



Age of Fusion of Manubrium-sternum in Delhi City of India- A Digital Radiographic Study

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Abstract

Background: Forensic experts are treated as skilled witness by the court of law in resolving various medico-legal issues in relation to civil and criminal cases. Estimation of age is one of the important parameter in identification of an individual both in living as well as dead. Many drawbacks of general physical, dental & osteological examination, to arrive with a fair amount of accuracy all the scientific methods should be taken together into consideration. The aim of this study to find out the estimation of age by fusion of manubrium with the body of sternum in dead body.

Material & Methods: The study was conducted in Department Of Forensic Medicine, UCMS Delhi. 150 sternum bones were collected from the dead bodies of more than 20 years of age brought to the mortuary of G.T.B. hospital for medico-legal autopsy. Written informed consent was taken from the relatives before collecting the study material. Deceased of known age confirmed from municipal birth certificate, matriculation certificate or personal enquiries from the relatives were taken.

Results: In the present study, out of 150 cases 120 were males and 30 were females, male to female ratio was 4:1. The mean age for complete fusion of manubrium with the body of sternum was 50.30 years in males and 49.51 years in females.

Conclusion: The fusion of sternum in our study was more than 25 years of age, the results is great help in estimation of age of individuals alleged to be.

Keywords: Manubrium, Fusion, Age estimation, Radiological.

Introduction

Forensic word is originated from a medicine is a branch of science which deals with the application of medical knowledge to the administration of law¹. Forensic experts are treated as skilled witness by the court of law in resolving various medico-legal issues in relation to civil and criminal cases. The various civil cases include Identification, marriage contract, attainment of majority, competence as witness, eligibility for employment, admission in professional courses, senior citizen concession, retirement age disputes, management of properties, voting right, testamentary capacity. The various criminal cases include Criminal responsibility, kidnapping, rape, homicide, infanticide, criminal abortion, prostitution. Estimation of age is one of the important parameter in identification of an individual both in living as well as dead.

Estimation of age by scientific methods includes²

- 1) General physical examination
- 2) Dental examination
- 3) Osteological examination

General physical examination includes measurements of height & weight, presence of secondary sexual characters, greying of body hair & eruption of teeth which varies/ show changes depending on the age of the individual. It is used along with the other methods for estimation of age to arrive at a close age range of an individual.

Examination of the above three parameters individually does not give a correct picture of the age of a person. To arrive with a fair amount of accuracy all the above mentioned methods should be taken together into consideration. Ossification of bones includes both appearance of ossification centre and fusion of the same. Among the scientific method, ossification of bone and dental examination are more reliable scientifically. Age estimation can be done with fair amount of accuracy by general physical examination and dental examination up to the age of 25 years^{3,4} after which it becomes difficult with advancing age.

The various methods available for estimation of age after 25 years of age are changes in tooth morphology, study of changes of articular surface of pubis symphysis⁵, fusion of hyoid bone⁶, closure of skull sutures⁷, fusion of manubrium and xiphisternum with the body of sternum⁸, changes in the vertebrae⁹.

Various methods such as demirjian & Goldstein method,¹⁰ haavikko method, Cameriere method, Willems¹¹ for dental examination of estimation of age by orthopantomogram. Clinical and radiological dental findings could not be used, not even in combination, for accurate age estimation as a single method, but that they could support other methods after the age of 20 years.¹² Closure of skull sutures occurs both ectocranially and endocranially which is difficult to distinguish radiologically and there is a wide range of age difference in the fusion of skull sutures which is not acceptable in court of law.

As compared to the above mentioned method the sternum being a flat and superficial bone is easy to study radiologically in living and anatomically in dead.

The present study was therefore conducted:

- 1) For estimation of age of fusion of manubrium with the body of sternum.
- 2) To find out differences, if any, between both sexes in fusion of manubrium with the body of sternum.
- 3) To find out differences, if any, between AP and Lateral radiological view.

Materials and Methods

The study was conducted in Department Of Forensic Medicine, UCMS Delhi. 150 sternum bones were collected from the dead bodies of more than 20 years of age brought to the mortuary of G.T.B. hospital for medico-legal autopsy. Written informed consent was taken from the relatives before collecting the study material. Deceased of known age confirmed from municipal birth certificate, matriculation certificate or personal enquiries from the relatives were taken. Cases where bony abnormalities or

fracture was suspected were not included in the study. The sternum was exposed and the bones were removed by cutting the costal cartilages at their junction with the ribs, sterno-clavicular joint on both sides and the bone was removed intact¹³. Each specimen was labeled which included the name, age, sex of person, date and post mortem number. Each sternum was digitally radio graphed along with soft tissue in both AP and Lateral view. Exposure factors for AP view are 49 kV, 10 m amp, 20 msec and for Lateral view 52kv and 12.5 m amp, 25msec for radiograph of each sternum bone. Non fusion of joint was observed as gap between the joint space with smooth and regular articular surfaces. In partial fusion the joint space was partly obliterated with evidence of sclerosis and irregular articular surface. There was no gap visible in complete fusion and trabeculae continued across the joint. The information gathered from the subjects and their radiological findings of sternum were entered in a predesigned Performa. The data thus collected was analyzed statistically.

Results

In the present study, out of 150 cases 120 were males and 30 were females, male to female ratio

was 4:1 (Table 1). Out of 120 cases, 75 (62.5%) showed non fusion whereas 45 (47.5%) showed fusion of manubrium with the body of sternum. Further more in 32 (26.6%) cases there were partial fusion and in 13 (10.8%) cases complete fusion in male (Table 2).

