Original Article

MANUBRIAL INDEX–A RELIABLE GUIDE IN DETERMINING THE SEX OF THE STERNUM

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ABSTRACT

Objective: Sexing an unknown skeleton is a very important and difficult process that anatomists and jurists have to fulfill. Sex can be predicted by the sternum with 90% accuracy. It is crucial to predicting age in the middle age range and sternum is particularly useful for it. In the study conducted for sexing the sternum, different measurements were compared and it was found that manubrium alone is a good tool for gender differentiation of the sternum.

Methods: Study was conducted on 100 Sternums of known age and sex which were collected from the postmortem room of the forensic department after taking due consent from the attendants of the deceased. Different measurements of manubrium were taken and contrasted for gender differentiation. ANOVA was used to evaluate the statistical significance.

Results: It was found that among morphometric criteria of prosternum manubrial index was found to be accurate and reliable along with clear-cut demarcation in length and width of the manubrium sterni of two sex.

Conclusion: It was concluded by this study that the manubrial index is a trustworthy tool for sexing sternum and manubrial width could be fairly reliable criterion for determining sex of the sternum.

Keywords: Manubrium, Sternum, Sex differentiation

INTRODUCTION

Identification of unknown skeleton as male and female is always a challenging task in anatomy andthe forensic medicine. Sternum can serve the purpose. Sternum (the breastbone) is a flat bone situated vertically in the median plane and anterior part of the thoracic cage [1-11]. It is the main bone that distinguishes between humans and animals. In humans it is simply an elongated flat bone. In other species it is a composite bone [1-3]. Human sternum consists of three parts: prosternum (manubrium), mesosternum (body) and metasternum (xiphoid process). The three piecewise. manubrium, body and xiphoid process are united by cartilage [4, 5]. When prosternum and mesosternum were measured, a clear-cut difference was found among bones of two genders. It could be done with the help of skull and pelvis but in the absence of these sternum is fairly good option for determining the gender and it recovers more quickly and easily than other skeleton components [6]. Study of sternum as whole and study of manubrium alone as an individual parameter for the determination of sex is done by many researchers. The difference in length, width and manubrial index have been described.

MATERIALS AND METHODS

Methodology: the study was conducted on 100 sterna of known age and sex (68 males and 32 females) obtained from the postmortem room of the forensic department. The age of the deceased was obtained from the close relatives, police and, verified by necessary documents and was rounded off to full whole figure [5]. Sterna were removed from the carcass by sectioning costal cartilages close to lateral border of sternum. Sternoclavicular joints were dissected to separate the bones from the clavicle and joint capsule and ligaments were cleared off. The sterna were cleaned. Any remains of muscles, ligaments, costal cartilages and any other soft tissues are removed. The sterna thus obtained were kept in 10% formalin solution.

Observations: Followig observation were considered for the determination of sex of sternum in present study;

- Length of manubrium(ML): from the supra sternal notch to sternal angle/manubriosternaljunction in the midline.
- Width of manubrium(MW): measured by vernier caliper just below the clavicular notch
- Manubrialindex(MI)(12): is calculated as proportion of length and width of manubrium - $\frac{Width\ of\ manubrium}{Length\ of\ manubrium} \times 100$

Length and width of manubrium were measured in millimeters (mm).

Inclusion criteria

1. The bone obtained in more than 16 y of age (post-pubertal)
2. Bone should be free of deformity.

Exclusion criteria

1. Age below 16 y
2. Deformed or fractured bone

RESULTS

All the observations were grouped according to measurements. All values were arranged in increasing order. It was seen that male and female have clear-cut differences length and width of the manubrium sterni of the two genders. MI was calculated and it also shows a considerable difference among the bones of two genders. Details of observation are given in tables below. Graphs were plotted. ANOVA was done, an result are seen in table 1.

