DIAMORPHISM OF CLAVICLE IN MAHARASHTRA POPULATION

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ABSTRACT

Background: Sexual dimorphism of the clavicle is often difficult to study, as it develops in the membrane; it has two primary centers that appear before birth and are more influenced by sex hormones during fetal life, and the pathophysiology of the uterus directly impacts on membranous bones like the clavicle. **Materials and Methods:** 25 male and 25 female adult non-pathological clavicles are studied; maximum length is measured with the help of an osteometric board, and the diameter of both ends is measured by digital vernier caliper. **Result:** Maximum length of the clavicle of males and females had a significant p-value ($p<0.001$); the maximum breadth at sternal end and acromion ends had an insignificant p-value, but the maximum length and maximum breadth of both ends on both sides in both sexes also had a significant p-value ($p<0.001$). **Conclusion:** The present will be useful for anatomist, anthropologists and medico-legal experts to differentiate sex and regional clavicle bones.

INTRODUCTION

The clavicle is named after "Clavus," which means a Roman key-like structure. It forms a triangle in the root of the neck for the passage of important blood vessels to the head and brain. Though it is curved, it performs two functions. It keeps the upper limb away from the trunk and helps in body weight transmission.[1]

As it ossifies in the membrane, it requires a particular time and place for osteoblasts to appear at a point in the membrane for the primary center of ossification and begin to lay down a network of cancellous bone. As the bony network grows, its interior becomes remodeled by osteoclasts and osteoblasts. For this normal process, an adequate amount of calcium and other minerals are required; otherwise, the length and diameter of the bone are impaired, hence it becomes difficult to identify the gender of the bone.[2] Move over, females reach puberty earlier and experience more rapid changes in bone than males. Unlike males, females's bones have a lesser quantity of minerals, which has a greater impact on the morphometrical values of female bones.[3] Moreover, it is revealed that direct action of androgens and estrogens acts on the bones.[4] Nevertheless, nutritional, genetic, and environmental factors also play a vital role in sexual dimorphism. Hence, an attempt is made to study the gender differences in clavicle.

MATERIALS AND METHODS

25 male and 25 female adult clavicles available in the Anatomy and Forensic Medicine Department of Vendant Institute of Medical Sciences, Dundhawadi, Dhanu, Palgarh (dist), Maharashtra-410606, were studied.

Inclusion Criteria: A non-pathological dried clavicle was selected for study.

Exclusion Criteria: Broken, pathological clavicles were excluded from the study.

Method: 50 clavicles with known sex were selected. maximum length in cms was measured with the help of osteometric board; maximum breadth of the acromion end and sternal end was measured by digital caliper.

The duration of the study was from April 2024 to May 2025

Statistical Analysis: Morphometric studies of clavicles of both sexes were studied by t-test and ANOVA TEST. The statistical analysis was carried out in SPSS software. The ratio of male and female was 1:1.

RESULTS

Table 1: Comparison of Metrical Study of Clavicle in Both Sexes:

- Maximum Breadth (cms): 14.42 (± 0.70) in male, 12.7 (± 0.02) in female, t-test was 14.4, and $p<0.001$ (p-value is highly significant).

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- Maximum breadth at the sternal end: 2.05 (± 0.27) in males and 1.90 (± 0.30) in females. The t-test was 1.8 and p>0.062 (the p-value is insignificant).
- Maximum Breadth at Acromion End: 0.95 (± 0.25) in male, 0.86 (± 0.24) in female; the t-test was 1.2 and p>0.2003 (the p-value is insignificant).

Table 2: Comparative study between both sexes on both sides (ANOVA TEST):-

- Maximum length (cm): 14.16 (± 0.75) in right male, 12.70 (± 0.88) in right female, 14.52 (± 0.70) in left male, 12.8 (± 0.18) in left female, F value is 46.5, and p<0.001 (p value is highly significant).
- Maximum breadth at the sternal end: 2.23 (± 0.25) in right male, 1.95 (± 0.30) in right female, 1.96 (± 0.22) in left male, 1.28 (± 0.15) in left female, F value is 73.3, and p<0.001 (p-value is highly significant).

Maximum breadth at acromion end (cm): 0.96 (± 0.07) in right male, 0.84 (± 0.05) in right female, 1.02 (± 0.06) in left male, 1.01 (± 0.05) in left female, F value is 54.1, and p<0.001 (p value is highly significant).

Table 1: Comparison of metrical study of clavicle in both sexes

Metrical Parameters	Male clavicle (SD±)	Female clavicle (SD±)	t test	p value
Maximum of clavicle (cms)	14.42 (± 0.70)	12.7 (± 0.02)	14.4	P<0.001 *
Max. Breadth at sternal end	2.05 (± 0.27)	1.90 (± 0.30)	1.8	p>0.062
Max. Breadth at Acromion end	0.95 (± 0.25)	0.86 (± 0.24)	1.2	p>0.2003

Table 2: Comparative study between right and left clavicle in both sexes (ANOVA TEST)

Parameters	Right Male	Right Female	Left Male	Lest Female	F value	P value
Maximum length (cm)	14.16 (± 0.75)	12.70 (± 0.88)	14.52 (± 0.70)	12.8 (±0.18)	46.5	P<0.001 *
Maximum breadth at sternal end (cms)	2.23 (± 0.25)	1.95 (± 0.30)	1.96 (± 0.22)	1.28 (± 0.15)	73.3	P<0.001 *
Max. Breadth at Acromion (cms)	0.96 (± 0.07)	0.84 (±0.05)	1.02 (±0.06)	1.03 (±0.05)	54.1	P<0.001 *

