



ESTIMATION OF BONE AGE BY RADIOLOGICAL EXAMINATION OF THE MEDIAL END OF THE CLAVICLE BONE.

Radiology

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ABSTRACT

The cross-sectional observational study conducted at UCMS & GTB Hospital, Delhi, aimed at investigating the ossification process of the medial end of the clavicle in individuals aged 18 to <25 years from North India. The study involved 200 volunteers (100 males and 100 females) whose ages were confirmed through official documents. Digital radiographs of the right sternoclavicular joint were taken using a specific X-ray machine, and the presence of complete ossification was examined. The results were categorized based on age groups and sex. In males, the fusion of the clavicle's medial end began at 19 years and completed at 23 years, with a mean age of 21.41 ± 1.06 years. For females, the fusion process started at 19 years and concluded at 23 years, with a mean age of 21.5 ± 0.84 years. Overall, the study revealed the timing of epiphyseal fusion in the clavicle's medial end for both males and females in the specified age range.

KEYWORDS

Bone Ossification, Age estimation, Medial end of the clavicle, Radiological Examination.

INTRODUCTION:

"Every person domiciled in India shall attain the age of majority on his completing the age of eighteen years and not before" as per section 3(1) of the INDIAN MAJORITY ACT, 1875. "A marriage may be solemnized between any two Hindus if the bridegroom has completed the age of [twenty-one years] and the bride, the age of [eighteen years] at the time of the marriage" as per section 5 (iii) of THE HINDU MARRIAGE ACT, 1955. "Juvenile" means a child below the age of eighteen years; as per section 1(35) of THE JUVENILE JUSTICE (CARE AND PROTECTION OF CHILDREN) ACT, 2015.¹ Thus age is an important parameter in many such Acts and Indian penal code to understand and implementation of the law.

Estimation of age can be done by various methods like dental eruption and occlusion wear and tear, secondary sexual characteristics, general physical development, ossification of long bones and skull, and metamorphosis of the pelvis, and vertebra, etc.⁴ The clavicle is a long bone and the first foetal bone to undergo primary ossification. However, unlike other long bones, it is initially ossified by membranous ossification without prior endo-chondral ossification. There are two primary ossification centres for the clavicle, one medial and the other lateral, which appear during the 5th and 6th week of intrauterine life and are ossified during foetal life. Cartilaginous growth (epiphyses) develops at both the lateral and medial end of the clavicle. A secondary epiphyseal ossification centre appears at the medial end of the clavicle during adolescence. The analysis of its complete ossification of the secondary epiphysis with the clavicular shaft is used to estimate age.^{5,6}

MATERIAL AND METHODS:

A cross-sectional, observational study was carried out in the Departments of Forensic Medicine and Radiology, UCMS & GTB Hospital, Delhi on the volunteers of the North India population between 18 to <25 years of age from November 2019 to November 2021. Total of 200 volunteers (100 male and 100 female) of known sex, native residence, and age between 18 years to <25 years were included. Age was verified by any one of documentary evidence in the form of an Aadhar Card/ Voter ID /Secondary school certificate/or any documents issued by the Government of India. The Digital radiograph of an oblique view of the right sterno-clavicular joint was taken and the radiograph was examined for complete ossification of the right medial end of the clavicle.

The X-Ray was performed with a General Electric (X-Ray Machine, Wipro GE Healthcare Pvt Ltd, India) (standard settings: 337.5 mA; 75 kVp; 3.38mAs; Radiation dose 0.134 mGy, 1.568 dGy*cm²)

The age was presented as a minimum, maximum, mean $\pm$ standard deviation.

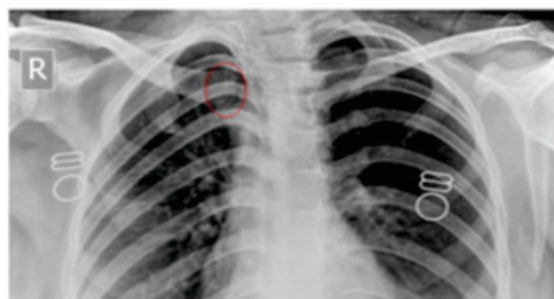
OBSERVATIONS & RESULTS:

Two hundred Radiographs (100 males and 100 females) of an oblique view of the right shoulder joint in the age group of 18-<25 years were analysed. The total population was further divided into even age groups which were 18-<19 years, 19-<20 years, 20-<21 years, 21-<22 years, 22-<23 years, 23-<24 years and 24-<25 years in both males and females separately. The data thus obtained was subjected to the statistical calculation by using SPSS 20.0 software.

