*Original Research Article*

# Age Estimation from Fusion of Manubrium & Xiphoid Process with Sternal Body: A Radiological Study in Living Individuals from Central India

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## Abstract

Forensic Age Estimation is an expertise in Forensic Medicine which aims to find out the most accurate way of determining the chronological age of the unknown person involved in judicial or legal proceedings. This study aims to investigate the relationship between the stage of union at Manubrium, Sternum & Xiphoid Process and biological age in Chhattisgarh population. The study was carried out in 270 healthy subjects (135 males and 135 females) aging from 25 to 70 years. The obtained results from the radiographs revealed that the complete fusion of Xiphoid process & Manubrium with the body of sternum is seen in more than & 70% of individuals in the age group of 50-55 years. Females were consistently developing union at a younger age than their male counterparts. Results also suggest that the age of union is found to vary greatly all over the India indicating the need for separate standards of age of epiphyseal union for separate regions.

***Key Words:*** *Manubrium, Sternum, Xiphoid, Union, Central India.*

## Introduction

Age Estimation is necessary in the identification and creation of biological profiles, which can then be compared with suspects, victims or missing persons. Human identification whether living or dead is one of the most crucial tasks in medico-legal practice[1]. The services of Forensic Medicine experts are sought in establishing the identity of the dead, especially in mass disasters. Extreme mutilation, advanced decomposition, skeletal and fragmentary remains, makes the process more complicated. Most of the time, Forensic Medicine specialists have to mainly depend upon bones for establishing the identity. Estimation of age in elderly person is comparatively more difficult than in young persons[4]. The young individual has various factors for age estimation such as physical and morphological features, eruption of teeth, ossification activities and growth of bones which help in establishing the age with utmost accuracy. On the contrary, the elderly persons have very few identifying factors like fusion of sternal bones, fusion of skull sutures, changes that occur in the pubic symphysis, degenerative changes and application of Gustafson's formula[6]. Age estimation in elderly person has limitations due to paucity of anatomical factors. The present study is an attempt to assess the age of an individual from sternum which is one of the superficial bones, and is spared even in a highly decomposed body. Moreover, it is a bone which can be easily procured from cadavers, without the slightest damage during a routine autopsy procedure[9].

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## Aims & Objectives

1. To estimate age from union of manubrium sterni & xiphoid process with sternum.

2. To compare bisexual difference in union of manubrium sterni & xiphoid process with sternum.

3. To compare the findings of union of manubrium sterni & xiphoid process with sternum in Central Indian population with other parts of India on the basis of previous studies.

## Material & Methods

The present study was carried out in the Department of Forensic Medicine & Department of Radiology, SSIMS, Bhilai, Chhattisgarh (Central India). A total of 270 individuals participated in this study. The subjects included were individuals of 25-70 years of age from Bhilai city. They are born to parents living in Central India and have lived here since birth. The subjects do not have any disease/deformity pertaining to bones or chronic disease affecting the general health. Only those cases were considered whose records for date of birth were available. The X-Ray Sternum Lateral View was taken of study cases after obtaining their written informed consent. In this study only bonafide residents, who do not show any disease in respect to anterior chest wall were considered. The female cases were taken less because of poor quality of X–Ray film due to over shadowing of the breast tissue. The status of Fusion of Xiphisternum and Manubrium with the body of sternum was studied. At the end conclusions were drawn, which were compared with available results of various previous studies.

## Results

**TABLE 1: Fusion between Xiphoid process & body of sternum:**

| Age group | No of Male cases | Male – complete fusion | Male – no fusion | No of Female cases | Female – complete fusion | Female – no fusion | Total % showing fusion |
|---|---|---|---|---|---|---|---|
| 25-30 | 15 | 0 (0%) | 15 | 15 | 0 (0%) | 15 | 0 |
| 30-35 | 15 | 0 (0%) | 15 | 15 | 1 (6.66%) | 14 | 3.33 |
| 35-40 | 15 | 1 (6.66%) | 14 | 15 | 3 (20%) | 12 | 13.33 |
| 40-45 | 15 | 3 (20%) | 12 | 15 | 4 (26.66%) | 11 | 23.33 |
| 45-50 | 15 | 5 (33.33%) | 10 | 15 | 6 (40%) | 9 | 36.66 |
| 50-55 | 15 | 12 (80%) | 3 | 15 | 10 (66.66%) | 5 | 73.33 |
| 55-60 | 15 | 14 (93.33%) | 1 | 15 | 14 (93.33%) | 1 | 93.33 |
| 60-65 | 15 | 14 (93.33%) | 1 | 15 | 15 (100%) | 0 | 96.66 |
| 65-70 | 15 | 15 (100%) | 0 | 15 | 15 (100%) | 0 | 100 |
| Total | 135 | | | 135 | | | |

In males, xiphoid process shows: non fusion in age group of 25-35 years. 80% of individuals show fusion in age group of 50-55 years & 93% individuals show fusion in age group of 55-65 years. Complete fusion is seen in all the subjects in age group of 65-70 years.

