



## RADIOLOGICAL STUDY OF EPIPHYSEAL UNION IN EXTENDED HAND IN AGE GROUP 16-22 YEARS IN WESTERN RAJASTHAN POPULATION

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### ABSTRACT

#### Introduction

Determination of age is prerequisite for personal identification in living as well as dead. Age estimation becomes a valuable tool to assist in administration of many civil and criminal procedure codes. Questions of juvenility are often a question that has to be answered correctly in connection with criminals of younger age group in cases where biological study of maturity of a child has to be performed to assess the development of a child, age estimation is of paramount importance.

#### Material and Methods

The present study was carried out on 100 healthy students (50 males&50 females). The subjects aged between 16-22 year of mbbs first year, Dr. S.N. Medical College, Jodhpur (Rajasthan)

**Radiological specification** -X ray of left hand and wrist-AP view.KV- 45 (centering midway between tip of mid finger and wrist).mAs-8-12

#### Result & Conclusion

The process of union of epiphyseal ends starts around 16 years of age in both male and female. Epiphyseal fusion at lower end of radius occurs in advance of the lower end of ulna and the difference is about one year.

Average age for complete epiphyseal fusion of lower end of radius among the people of western Rajasthan is 18-19 years for males and 17-18 years in females.

Average age for complete epiphyseal fusion of lower end of ulna among the people of western Rajasthan males is 19-20 years and for females 18-19 years. Average age of fusion of the base of the first metacarpals complete in 16-17 years in females and 17-18 years in males.

In current study it is observed that fusion of epiphyseal ends of phalanges of proximal row completes in 18-19 years in females and 18-19 years in males, middle row complete in 18-19 years in females and in male complete in 18-19 years, in distal phalanges fusion complete in 18-19 years in females and 18-19 years in females.

**Key words:** epiphyseal fusion, x-ray, age estimation, identification

## INTRODUCTION

Determination of age is prerequisite for personal identification in living as well as dead. Age estimation becomes a valuable tool to assist in administration of much civil and criminal procedure. Questions of juvenility are often questions that have to be answered correctly in connection with criminals of younger age group. In cases where biological study of maturity of a child has to be performed to assess the development of a child, age estimation is of paramount importance. Age estimation in the maturing skeleton is dependent upon three processes;

1. The appearance of primary and secondary ossification centres,
2. The growth of these centres and
3. The timing of fusion of primary and secondary centres.

These appearances and changes have been well documented both in dry bone and radiographic studies. Age determination of an individual from appearance & fusion of centres is a well accepted fact. After puberty the process of growth in length of the long bones stops at different ages in different parts of different long bones. This stoppage of growth process is indicative on x-ray examination by fusion of the epiphysis with its respective diaphysis, or can say secondary centre with primary centre. This process is completed by the age of 22 years as described by various authors.

The minor differences in the age of fusion could be due to effects of changes in climate, economic, hereditary, dietic conditions or involving some unknown factors<sup>[31]</sup>. The epiphyseal union during age periods is remarkably constant for particular epiphysis. Estimation of skeletal age from radiograph is a matter of everyday occurrence in every part of the world. The present study has been carried out retrospectively to explore the pattern of epiphyseal union in the bones of wrist joint & extended hand in growing population of western Rajasthan.

## AIMS AND OBJECTIVES

The present study is conducted with following aims and objectives:-

1. To estimate age from epiphyseal fusion of base of first metacarpal & head of phalanges in extended hand
2. To assess age specific difference in epiphyseal fusion in extended hand
3. To know the factors influencing epiphyseal fusion like race, sex, geographical distribution and nutritional status.
4. To assess if there is significant difference between the bone age of today's population with that of the standards.

## MATERIAL AND METHOD

The present study was carried out on 100 healthy subjects (50 males&50 females). The subjects aged between 16-22 year.

-Ethical committee permission obtained

-Consent of parents obtained

## Inclusion criteria

- Apparently normal healthy children between age group of 16-22 years.
- Children who have documentary evidence for date of birth.
- Date of delivery details, birth certificates, school records.

### **Exclusion criteria**

Subjects with criteria affecting the growth of bones and epiphyseal fusion like congenital deformities, fracture cases, chronic illness, on steroid therapy etc. were excluded from the study.

The proforma of all the students who participated in this study was prepared and filled up with the details provided by the students and their parents along with their radiological finding. Height, weight, general physical development and diet were recorded in all cases and the menstrual history of girls was also accounted for.

