

A Cross-sectional Study on Sex Difference in Length of Manubrium and Mesosternum in Dry Ossified Human Sternum

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Abstract

Context: Examination of bone is important for identification of deceased and estimation of sex. The present study was planned to collect data regarding length of manubrium and mesosternum of dry ossified human sternum and to find out possible variations regarding sex.

Materials and methods: This was a cross-sectional analytical study, conducted in the Department of Anatomy, Dhaka Medical College, Dhaka, from July 2011 to June 2012. The study materials consist of 112 dry ossified human sternum. The length of manubrium and mesosternum was measured and comparison of values between male and female were done.

Results: The mean length of manubrium in male and female was 49.92 ± 3.22 mm and 40.74 ± 4.19 mm respectively and the mean length of mesosternum in male and female was 102.56 ± 6.10 mm and 83.44 ± 10.19 mm respectively.

Conclusion: The length of manubrium and mesosternum was greater in male than that of female which was statistically significant ($P < 0.001$). The length difference can be useful in sex differentiation.

Key words: Manubrium, mesosternum, sex, discriminant analysis technique

Introduction:

The sternum is a flat bone and divided into three parts from above downwards; manubrium sterni, body of sternum or mesosternum and xiphoid process.¹ Manubrium is broad and thick above and

narrow to its junction with the body where it forms sternal angle or angle of Louis. It is a bony landmark. The superior border of manubrium is thick and present suprasternal notch.³ Trabecular thicknesses are larger and marrow spaces are smaller in the manubrium than the mesosternum. For this reason manubrium present higher percentage of bone volume near about 56%, which, apart from its larger overall width and thickness, gives it more strength than the mesosternum.² The marrow space of this bone contain red bone marrow which persists throughout the life. For this reason, sternum is a common site for marrow biopsy.¹

The mesosternum is longer, narrower and thinner than manubrium and is broadest near its lower end.

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Morphological knowledge of sternum is very useful for the radiologist so that they should not be confused by the pathological condition of sternum with those of sternal variation and anomalies.⁷ Sternum presents sexual dimorphism⁶ and racial difference. So far it is known that there is no published work on sternum in our country. We need our own standard baseline which can be used in clinical practice by cardiothoracic surgeons, orthopaedic surgeons, neurosurgeons, radiologist and oncologist.

Materials and methods:

A total of one hundred and twelve fully ossified and dried human sterna of unknown sex were collected from the Department of Anatomy of Dhaka Medical College and other eight (government and non-government) medical colleges in Dhaka. The sex of collected sterna was determined by a multivariate linear discriminant function analysis technique.⁹ This multivariate linear discriminant analysis technique was applied to the collected data & discriminant linear functions were generated.

The linear function is given by-

$$Z = b_0 + x_1b_1 + x_2b_2 + x_3b_3 + \dots + x_nb_n$$

Here b_0 is constant, b_1 to b_3 are the coefficients and x_1 to x_3 are the variables which are mentioned below-

x_1 = length of manubrium (independent variable).

x_2 = length of mesosternum (independent variable).

x_3 = combined length of manubrium & mesosternum (dependent variable).

In this study the value of Z for each specimen was calculated by substituting the values of the variables in the linear function. A sectioning (SP) point was created by using the mean discriminant scores which were also known as the group centroids. To assign the case to either male or female sex, the product Z was compared to the sectioning point derived by the discriminant function. A value higher than the sectioning point was considered to be male and a value below it was considered to be female.

The length of manubrium was measured from the distance between the center of jugular notch to the center of manubriosternal junction.⁸ Length of mesosternum was measured anteriorly from the

center of manubriosternal junction to the center of xiphisternal junction.⁸ Both the measurements were taken with a flexible wire (Figure 1, Figure 2) and the reading was recorded with the help of digital slide calipers.



Fig.-1: Photograph showing the measurement of the length of the manubrium by using a flexible wire. Black dot indicates center of suprasternal notch and white dot indicates midpoint of manubriosternal junction



Fig.-2: Photograph showing the measurement of the length of the mesosternum by using a flexible wire. Black dot indicates center of manubriosternal junction and White dot indicates center of xiphisternal junction

Statistical analysis was done by SPSS version 17. Comparison of the values of the variables between male and female was done by unpaired Student's 't' test.

Ethical clearance:

The study was approved by Ethical Review committee of Dhaka medical college, Dhaka.

Results

The dry ossified human sterna were grouped into male and female by discriminant function analysis technique.

Table-I
Grouping of the samples:

Sex	Number of sternum
Male	63
Female	49

The mean length of manubrium in male and female was 49.92 ± 3.22 mm and 40.74 ± 4.19 mm respectively and the mean length of mesosternum in male and female was 102.56 ± 6.10 mm and 83.44 ± 10.19 mm respectively. The length of manubrium and mesosternum were greater in male than female which were statistically significant ($P < 0.001$) (Table II).

Table-II
Length of manubrium and mesosternum

Sex	Manubrium length (in mm) Mean \pm SD (Range)	Mesosternum length (in mm) Mean \pm SD (Range)
Male (n=63)	49.92 ± 3.22 (40.43-59.83)	102.56 ± 6.10 (90.84-115.64)
Female (n=49)	40.74 ± 4.19 (32.39-49.13)	83.44 ± 10.19 (54.08-97.23)
<i>P value</i>	$<0.001^{***}$	$<0.001^{***}$

Figures in parentheses indicate range. *** = significant

Discussion:

In the present study, the length of manubrium and mesosternum were greater in male than that of female and the difference was statistically significant ($P < 0.001$). Length of manubrium and length of mesosternum were significantly ($P < 0.001$) differ from those reported by Puttabanthi¹⁰, Mahajan et al¹¹, Dahiphale et al⁴ and Jit et al⁹ who carried out study on sterna of Indian population. Jit et al⁹ studied 312 male and 88

female adult North Indian sterna. The researchers measured the straight length of manubrium and mesosternum with the help of slide calipers. But in the present study length of manubrium and mesosternum were measured with a flexible wire then the reading was recorded with the help of digital slide calipers. In the present study the mean difference in the length of manubrium between male and female was 9.22 mm and the mean difference in the length of mesosternum between male and female was 19.12mm. These findings were in accordance with Mahajan et al.¹¹ Osunwoke¹² conducted a study on sexual dimorphism of the human sternum in the southern Nigerian population. Measurements were done using a meter rule. Torwalt et al¹³ carried out his study on Canadian population and used X-ray film to measure the sterna. The findings of these two studies also significantly ($P < 0.001$) differ from that of present study. Research findings of Macaluso¹⁵ who measured African sterna revealed that the length of manubrium was significantly differ in male ($P < 0.05$) and female ($P < 0.001$) from present study; Length of mesosternum was significantly differ in male ($P < 0.01$) but in female no significant difference was found ($P > 0.05$).

The findings of the present study were dissimilar ($P < 0.001$) to that of Selthofer⁷, Yutain et al¹⁴, who measured the Croatian and Chinese sterna respectively. The dissimilarities in the findings of the present study with the findings of the researchers mentioned above might be due to racial variation and different techniques of measurements.

Conclusion

The length of manubrium and the length of mesosternum were greater in male than that of female which were statistically significant. Sex can be determined by using sternum morphometry that play an important role in anthropological researches. Further studies with larger sample size to get more precise picture of Bangladeshi people to establish a baseline data is recommended.

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