In females, xiphoid process shows: non fusion in age group of 25-30 years. 73% of individuals show fusion in age group of 50-55 years & more than 90% of individuals show fusion in age group of 55-65 years. Complete fusion is seen in all the subjects in age group of 65-70 years.

**Table 2: Fusion between Manubrium & body of sternum:**

| Age group | No of Male cases | Male – complete fusion | Male – no fusion | No of Female cases | Female – complete fusion | Female – no fusion | Total % showing fusion |
|---|---|---|---|---|---|---|---|
| 25-30 | 15 | 0 (0%) | 15 | 15 | 0 (0%) | 15 | 0 |
| 30-35 | 15 | 0 (0%) | 15 | 15 | 0 (0%) | 15 | 0 |
| 35-40 | 15 | 1 (6.66%) | 14 | 15 | 2 (13.33%) | 13 | 10 |
| 40-45 | 15 | 3 (20%) | 12 | 15 | 5 (33.33%) | 10 | 26.66 |
| 45-50 | 15 | 5 (33.33%) | 10 | 15 | 7 (46.66%) | 8 | 40 |
| 50-55 | 15 | 12 (80%) | 3 | 15 | 12 (80%) | 3 | 80 |
| 55-60 | 15 | 14 (93.33%) | 1 | 15 | 15 (100%) | 0 | 96.66 |
| 60-65 | 15 | 14 (93.33%) | 1 | 15 | 15 (100%) | 0 | 96.66 |
| 65-70 | 15 | 15 (100%) | 0 | 15 | 15 (100%) | 0 | 100 |
| Total | 135 | | | 135 | | | |

In males, manubrium shows: non fusion in age group of 25-35 years. 80% of individuals show fusion in age group of 50-55 years & 93% individuals show fusion in age group of 55-65 years. Complete fusion is seen in all the subjects in age group of 65-70 years.

In females, manubrium process shows: non fusion in age group of 25-35 years. 80% of individuals show fusion in age group of 50-55 years & more than 95% of individuals show fusion in age group of 55-65 years. Complete fusion is seen in all the subjects in age group of 65-70 years.

## Discussion

**Table 5: Comparison of Age of Fusion with previous studies:**

| Sr. No. | Researcher | Region/ population | Age of fusion (years) | |
|---|---|---|---|---|
| | | | Between Xiphoid & body | Between Manubrium & body |
| 1 | Vasaiya K2 | Ahmedabad | 50 | 55 |
| 2 | Gautam S3 | Ahmedabad | 50 | 55 |
| 3 | Tailor C5 | Surat | >40 | 60 |
| 4 | Gaur et al7 | Pune | >41 | >41 |
| 5 | Vora D8 | Rajkot | 44-45 | 55-60 |
| 6 | Patel D et al10 | Bhavnagar | 42-44 | 59-64 |
| 7 | Manoharan C et al11 | Tirunelveli | 35-43 | Extremely variable |
| 8 | Reddy R et al12 | Bangalore | 40-42 | 55-58 |
| 9 | Present study | Bhilai | 50-55 | 50-55 |

## Summary and Conclusion

1. This study was conducted exclusively on the young indigenous population of Central India (Chhattisgarh).

2. The union of Xiphoid process with sternum in 80 % males is seen in the age group of 50-55 years.

3. The union of Xiphoid process with sternum in >70 % females is seen in the age group of 50-55 years.

4. The union of manubrium with sternum in 80% males & females is seen in the age group of 50-55 years.

5. Females were consistently developing union at a younger age than their male counterparts.

6. Fusion was delayed by 5-10 years in this study (Central India) as compared to population of South India but is in agreement with some studies done in Gujarat.

7. Central Indian population is of mixed type comprising of various religions and castes. The opinion about age should always be given in the range.

8. For age estimation, relevant joints should be radiologically examined for different centres and opinion should be arrived considering the status of multiple centres.

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**Conflict of interest**: Author declares that there is no conflict of interest

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