### **Radiological specification**

- X ray of left hand and wrist-AP view
- KV- 45 (centering midway between tip of mid finger and wrist)
- mAs-8-12

The left hand should be faced downward, extended, and flat on the x-ray cassette to generate a posterior-anterior radiograph of the hand .

The axis of middle finger should be in direct line with the axis of the forearm , and the centre of the x-ray tube above the distal end of the third metacarpal. A tube-cassette distance of 76 cm is recommend by tanner et al , although roche et al recommend a tube- film distance of 91 cm , on the basis that shorter distances may tend to increase the apparent skeletal age for some methods of assessment.

The fingers are spread so they are not quite touching , and the thumb is rotated out to a natural position of around 30 degrees to the first finger.the x-ray beam should Be perpendicular to the cassette.

The x-ray is usually performed of 45-60kVp.x-ray of both wrist joints showing lower end of radius and ulna were in anterior –posterior view in all 100 subjects .subjects of either sex were grouped into 4 age-groups as follows

- 1. Group one: 16-17 years**
- 2. Group Two: 17-18 years**
- 3. Group Three: 18-19 years**
- 4. Group Four: 19-20 years**
- 5.Group five: 20-21 years**
- 6.Group six: 21-22 years**

The findings of epiphyseal fusion are divided into 4 stages.

**1.stage 0: non union – (0)** a dark black radiolucent line seen between the area of diaphysis and epiphysis .

**2.stage I: union in progress-(I)** gap between diaphysis and epiphysis begins to decrease but complete union does not occur.

**3.stage II: complete union with white dense line: (II)** union between diaphysis and epiphysis completed but white dense line still visible at diphysio-epiphyseal junction.

**4.stage III: complete union without any white line. (III)** union between diaphysis and epiphysis completed and no white dens line visible at diphysio-epiphyseal junction. The findings are recorded on specially designed proforma, tabulated, analyzed and compared with similar studies by different authors.

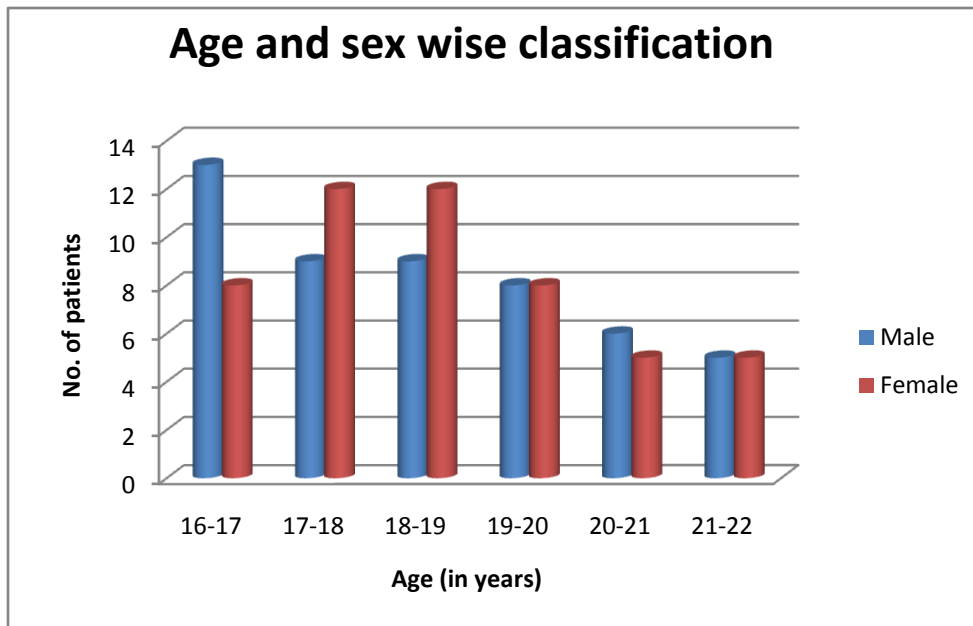
**OBSERVATION & RESULTS**

Data is tabulated and statistically analysed below

Age (in years)	Male	Female	Total
16-17	13	8	21
17-18	9	12	21
18-19	9	12	21
19-20	8	8	16
20-21	6	5	11
21-22	5	5	10
Total	50	50	100

