

Age Determination by Medial End of Clavicle- Radiology Study

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Introduction

The clavicle is the modified long bone with S-shaped curve. It is placed horizontally and articulates medially with the sternum and laterally with the acromion process of the scapula. It consists of four ossification centres – two primary centres for shaft and two secondary centres. The secondary centre on the medial end appears on 19–20 years (2 years earlier in female) and completes at age of 25th.

Methods

The study was conducted on 369 chest X-ray of a patient from Department of Radiology, Kathmandu Medical and Teaching hospital, Duwakot, Bhaktapur in between April 2020–March 2021 after getting the ethical clearance from the Institutional Review Committee (reference no. KMC-IRC 2003202005). The convenient sampling was done. The stages of ossification of the medial epiphysis of clavicle were studied. The data was analysed with Statistical Package for the Social Sciences 20 version.

Results

The total sample sizes were 369. Out of that 208(56.4%) were male and 161(43.6%) were female. The 1st stage of the ossification in medial epiphyses of clavicles was found at the age of 15 in male and 12 in female. However, the medial epiphysis completed its ossification i.e stage 5 was found at 26 years of age. However, there was no difference in the stages of ossification in between the right and left side of clavicle.

Conclusions

The ossification of the medial epiphysis of right and left side of clavicle completes at age of 26 years in both gender of participants. This derivative can be used as a tool to predict the age of individual in future if supported with further studies.

Keywords: gender; ossification; stages.

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INTRODUCTION

Clavicle is a modified long bone and placed horizontally. It is slightly S shaped and consists of the medial and lateral end. It is the first bone to start ossifying between the fifth and sixth week of intrauterine life and last bone to complete at the age of 25.¹

It shows the membranous-cartilaginous ossification which ossifies in the membrane except medial end which ossifies in the cartilage. It consists of four ossification centers: two primary centers for shaft and two secondary centers. Two primary centers in the shaft appear at 5–6 weeks of intrauterine life (IUL) and fuse at 45th day of IUL. Whereas the Secondary center at sternal end appears at 19–20 years (2 years earlier in female) and fuses at age of 25. Another secondary center at the acromial end appears at 20th year and fuses immediately.³ Therefore it plays an important role for the forensic age estimation.⁴

Therefore, the aim of this study was to determine the stages of ossification in the medial epiphysis of the clavicle.

METHODS

The descriptive-cross sectional study was carried out in Kathmandu Medical College and Teaching Hospital, Duwakot in between April 2020–March 2021 after getting the ethical clearance from the Institutional Review Committee - reference no. KMC-IRC 2003202005. A total of 369 Patients were enrolled in the study of Kathmandu Medical College and Teaching Hospital from Department of Radiology, Duwakot.

The sample size was calculated based on the 28% prevalence of Type V ossification stage of medial epiphysis of clavicle was 300 participants⁵

Sample size (N) = $n = Z^2 p(1-p) / e^2$, n = sample size, confidence interval- 95% Z= 1.96

p = prevalence 28%, q = 1-p, e = allowable error, 5%(0.05). 20% extra samples were taken for minimum error. Therefore, the total sample size was 369. Hence, 369 chest x-ray was taken.

The participations were included after taking verbal informed consent among the patients of Kathmandu Medical College and Teaching Hospital between 18-50 years of age by a simple random sampling method from the Department of Radiology of Duwakot. Any history of surgery, trauma and congenital disorder of clavicle were excluded. The following different categories in the selected features were descriptively analysed in SPSS version 20.

The stages of maturity and union of the medial clavicular epiphysis were then observed and recorded chronologically according to the scoring system of Schmeling et al.⁶ on the medial clavicle as follows:

Stage 1: ossification center not ossified

Stage 2: Visible ossification center, but the epiphyseal plates are not fused

Stage 3: Metaphysis and epiphysis are partially fused.

Stage 4: Complete fusion and union of metaphysis with epiphysis, but with a visible scar - This stage describes the complete union of the epiphysis and metaphysis of the medial clavicle.

Stage 5: Total fusion of the ossification centers without any visible union scar.

RESULTS

In this study, the total sample sizes were 369 in which 208(56.4%) were male and 161(43.6%) female. The maximum participants were in between 21-30 years of age in both gender (Figure 1).

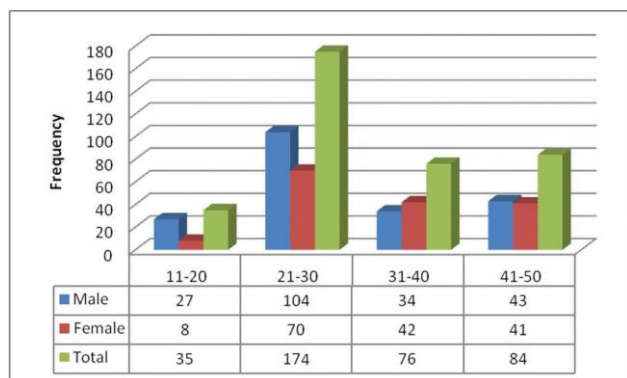


Figure 1. Age-wise distribution of participants among different gender (n=369).

In this study, maximum participants had median eipiphyseal clavicle ossification at stage 5 in both side i.e., 171 (46.3%) right and 172 (46.6%) left side. And it was seen least in Stage 1 (Figure 2.)

