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Research Article

A STUDY OF SEXUAL DIMORPHISM IN HUMAN STERNA

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ABSTRACT

In the present study, 100 human, dry adult sterna, 45 male and 55 female, from various medical colleges of Saurashtra region of Gujarat were measured for length of manubrium, length of mesosternum and combined length of manubrium and mesosternum. The data was statistically analysed for mean, standard deviation and p value. "The Rule of 136" given by Ashley (1956) was applied to determine the sex of sterna and to determine the number of male and female sterna obeying the rule. Statistically significant difference in mean values of length of manubrium, length of mesosternum and combined length of both sexes was observed. "Rule of 136" determined 34 male and 66 female sterna, while 71.11% (32) of male sterna and 96.34% (53) of female sterna obeyed the rule. It concluded that of all the three parameters measured, combined length of manubrium and mesosternum was the best discriminating parameter of sex and Rule of 136 was helpful in determination of sex.

Keywords: Human Sternum, Combined length of manubrium and mesosternum, Rule of 136

INTRODUCTION

Sex determination from unknown human skeletal remains or decomposed bodies is an important initial step in forensic investigation[1]. Experts are always facing a problem in identifying whether the skeletal remains are human or not as well as estimation of correct age and sex of specimen available[2]. Accurate determination of skeletal sex has been a critical issue in medicolegal cases and the accuracy depends on the nature of material available and methods applied[1].

The human sternum is a flat elongated shield of bone that forms the middle of anterior part of thoracic cage forming a and protects the inner vital organs[1].

Various studies have been carried out by various workers by using Sternum as an individual parameter of the determination of age and sex. The first work was done in 1788 by Wenzel[3], who studied the ratio between the length of manubrium and that of mesosternum in both the sexes.

Wenzel's work lead to enunciation of Hyrtl's law (1788)[4] which stated that the Manubrium-Corpus Index also now known as Sternal Index (M/B ×100) exceed 50 in females while it is less than 50 in males. This was followed by works to correlate the total length of Manubrium and mesosternum (M+B) with sex. Dwight (1890)[5] concluded from his study that combined length

577

of sternum is more reliable and accurate. Further Ashley (1956)[6] studied the combined length in both sexes in European population. He forwarded "rule of 149", according to which if the combined length is more than 149mm than it was male and it the value is less than 149 it was female sternum, but its application on African population was not conclusive; so he forwarded rule of "136"(1956)[6] for African Population.

Recent works on Combined length of Sternum includes the works of Inder Jit (1980)[7], Dahipale et al.(2002)[8], Gautam et al. (2003)[2], Mahajan et al.(2009)[9] and Puttabandthi et al. (2012)[1].

MATERIALS AND METHOD

The present study, material consisted of 100 normal, dry, human adult sterna (45 male and 55 female) obtained from skeletal collection of Anatomy department of various medical colleges of Saurashtra region. Random sampling was done and sterna were measured with help of Vernier Caliper. Measurements were taken in millimetres according to technique described by Dahipale et al (2002)[8].

 1. Length of Manubrium (M)

 2. Length of Mesosternum (B)

 3. Combined length of sternum (M+B)

Data obtained was analyzed statistically to find out mean, standard deviation, p value. The 'z' test was applied to determine the significance of sexual difference obtained in means of above parameters. Data was analysed for the overlapping zone for all the three parameters to determine their reliability in determination of sex.

Rule of 136, given by Ashley (1956)[6] was applied, which states that if the combined length is more than 136 mm than it was male and it the value is less than 136 it was female sternum. The results were obtained in two forms, one, as the number of male and female sterna determined by the rule and second, as the number of actual male and female sterna obeying this rule. The data was analysed for its statistical significance by using chi-square test.

RESULTS

Various observations of the present study are presented in table I and table II

Table: 1. Measurements of sternum of both sexes

PARAMETER	SEX	RANGE	MEAN±SD	P VALUE	No.&% of overlapping specimen
Length of manubrium (M) (in mm)	M	39.61 - 58.2	48.95±4.25		39 (86.66)
	F	33.90-53.30	44.03±4.21	$P<0.001$	52 (94.54)
Length of mesosternum (B) (in mm)	M	67.78– 116.78	92.11±9.55		28 (62.22)
	F	62.20 - 94.20	78.28±7.59	$P<0.001$	52 (94.54)
Combined length (M+B) (in mm)	M	107.39 - 173.1	141.06±10.64		29 (64.44)
	F	103.81– 143.69	122.31±9.38	$P<0.0001$	52 (94.54)

Table: II. Statistical analysis of sterna of both sexes

	Male	Female	P value
Actual sample size	45	55	-------
BY RULE OF "136"	34	66	$P>0.05$
No. of Specimen obeying Rule of 136	32 (71.11%)	53 (96.34%)	$P >0.05$

DISCUSSION

The observations of various workers regarding the sexual dimorphism in length of manubrium, length of mesosternum and combined length are presented in table III.

Length of Manubrium : In the present study, mean length of manubrium In male and female sterna is 48.95 mm and 44.03 mm respectively, in accordance with the observations of Dahipale et al. (2002)[8] and Jit et al (1980)[7]. The difference in mean length of manubrium of male and female sterna is 4.92 mm which is statistically highly significant ($P <0.001$) and in accordance with the value of Gautam et al (2003)[2] and Dahipale et al. (2002)[8], but the parameter is not so useful in determination of sex of individual specimen because 91% specimens lie in overlapping zone. This is in accordance with Ashley (1956)[6], Jit et al. (1980)[7] and Dahipale et al. (2002)[8].