Maximum proportion of cases showing partial fusion were 15 (57.7%) in age group 51 – 59.9 years whereas cases with complete fusion were 4 (19.0%) in age group +60 years. Earliest fusion of manubrium with the body of sternum was present at the age of 25 years whereas latest non fusion was seen till the age of 73 years of age.

In females, Out of 30 cases 12 (40%) showed non fusion whereas 18 (60%) showed fusion of manubrium with the body of sternum. Further more in 12 (40%) cases there were partial fusion and in 6 (20%) cases complete fusion was seen. (Table 3)

The proportion of females showing fusion was 25% in age group 20 – 29.9 years whereas it increased as age advances. Earliest fusion of manubrium with the body of sternum was present at the age of 23 years whereas latest non fusion was seen till the age of 70 years of age.

Table 1 showing age and sex distribution of study subjects.

Age Group (in years)	No. of Cases		Total
	Male	Female	
20- 30	22	8	30
30.1- 40	23	10	33
40.1- 50	28	3	31
50.1- 60	26	5	31
>60	21	4	25
Total	120	30	150

Table 2: fusion status of Manubrium with body of sternum in males

Age Group (in years)	Non Fusion		Partial fusion		Complete fusion		Combined fusion (partial+complete)	
	No.	%	No.	%	No.	%	No.	%
20- 30	16	72.7	4	18.1	2	9.1	6	27.3
30.1- 40	17	73.9	4	17.3	2	8.6	6	26.1
40.1- 50	20	71.4	7	25.0	1	3.5	8	28.6
50.1- 60	11	42.3	11	42.3	4	15.3	15	57.7
>60	11	52.3	6	28.5	4	19.0	10	47.7
Total	75	62.5	32	26.6	13	10.8	45	47.5

Table 3: fusion status of Manubrium with body of sternum in females

Age Group (in years)	Non Fusion		Partial fusion		Complete fusion		Combined fusion (partial+complete)	
	No.	%	No.	%	No.	%	No.	%
20- 30	6	75.0	1	12.5	1	12.5	2	25.0
30.1- 40	4	40.0	5	50.0	1	10.0	6	60.0
40.1- 50	0	0.0	3	100	0	0.0	3	100
50.1- 60	1	20.0	1	20.0	3	60.0	4	80.0
>60	1	25.0	2	50.0	1	25.0	3	75.0
Total	12	40.0	12	40.0	6	20.0	18	60.0

Table 4: Showing mean age of fusion of manubrium.

	Mean age		Standard deviation		Number	
	Male	Female	Male	female	Male	female
Non fusion	42.17	33.65	13.49	14.42	75	12
Partial fusion	48.46	44.33	13.00	14.47	32	12
Complete fusion	50.30	49.51	17.12	17.66	13	6



Discussion

The studies done on estimation of age of ossification of sternum bone are very few. It is further rare in this part of India. Most of the studies done are related to the sex differentiation¹⁴. The various parameters which are usually taken into consideration for estimation of age of an individual are fusion of sternal segments with each other, fusion of manubrium with the body of the sternum¹⁵.

Garg et al¹⁶ examined fusion of manubrium with the body of the sternum in 135 males and 27 females in state of Punjab of India. They observed complete fusion of manubrium with the body of the sternum in male subjects the trend of which is in conformity with the male subjects of the

present study. There is a significant difference between the present study and the study of Garg et al¹⁷ as far as the fusion of manubrium is concerned in female subjects. The reason could be because of small sample size of female subjects in both the studies.

Waghmare et al¹⁸ found that a sudden increase in percentage of fusion from 36-40 years (36.50%) to 41-45 years (65.10%) of age group whereas the present study showed sharp rise in fusion of manubrium from 40.1-50 years (28.6%) to 50.1-60 years (57.1%) age group. The study done by author does not specify about sex.

Chandresh I & Tailor et al¹⁹ observed that manubrium was un-fused till 40 years of age in males and 50 years of age in female which is in sharp contrast to the present study as we have found it fused at the age of 25 years in male and 23 years in female. Similarly non-fusion was not observed after 50 years of age in both sexes in their study whereas in present study un-fused manubrium was found at 73 years and 70 years in males and females respectively.

Manoharan c did study on manubrium in south Indian population where they found that the fusion of manubrium with body of sternum was not observed below 35 years in males and below 43 years in females but it does not fuse even in extreme old age, which is in conformity of the present study²⁰.

Kaneriya D et al studied fusion of manubrium in surat, gujrat. They found below the age of the 40 years there was no complete or partial fusion of the manubrium and the body of the sternum. Above 55 years fusion is complete/ partial in all²¹. The present radiological study shows that mean age for complete fusion of manubrium with the body of sternum was 50.30 years in males and 49.51 years in females (Table 6). The frequency of fusion of manubrium shows a sharp increase after the age of 50 years. The above results are in agreement with the study done by some foreign and Indian workers. No significant difference of age of the fusion of manubrium with the body was found in males and females in the present study

which is in conformity with the studies done by other workers.

Fusion was equally well seen on AP and lateral views for manubrium-sternal joint. The possible reason being overlapping due to surrounding costal cartilage shadows. AP view is possible only in dead bodies in which sternum can be dissected during autopsy. Lateral view is possible in both living and dead without dissection. Radiological examination provides immediate results whereas in anatomical study it takes quite long time for the bone to be dried. Since very few studies have been done in Delhi on fusion of sternum the present study will be of great help in estimation of age of individuals alleged to be more than 25 years of age. The above mentioned observations are population specific and may not be applicable to non Indian population.

Conclusion

Since very few studies have been done in Delhi on fusion of sternum the present study will be of great help in estimation of age of individuals alleged to be more than 25 years of age. The above mentioned observations are population specific and may not be applicable to non Indian population.

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