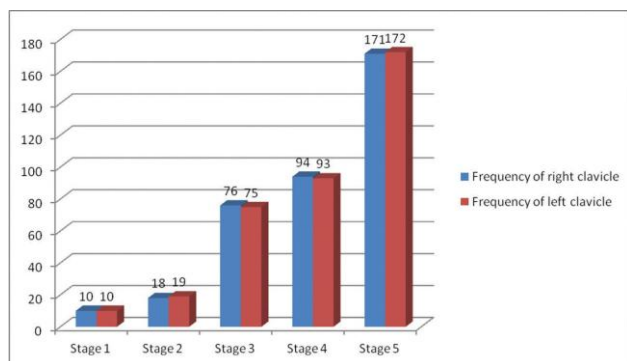


Figure 2. Distribution of the stage of ossification of medial epiphyses of clavicle among the participants (n=369).

In this study, maximum participants had median epiphyseal clavicle ossification at stage 5 in both side i.e 171(46.3%) right and 172(46.6%) left side. And it was seen least in Stage 1(Figure 2).

The age wise distribution of clavicle ossification stage showed the lower age group were having

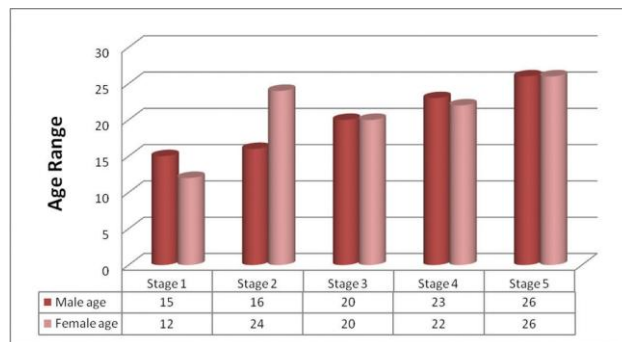


Figure 3. Stages of epiphyseal ossification of earliest appearance according to the age and gender.

clavicles ossified in stage 1,2 and 3. With increasing age, the clavicles were ossified to 4 and 5 stages (Table 1).

In this study, at the age of 15, Stage 1 begins in the male whereas in case of female at the age of 12. However the Stage 5 was seen at the age of 26 in both the gender (Figure 3).

DISCUSSION

Clavicle is a modified long bone which is placed horizontally. Its shape is S shaped. It consists of four ossification centres – two primary centres for shaft and two secondary centres, one for each end. Two primary centres i.e medial and lateral in the shaft appear at 5–6 weeks of intrauterine life (IUL) and fuses at 45th day of IUL. Whereas the Secondary centre at sternal end appears at 19–20 years (2 years earlier in female) and completed its fusion at age of 25.³In this study, the ossification stages of medial clavicular epiphysis were defined by using Schmeling classification which is a widely used by many researchers.⁶

Table 1. Age wise distribution of clavicle ossification stage in right and left clavicles.

Age group (years)	Right clavicle ossification stage					Left clavicle ossification stage				
	1 n(%)	2 n(%)	3 n(%)	4 n(%)	5 n(%)	1 n(%)	2 n(%)	3 n(%)	4 n(%)	5 n(%)
11-20	10 (28.6)	11 (31.4)	12 (34.3)	-	2 (5.7)	10 (28.6)	12 (34.3)	11 (31.4)	-	2 (5.7)
21-30	-	6 (4)	45 (25.9)	53 (30.5)	70 (40.2)	-	6 (3.4)	45 (25.9)	52 (29.9)	71 (40.8)
31-40	-	1 (1.3)	12 (15.8)	30 (39.5)	33 (43.4)	-	1 (1.3)	12 (15.8)	30 (39.5)	33 (43.4)
41-50	-	-	7 (8.3)	11 (13.1)	66 (78.6)	-	-	7 (8.3)	11 (13.1)	66 (78.6)

The study conducted by Ufuk F⁵ et al showed Stage I last appeared in females at 14 years of age and in males at 16 years of age which supported this study. In this study the last Stage 1 was seen at the age of 16. Whereas the research carried out in Srilanka⁷ revealed that an earliest appearance of stage 3 was 19 years which definitely support this study.⁸ In this study the stage 1 ossification was seen 2 years earlier in Female than a male which was completed supported by the researched done by Ufuk⁵ and Preetam Patil et al.⁹

The stage IV was seen in between 21-30 in this research whereas the study in Northwest Indian population of the Chandigarh region showed that Complete fusion of the medial end of the clavicle was seen latest at 32 years in the male clavicles and 31 years in the female bones respectively.¹⁰

Murata came with the theory that the genetic difference plays an vital role in skeletal maturation In a separate investigation revealed that Japanese children reached skeletal maturity 1- 2 years earlier than European and Chinese children.^{11,12}

There are several limitations in this study. First, of all the number of patients at each ages were relatively small and data were collected from a

single center. There was a lack of correlation with chest xray or anatomic evaluation which might be another limitation of our study. Another limitation was instead of using the xray, if the other advance technique was used would have been more beneficial.

CONCLUSIONS

There were no changes in the stages of ossification of right and left side of clavicle. The ossifications of the medial epiphysis of clavicles start 2 years earlier in female when compare to male participants. Also, the Stage-5 ossification completes at age of 26 years in both gender. As the age increased, the stages of ossification also increased. Therefore, the age can be used as a demarcation reference to predict of age of Nepalese individual when required if supported with further evidences.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to the Principal, entire team members of IRC-KMC, Dr. Smriti Mulmi former Consultant Radiologist of Kathmandu Medical College and Teaching Hospital- and Miss Sarishma (Department of Radiology, Duwakot) for their immense help and cooperation.

Conflicts of interest:

None

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Citation: Makaju S, Karmacharys M, Chaudhary S. Age determination by the medial end of the clavicle- Radiology study. *JCMS Nepal.* 2021; 17(2); 165-69.