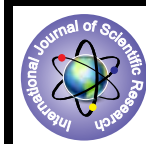


Radiological Age & Sex Determination from Sternum



Technology

KEYWORDS : Sternum, Ossification, Xiphi-sternal Joint, Xiphoid Process.

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ABSTRACT

Imaging techniques plays a significant role in determining the age and sex of an individual. The aim of this study is to determine the age and sex of an individual through the calculation of the size of the sternum and also the degree of ossification of various element of sternum process radio-graphically. This relatively slow ossification rate of the sternum interfered with accurate age determination(1).The length and diameter of the sternum varied with age but was also gender dependent. Sternal ossifications are taken as a guide for determination of olderage most commonly used to fix up retirement age (1).

Introduction

Forensic Radiology of the study of the sternum was first performed by Wenzel (1788). He described the difference in the ratio between the length of manubrium and that of meso-sternum in both sexes (6). This study was designed to get lateral view sternum from a living person whose exact age is available from birth certificates etc. Sex differentiation in the sternum is based on overall size and proportion. (Jit et al., 1980, Stewart and McCormack, 1983). Two methods components and phase analysis to estimate age from morphology of the sternum have been developed (Iscan et al., 1985)

Materials and Methods

Research approach: Evaluative approach
Study design: Prospective observational study design.
Study period: 6 months.
Population: Patients scheduled for CT
Sampling technique: Non-probability sampling technique.

Materials used consist of 30 male and 30 female patients of different age groups, free from any musculoskeletal, nutritional and endocrinal disorders and confirmed dates of births were selected. The subjects were divided into groups on the basis of their age and sex. 3D reconstruction of the computed tomography scan images of the sternum of patients undergoing chest scan are taken in accordance to the age group. Anticipated findings and radiological changes were observed and recorded.

For estimation of age, the elements of each sternum i.e. manubrium, body and xiphoid process were examined for their fusion. The manubrio-sternal and xiphi-sternal articulations and sternal segments were carefully examined for degree of fusion i.e. complete / partial / absent. For sex determination, the length of the manubrium and the entire length of the sternum were measured and noted.

Observation

Table I: Fusion of Xiphoid Process with body of sternum according to age n sex.

AGE GROUP	NOS OF CASES	MALE		FEMALE	
		COMPLETE FUSION	NOT FUSION	COMPLETE FUSION	NOT FUSION
25-30	30	0	30	0	30
31-35	30	6	24	7	23
36-40	30	11	21	9	21
41-45	30	12	18	13	17
46-50	30	18	12	14	16
51-55	30	26	4	24	6
56 - above	30	27	3	28	2
Mean		14.28571	16	13.57143	16.42857
Standard deviation		10.0119	10.14889	9.710083	9.710083

Table II: Fusion of Manubrium-sterni with the body of sternum according to age n sex.

AGE GROUP	NOS OF CASES	MALE		FEMALE	
		COMPLETE FUSION	NOT FUSION	COMPLETE FUSION	NOT FUSION
25-30	30	0	30	0	30
31-35	30	0	30	1	29
36-40	30	3	27	4	26
41-45	30	7	23	5	25
46-50	30	9	21	11	21
51-55	30	19	11	19	11
56 - above	30	25	5	24	6
Mean		9	21	9.142857	21.14286
Standard Deviation		19.2873	9.643651	9.263343	9.227289

Table III: Length of manubrium according to sex.

INTERVAL (mm)	FREQUENCY	
	MALE	FEMALE
30-39	17	30
40-49	51	52
50-59	19	7
60-69	3	1
70-79	0	0
TOTAL	90	90

Table IV: Length of meso-sternum according to sex.

INTERVAL (mm)	FREQUENCY	
	MALE	FEMALE
60-69	1	3
70-79	5	37
80-89	43	41
90-99	37	7
100-109	4	2
TOTAL	90	90

Table IV: Combined Length of sternum according to sex.

INTERVAL (mm)	FREQUENCY	
	MALE	FEMALE
130-139	5	41
140-149	7	36
150-159	31	6
160-169	44	7
170-179	3	0
TOTAL	90	90

Discussion

Sternum is a long flat bone lying in the median part of the anterior thoracic wall. It is divided in three parts namely manubrium sterni, body of sternum, xiphoid process. Its upper end articulates with the clavicle and its marginal articulates with costal cartilage of first seven pairs of ribs (9). Ossification of sternum occurs in five primary centers and one secondary center. One center for manubrium sterni appears at the age of 20th week, other two centers for 1st and 2nd segment of sternebrae respectively appear at the age of 24th-28th weeks. Sternebrae fuse with each other from below upward which begins at puberty and is completed by 25 years of age. The last two centers are for 3rd and 4th segment which appear at 28th-32th weeks and unites with the body the age of 40 years. The secondary center is for ossification xiphoid process at the 3rd year of age (9). According to Jit and Bakhshi (1986), the fusion of xiphoid process with body of sternum is completed by 50 years of age. Fusion of manubrium with body of sternum starts at the age of 40 years and is completed by 55 years of age. The present study shows that age group between 25-30 years shows no fusion of manubrium sterni with body. Similarly, the fusion of xiphoid process with the body is also absent. The age group of 50 years and above shows complete fusion of manubrium sterni with body and similarly fusion of xiphoid process with the body is completed.