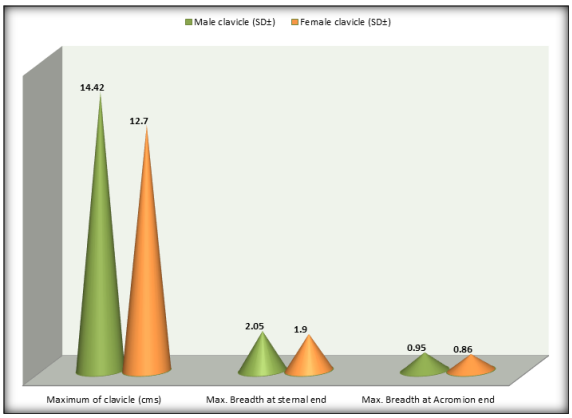

Figure 1: Comparison of metrical study of clavicle in both sexes

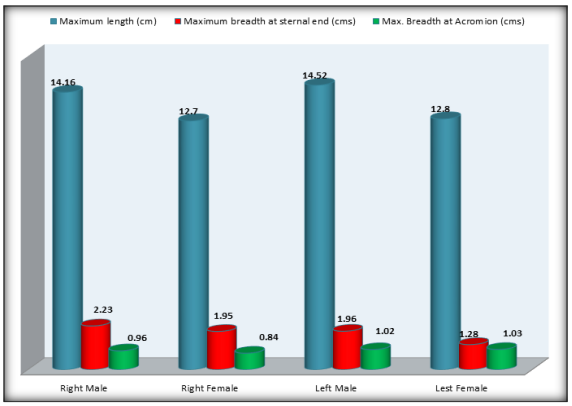

Figure 2: Comparative study between right and left clavicle in both sexes (ANOVA TEST)

DISCUSSION

Present study of sexual dimorphism of the clavicle in the Maharashtra population. The comparison of male and female clavicles shows the maximum length of the clavicle is 14.42 (± 0.70) in males and 12.7 (± 0.02) in females; the t-test was 14.4 and p<0.001. Maximum breadth at the sternal end is 2.05 (± 0.27) in the male clavicle and 1.90 (± 0.30) in females. The t-test was 1.8 and p>0.062 (p-value is insignificant). Maximum breath at the acromion end is 0.95 (± 0.25) in the male clavicle and 0.86 (± 0.24) in the female clavicle; the t-test was 1.2 and p>0.2003 (the p-value is insignificant) (Table 1). Comparative study between right and left clavicles in both sexes Maximum length of right male had 14.16 (± 0.75) in right female, 12.70 (± 0.88) in left male, 14.52 (± 0.70) in left male, and 12.8 (± 0.18) in left female; the p-value is highly significant. Maximum breadth of sternal end (cms) is 2.23 (± 0.25) in male right, 1.95 (± 0.30) in female right, 1.96 (± 0.22) in left male, 1.28 (± 0.15) in left female, and p<0.001. Maximum breadth at acromion end (cm): 0.96 (± 0.07) in right male, 0.84 (± 0.05) in right female, 1.02 (± 0.06) in left male, 1.01 (± 0.05) in left female, and p<0.001. These findings are more or less in agreement with previous studies.[5,6,7]

Variations in the male and female clavicles are due to male bones being hypermasculine and female bones being hypomasculine; hence, a smaller morphometric value is observed in the female clavicle. Sex

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hormones and hormones of the adrenal cortex antagonize the actions of growth hormone and thyroxine and bring about cessation of growth in adolescence; hence, the morphometric parameters of female bones differ from male bones.[8]

Secondary centers of ossification almost all appear after birth. The dates of their appearance vary considerably from one individual to different individuals. They were somewhat precocious in females; hence, it is hypothesized that morphometric values differ from male bones because the factors that determine the time of ossification are obscure.[9] Moreover, the rate of bone growth and maturation is influenced not only by age and sex but also by economic status of individual. It may be related to nutritional, climatic, and other factors. Vitamin A controls the activity distribution and coordination of the osteoblastic and osteoclastic activities.[10]

Moreover, hormones also play a vital role in morphometric parameters because in females, oestrogen presence bone mass, suppresses bone turnover, and maintains balanced rates of bone formation and bone resorption along with influencing the functional activity of bone cells and inducing epiphyseal closure, which leads to differences in the morphology of male and female bones.[11]

The male versus female difference is influenced not only by the chronological aging process but also because women lose estrogens during menopause. However, bone loss begins long before the onset of menopause and is accelerated after menopause due to the associated decrease in estrogen; hence, males exhibit more pronounced skeletal rigidity or mineral content than females, who exhibit higher morphometric parameters.[12]

CONCLUSION

The present study of sexual dimorphism of the clavicle is important for medico-legal expert, anatomists and anthropologists to indicate regional or ethnic significance, but this demands further genetic, hormonal, nutritional, and environmental studies because the factors that determine the ossification are still unclear.

Limitation of study: Owing to remote location of research centre, small number of bones lack of latest techniques we have limited finding and results.

- This research work was approved by the ethical committee of Dhundalwadi Dhanu, Palgarh (dist), Maharashtra-410606.
- No Conflict of Interest
- Self Funding

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