Table 1: Length of manubrium

S. No.	Manubrial length (mm)	No of males	No. of females	Total
1	21-25	0	1	1
2	26-30	0	2	2
3	31-35	0	12	12
4	36-40	5	6	11
5	41-45	5	5	10

S. No.	Manubrial length (mm)	No of males	No. of females	Total
6	45-50	9	5	14
7	50-55	28	0	28
8	55-60	13	0	13
9	60-65	8	1	9
Total		68	32	100

Table 2: Width of manubrium

S. No.	Manubrial width	No. of males	No. of females	Total
1	25-30	0	1	1
2	31-35	0	4	4
3	36-40	0	9	9
4	41-45	0	6	6
5	46-50	2	2	4
6	51-55	4	6	10
7	56-60	3	3	6
8	61-65	7	1	8
9	66-70	18	0	18
10	71-75	16	0	16
11	76-80	10	0	10
12	81-85	7	0	7
13	86-90	1	0	1
Total		68	32	100

Table 3: Manubrial index

M. I	No. of males	No. of females
56-60	0	0
61-65	2	0
66-70	2	0
70-75	24	0
76-80	39	1
81-85	1	13
86-90	0	13
90-95	0	4
95and above	0	1

Table 4: Comparison of mean manubrial length, width and manubrial index

	No. of specimens	ML	Difference in mean ML	MW	Difference in mean MW	MI	Difference in mean MI
Male	68	52.68	14.8	69.9	25.3	75.43	10.57
female	32	37.88		44.6		85.97	

Table 5: Comparison of mean manubrial indexin male and female of different age groups

Age group	Male		female		p-value	Difference
	No. of individuals	Mean MI	No. of individuals	Mean MI		
16-20	6	76.15	2	88.9	.0005	HS
21-25	7	75.58	3	84.52	.0048	HS
26-30	6	75.15	2	87.65	.0278	HS
31-35	9	75.07	4	82.78.	.0279	HS
36-40	4	77.26	3	86.81	.0073	HS
41-45	8	75.96	3	86.79	.0003	HS
46-50	8	74.42	7	86.77	.0000	HS
51-55	6	74.35	8	85.90	.0491	S

DISCUSSION

Length of manubrium: manubrial length was found significantly higher in males. It was found to be ranging between 36-65 mm with mean 52 mm, which is coinciding WiyhJit *et al.*, Gautam *et al.* and Dahophale VP and of female 24-62 with mean 37.88 mm, which is coinciding with dahiphale *et al.* It was found that there was a difference of 14.8 mm in mean length of two genders which is considerable when they are arranged elaborately it was found that many of them (36% of total cases) are present in overlapping zone [7].

Manubrial width is the least considered criterion till now. In our study, it was found to be ranging between 46-87 mm in males and 29-61 mm in females with a mean of 69.9 mm in male and 44.6 mm in female. A difference of 25.3 mm was found, which is statistically significant [8, 9] though few values are present in the co-extensive zone but 88%of subjects can be sexed correctly by this criteria.

Manubrial index: it was found to be ranged between 60.9-80.7 in males with mean of 75.43 and SD of+/-3.81 which is statistically

significant. In female it was found to be ranging between 76.9-95.3 with mean of 85.97 and SD found to be±4.0. very few of i.e. only 2 cases are lying in co-extensive zone [10]. When it was analyzed statistically, a remarkable difference of 10, 54 was found between male and female values. They were present in+/-3SD [11, 12].

Application of ANOVA

When all the cases were grouped in different age groups and compared the MI of each group to judge the difference between two quantitative populations i.e. mean of MI of males and females of different age groups between males and females, it was found to be higher in females in every age-group. The mean of MI was found to be consistently higher in females in every age group [3, 6]. The 'p-value' is<0.04 in all the cases and results are found highly significant (table 5).

CONCLUSION

With the results of our study, it could be concluded that the length and width of the manubrium is consistently higher in males than in females. if length were compared, it shows considerable overlapping so could not be considered a reliable criteria. When we compare width of manubrium there is considerable difference with very little overlapping among the two genders, so it could be considered as a fairly good criterion for sex determination. Manubrial index. i.e. the proportion of width and length is consistently higher in females with minimal overlapping,. With application of ANOVA it is found to be consistently higher in every age group therefore, It is found to be reliable criterion for determining the sex of the sternum.

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AUTHORS CONTRIBUTIONS

All the authors have contributed equally.

CONFLICTS OF INTERESTS

Declared none

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