According to the previous study, the combined mean length of manubrium and body of sternum is 164.1 for male and 141.3 for female (Dwight, 1890); 156.9 for male and 138.7 for female (Ashley 1956); 147.08 for male and 127.02 for female (Jit and Bakhshi, 1986). In the present study, the length of manubrium ranges from 30 to 60 mm in male and 30 to 50 mm in female. The length of body of meso-sternum is found to be in the range of 80 to 100 mm in males and 70 to 90 mm in females. The total length ranges from 150-170 mm in males and 130-150 mm in females. Hence, our observation shows the differences between the average length of sternum between male and female indicating that the combined length of the male sternum is longer than that of the female sternum.

Figures



Figure 1: In the above figure of human sternum, A shows the complete fusion of Xiphoid Process with body and fusion of Manubrium sterni with the body of sternum. B indicates no fusion of xiphoid process with the body of sternum. In C it shows lateral view of sternum with incomplete fusion of Manubrium sterni with the body of sternum.

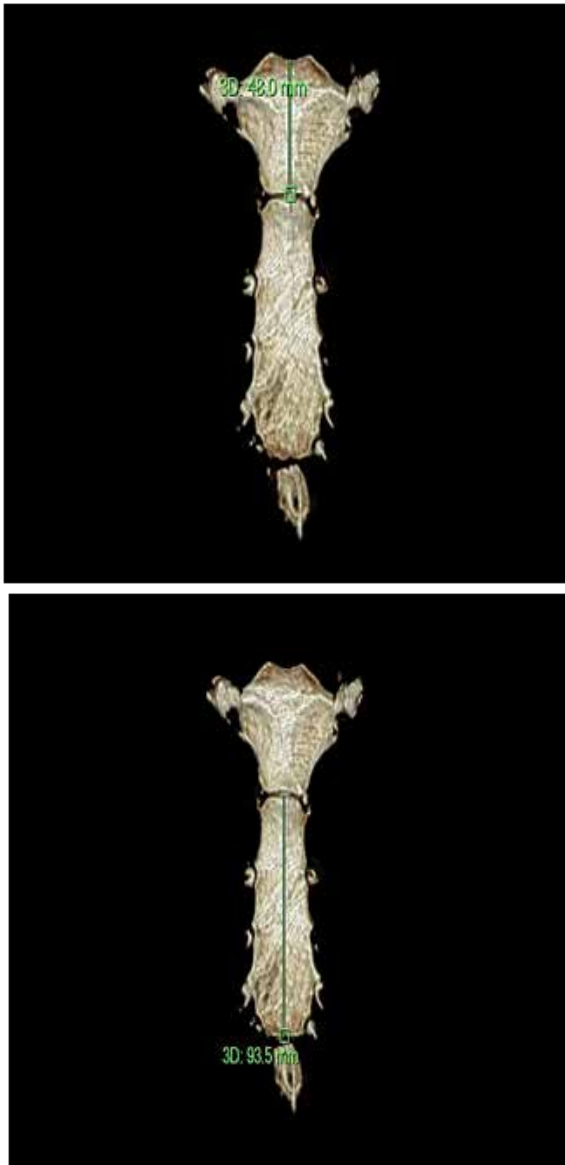


Figure II: In this figure A shows the length of a male manubrium to be 48 mm in size and in B it shows the length of the body of the sternum to be 93.5mm ,wherein the total length of the sternum is 141.5mm in male.

Conclusion

The fusion of xiphoid process with body of sternum starts after the age of 30 years. In most cases, the fusion is complete after the age of 50 years and above. The fusion of the manubrium with the body of sternum begins after 40 years of age but complete fusion occurs after the age of 50 years. Hence, it is concluded that at the age group of 40-50 years, only 50% of population shows fusion at Xiphi-sternal Joint. This ossification is of great significances as a guide for determination of older age which is most commonly to fix the standard retirement age of people.

Human sternum is a highly sexually dimorphic bone. The combined length of the sternum acts as a useful indicator in distinguishing a male from a female sternum.

Therefore, in the present study, it is concluded that if the total combined length of a sternum is less than 92mm, then it is of a female whereas if it exceeds 161mm, it is of a male. This significant difference between the male and female sternum is of great importance in medical science research for forensic investigations.

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