The authors observed that epiphysis of the medial end of the clavicle in all the 17 male candidates in the age group of 18-<19 years was unfused (Picture 1). In the age group 19-<20 years, only 5 (31.25%) male candidates showed complete epiphyseal fusion (Picture 2) out of a total of 16 male candidates. In the 20-<21 years age group, 12 (80%) male candidates showed complete epiphyseal fusion out of a total of 15 male candidates. In 21-<22 years, 10 (83.34%) cases out of 12 showed complete epiphyseal fusion. After 22 years of age all the male candidates (n=40) of age groups 22-<23, 23-<24 and 24-<25 showed complete epiphyseal fusion. In the male, the fusion of epiphysis of the medial end of the clavicle started at the age of 19 years and was completed at the age of 23 years. The mean age was 21.41 ± 1.06 years and the median was 21.55 years (Table no 1)

Table 1: Epiphysis Fusion Of Medial End Of Right Clavicle In Males

Agegroup (yrs)	Cases showed complete fusion	Total
18-<19	0(0%)	23
19-<20	1(0.6%)	16
20-<21	9(81.82%)	11
21-<22	14(93.34%)	15
22-<23	11(100%)	11
23-<24	22(100%)	22
24-<25	2(100%)	2



Photograph 1: X-Ray of chest of age group 18-<19 years showing unfused Medial end of Right Clavicle (circled in red)



Photograph 2: X-Ray of chest of age group 21-<22years showing fused Medial end of Right Clavicle (circled in red)

The authors observed that epiphysis of the medial end of the clavicle in all the 23 female candidates in the age group of 18-<19 years was unfused. In the age group 19-<20 years, only 1(0.06%) female candidate showed complete epiphyseal fusion out of a total of 16 female candidates. In the 20-<21 years age group, 9(81.82%) female candidates showed complete epiphyseal fusion out of a total of 11 female candidates. In 21-<22 years, 14(93.34%) female candidates out of 15 female candidates showed complete epiphyseal fusion. After 22 years of age all the female candidates (n=35) of age groups 22-<23, 23-<24 and 24-<25 showed complete epiphyseal fusion. In females, the fusion of epiphysis of the medial end of the clavicle started at the age of 19 years and was completed at the age of 23 years. The mean age was 21.5 ± 0.84 years and the median was 21.53 years (Table no 2)

Table: 2. Epiphyseal Fusion Of Medial End Of Right Clavicle In Females

Age group(yrs)	Cases showed complete fusion	Total cases
18-<19	0(0%)	17
19-<20	5(31.25%)	16
20-<21	12(80%)	15
21-<22	10(83.34%)	12
22-<23	18(100%)	18
23-<24	17(100%)	17
24-<25	5(100%)	5

DISCUSSION:

In the present study, the complete fusion of epiphysis of the medial end of the right clavicle has occurred at the age of 22-<23 years both in males (Mean age 21.41 ± 1.06 years) and in females (Mean age 21.5 ± 0.84 years). The median age for males was 21.55 years and for females 21.53 years. The fusion started at the earliest 19-<20 years in both sexes. These findings were close to the findings by other Indian researchers such as Chaurasia et al.⁷, Parikh et al.⁸, Krishnan V et al.⁹, & Bhise SS et al.¹⁰. All these studies were performed in the Indian subcontinent which has a similar type nutritional status and environment.

The present study was compared with the studies conducted by authors outside India, and it was observed that the findings were similar to the studies conducted by authors East to the Indian subcontinent, i.e. Ji L et al.¹¹ (Japan), & Zhang K et al.¹² (China), age of complete fusion was 19-<22 yrs. & 21-<22 yrs. respectively. In contrast to the western authors such as Kreitner et al.¹³ (Germany), Webb et al.¹⁴ (American), & Tangmose et al.¹⁵ (Denmark) mean age they observed was 26.3 ± 3.1 yrs. in males and 26.4 ± 3.1 yrs. in females respectively, these findings are on the higher side as compared to present study.¹⁶ All the European and American studies showed similar findings which were different from the Asian studies due to different racial factors, nutritional status and environmental factors present.

CONCLUSION:

The complete fusion of the epiphysis of the Medial End of the Right Clavicle has been prospectively analysed in the present research work. An equal number of candidates (100 each) of males and females in the age group of 18 to 24 years with a known date of birth were taken in this study.

Complete fusion of epiphysis of the Medial End of the Right Clavicle was observed at 21.41 ± 1.06 years in males and 21.5 ± 0.84 years in females respectively. So there was no difference in the age of fusion of

clavicle in males and females.

Comparison with other Indian and foreign authors showed that variable degrees of regional variation existed. Therefore, the latest data available for that region should only be used for a more accurate estimation of age.

It could be safely concluded that X-ray of clavicle (medial end epiphyseal fusion) can be used to determine a person's age in the second and third decade of life. It should be one of the most preferred modalities as the procedure is fast, non invasive and easy to perform and assess the fusion.

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