



## Sex Determination from the Clavicle

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### ABSTRACT

*Identification of sex from unidentified human skeleton remains is a challenge for anthropologists and forensic investigators. Determination of sex is relatively easy if the entire skeleton is available for examination. Even when skull and pelvis, the most reliable bones for sex determination are available not more than 98% of accuracy can be achieved in identifying the sex. Often in medicolegal cases it is expected to determine sex from isolated long bones or their fragments from the crime site in order to establish a possible identity. Various methods to do this on different bones of human skeleton have been extensively studied.*

*Different level of accuracy for sex determination using clavicle have been reported in various studies and on the other hand, anthropometric dimensions of different bones are unique in each race and geographic region. The purpose of this study was to find out an easy formula for determination of sex from unknown clavicle and to know about comparative differences between the right and left clavicle of male and female.*

**KEYWORDS:** Clavicle, Clavicular length, Mid clavicular circumference, Demarcating point, Sex determination

### INTRODUCTION

The human clavicle is described as a modified long bone. It has a shaft and two ends that are sternal and acromial ends. The shaft is generally curved with convexity forwards in its medial two third and concavity forwards in its lateral third. The clavicle is thicker and more curved in manual workers and its ridges for muscular attachments are better marked<sup>(1)</sup>. Clavicle fracture is more common and occurs more frequently (80 – 85%) at the junction of medial two third and lateral one third<sup>(2)</sup>.

Skeleton plays a significant role in various sciences like medicine, forensic sciences and anthropology. Estimation of sex, age, race, stature by skeleton and the presence of disease is discovered by Krogman and Iscan<sup>(3)</sup>. They stated that record of organic evolution is largely written by the hard parts of the body recognisable even after many years after death. Estimation of sex of deceased from its skeleton is not difficult task when a complete or an almost complete skeleton is available for examination<sup>(4)</sup>. Krogman (1962) obtained an accuracy of 95% with pelvis and 98%

when pelvis and skull were available. However, it become difficult to determine the sex of deceased if a single bone or a few bones are available. This is further complicated by racial differences that exist in the characters and measurements of bones including clavicle.

For determination of sex of clavicle, various parameters including length, weight, mid clavicular circumference, cortical index and volume have been studied by various workers. Terry (1932), Olivier (1951), and Jit and Singh (1966) observed that mid clavicular circumference was good parameter in identification of the sex of the clavicle. Mid clavicular circumference of clavicle is the most reliable indicator of sex; a combination of this measurement with weight and length yields better results<sup>(5)</sup>. That's why in this study we used length and mid clavicular circumference of the clavicle to determine the sex of an individual in Marathwada region.

## MATERIAL AND METHOD

The present study was conducted on 120 clavicles (60-male & 60-female) in the Department of Anatomy. These bones were collected from the Department of Anatomy as well as from the 1<sup>st</sup> and 2<sup>nd</sup> year medical students. Two measurements were taken. These measurements were taken using the digital vernier caliper & measuring tape. All readings were taken 3 times by same person to avoid interobserver error. The clavicle with congenital or acquired bone abnormality were excluded.

The maximum length of the clavicle i.e. distance between the medial and lateral end of the clavicle was measured and recorded in mm with the help of vernier caliper. Similarly, the mid point of the clavicle was determined and mid clavicular circumference was measured at that point with the help of measuring tape and recorded in mm. Then the data was analysed to find out the mean of the length and the mid shaft circumference of right and left clavicle in both sexes. After that demarcating points were calculated for the length

and mid clavicular circumference of right and left clavicles in both sexes.

**Demarcating point:** Demarcating point is the reading above that no female bone was found and below that reading no male bone was found<sup>(6)</sup>.

## RESULTS

The maximum length and mid clavicular circumference of clavicles were measured in 120 clavicles (60 male & 60 female) of both sides.

### Length

#### Right Clavicle

The length of male right clavicles varies from 123 – 158 mm. with a mean of 138 mm where as that of female ranges from 116 – 145 mm with a mean of 120 mm. No female clavicle in this series has been found to have length more than 145 mm. Similarly no male clavicle has been found to have length less than 123 mm.