Length of Mesosternum: In the present study, mean length of mesosternum In male and female sterna is 92.11 mm and 78.28 mm respectively, in accordance to the observations of other Indian workers, Jit et al (1980)[7], Dahipale et al. (2002)[8], Gautam et al. (2003)[2] and Puttabanthi et al. (2012)[1]. The difference in mean length of mesosternum of male and female sterna is 13.83 mm which is statistically highly significant ($P<0.001$) and in accordance with the value of Ashley (1956)[6] and Jit et al. (1980)[7]. Dahipale et al (2002)[8] found the length of mesosternum extremely useful in determining the sex, but in the present study 80% specimens lie in overlapping zone, so not useful in determination of sex of individual specimen.

Table.3: Observations of various workers regarding measurements of various parameters of sternum

NAME OF WORKER	SPECIMEN		MANUBRIUM (M) (in mm)		MESOSTERNUM (B) (in mm)		COMBINED (M+B) (in mm)	
	Sex	No.	Mean	Difference	Mean	Difference	Mean	Difference
Dwight (1881)[10]	M	30	51.8		105.9		-----	
	F	26	46.7	5.1	89.4	16.50	-----	--
Dwight (1890)[5]	M	142	53.7		110.4		164.1	
	F	86	49.4	4.3	91.9	18.50	141.3	22.80
Paterson(1904)[11]	M	310	52		103.7		-----	
	F	126	47.3	4.7	91	12.70	-----	--
Ashley (1956)[6] African	M	85	45.9		96.5		142.6	
	F	13	44.2	1.7	82.9	13.60	127.1	15.50
Ashley (1956)[6] European	M	378	52.2		104.7		156.9	
	F	168	47.9	4.3	90.8	13.90	138.7	18.20
JIT et al (1980)[7]	M	312	51.73		95.35		147.08	
	F	88	48.42	3.3	78.60	16.75	127.02	20.06
Mahajan et al (2009)[9]	M	98	57.86		115.19		173.05	
	F	55	46.96	10.90	93.85	21.34	140.82	32.23
Gautam et al (2003)[2]	M	56	53		95		149	
	F	44	48	5.00	76	19.00	124	25
Dahipale et al (2002)[8]	M	96	48.42		94.43		142.20	
	F	47	43.78	4.64	70.19	24.23	113.87	29.32
Puttabanthi et al (2012)[1]	M	57	47.48		92.36		139.55	
	F	22	21.68	25.80	88.95	3.41	110.64	28.91
PRESENT STUDY	**M**	**45**	**48.95**		**92.11**		**141.06**	
	F	**55**	**44.03**	**4.92**	**78.28**	**13.83**	**122.31**	**18.75**

Combined length of manubrium and mesosternum ; In the present study, mean Combined length of manubrium and mesosternum In male and female sterna is 141.06 mm and 122.31 mm respectively, in accordance to the observations of other Indian workers, Jit et al (1980)[5], Dahipale et al. (2002)[8] and Gautam et al. (2003)[2]. The difference in mean combined length of manubrium and mesosternum of male and female sterna is 18.75 mm which is statistically highly significant (P <0.0001) and in accordance with the value of Ashley (1956)[6] and Jit et al. (1980)[7]. Puttabanthi et al (2012)[1] found combined length as the best discriminator of sex. They had 100% accuracy to sex female and 68.42% to sex male. In the present study 81% specimens lie in overlapping zone, so the parameter is not useful in determination of sex of individual sex.

Of all the three parameters, the combined length of manubrium and mesosternum is the most reliable parameter for determination of sex with p value less than 0.0001 which is agreement with previous literature authors.

Rule of 136: This rule was given by Ashley (1956)[6] for the population of East Africa. It states that combined length of manubrium and mesosternum is more than 136 mm for male and less than 136 for female. But he found a co extensive range of 126 mm to 171 mm and therefore any sternum of unknown sex having combined length within this range cannot be sexed with certainity.

Jit et al (1980)[7] found the combined length extremely helpful in determination of sex of North Indian sterna. He applied "Rule of 136" , by which they determined the sex of 86% male and 78% female, but individually they can't say if any particular sternum given is definitely male of female.

In the present study, Rule of 136 was applied and it was observed that 32 (71.11%) male and 53 (96.34%) female sterna obeyed the rule. Total numbers of male and female sterna sexed by the rule were 34 and 66 respectively, while the actual sample size was 45 male and 55 female. On applying chi-square test, P value was more than 0.05, so the difference in observation from the Rule of 136 was not statistically significant. So "The Rule of 136" was considered reliable in determination of sex.

CONCLUSION

Following conclusions were drawn based on present study.

If the length of manubrium was less than 39.61 mm then it was of female and if it was more than 53.30 mm then it was of male.

If the length of mesosternum was less than 67.78 mm then it was of female and if it was more than 94.20 mm then it was of male.

If the combined length of manubrium and mesosternum was less than 107.39 mm then it was of female and if it was more than 143.69 mm then it was of male.

Of all the above three parameters, Combined length of manubrium and mesosternum was the most reliable parameter for determination of sex (P <0.0001). Rule of 136 for combined length was obeyed by 71.11% of male and 96.34% of female sterna, hence considered helpful for determination of sex.

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