#### Left Clavicle

The length of male left clavicles varies from 118 – 160 mm. with a mean of 140 mm where as that of female ranges from 111 – 143 mm with a mean of 123 mm. No female clavicle in this series has been found to have length more than 143 mm. Similarly no male clavicle has been found to have length less than 118 mm.

### Mid clavicular circumference

#### Right clavicle

The mid clavicular circumference of male right clavicles varies from 35 – 48 mm. with a mean of 39 mm where as that of female ranges from 28 – 36 mm with a mean of 31 mm. No female clavicle in this series has been found to have length more than 36 mm. Similarly no male clavicle has been found to have length less than 35 mm.

#### Left Clavicle

The mid clavicular circumference of male left clavicles varies from 34 – 50 mm. with a mean of 37 mm where as that of female ranges from 24 – 35 mm with a mean of 31 mm. No female clavicle in this series has been found to have length more than 35 mm. Similarly no male clavicle has been found to have length less than 34 mm.

Demarcating points from the above results calculated that is the measurement above which no female bone can be found and below which no

male clavicle can be found. So, demarcating points for various parameters found in our studies are shown in table 1.

**Table 1:** Demarcating points for the length and mid clavicular circumference of right & left clavicles of both sexes

Sex	Demarcating points			
	Length		Mid clavicular circumference	
	Right	Left	Right	Left
Male	>145 mm	>143	>36	>35
Female	<123 mm	<118	<35	<34

## DISCUSSION

Sex determination using human skeletal remains is one of the most important components in forensic identification and starting point of anthropologic researches. Previous studies have shown that various communities have different skeletal anthropometric parameters according to their race and sex<sup>(7)</sup>. Sex determination is the most significant information which can be obtained from bones. In previous studies, morphologic methods were mostly used to determine sex. However, metric measurements are preferred due to their easy repeatability, high accuracy and no requirement for special skills<sup>(8)</sup>.

Measurements of most human body bones indicated that men often have greater bone dimensions than women. This is applicable for the clavicle bone as well and different studies such as Thieme<sup>(9)</sup>, Mc Cormick<sup>(10)</sup>, Luis Fructos<sup>(11)</sup> and our study indicate that the length and mid clavicular circumference are larger in men comparing to women.

On comparing the measurable characters of clavicle of our region with findings from different zones of India, it provides us information regarding their racial and sexual differences.

**Table 2:** Mean values of length of right & left clavicles in different zones of India in mm

Zones	Male		Female	
	Right	Left	Right	Left
Gujrat	141	142	125	126
Amritsar	145	147	130	129
Varanasi	141	144	125	127
Patiala	146	148	132	133
Chandigarh	148	149	132	134
Present study	138	140	120	123

**Table 3:** Mean values of mid clavicular circumference of right & left clavicles in different zones in India in mm

Zones	Male		Female	
	Right	Left	Right	Left
Gujrat	37	36	30	30
Amritsar	36	35	29	29
Varanasi	35	34	28	28
Patiala	36	36	30	30
Chandigarh	36	35	30	30
Present study	39	37	31	31

Average length of clavicle has been compared by Olivier (1956)<sup>(12)</sup>. He found that the French left clavicle to be longer than the right. Similar results were obtained by Jit and Singh (1966) in Amritsar zone, Singh and Gongrade (1968) in Varanasi zone, Jit and Sahani (1983) in Chandigarh zone, and Kaur et al (1997) in Patiala zone. The present workers found that the left clavicle was longer than the right. Same result also we got in our study. This is due to the greater curvatures present in the right clavicle.

In the Gujrat zone best criterion for identification of sex was mid clavicular circumference for right clavicle and length for left clavicle in female. In Varanasi zone and Amritsar zone length was found to be better criterion for identification of female clavicles. In our study mid clavicular circumference was found to be best criterion for identification of female bone.

## CONCLUSION

The determination of sex from the clavicle has a great medicolegal significance to the toxicologists. The result of this study indicate that sex can be determined using clavicle dimensions with relatively high accuracy, if just clavicle bone is available due to explosion, plane crashes, mutilated bodies etc. It also helps the anthropologists in their study of evolution of mankind and migration of races. The knowledge of morphometric values is helpful to anthropological and forensic practice.

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