**Table 1: Age and sex wise classification**

**GRAPH I**



**Fusion of Phalanges in Males:** Present study showed that in males, fusion Head with shaft of phalanges of proximal row : in 16-17 years 38% showed grade I fusion and 61.53% showed grade II fusion. In 17-18 years , 33.33% showed grade II fusion and 66.66% showed grade III

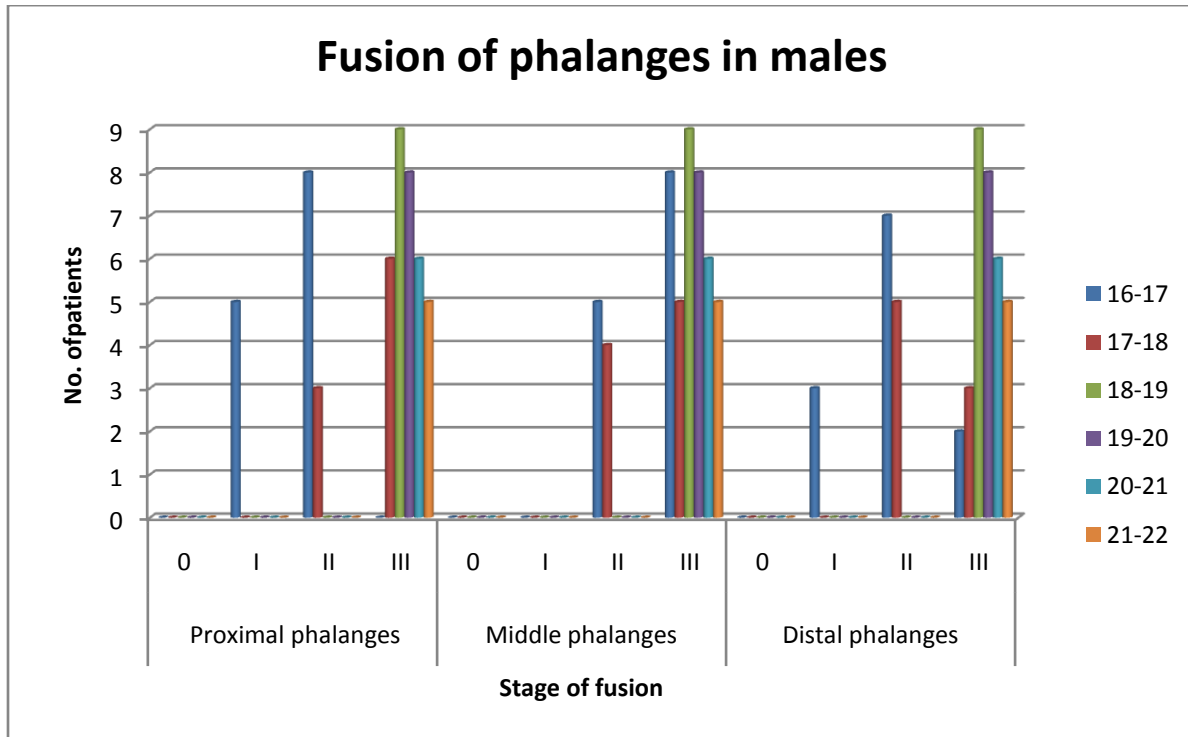
fusion. In rest of the age groups i.e 18-19, 19-20, 20-21, 21-22 years showed 100% grade III fusion.

Middle row: in 16-17 and 17 -18 years age group 38.46% and 41.66% showed grade II fusion respectively whereas as 61.5% and 58.33% showed grade III fusion. In rest of all age groups 18-19, 19-20, 20-21, 21-22 years showed 100% fusion.

Distal row: 16-17 years, grade I fusion in 23.07%, grade II in 53.84%, and grade III in 15.38% was present. In 17-18 years age group 55.55% of samples showed grade II fusion and 33.33% samples showed grade III fusion. Rest of the age groups showed 100% grade III fusion.

**Table 6: Fusion of phalanges in Males**

	Stage of fusion	Age (in years)					
		16-17	17-18	18-19	19-20	20-21	21-22
<b>Proximal phalanges</b>	0	0	0	0	0	0	0
	I	5	0	0	0	0	0
	II	8	3	0	0	0	0
	III	0	6	9	8	6	5
<b>Middle phalanges</b>	0	0	0	0	0	0	0
	I	0	0	0	0	0	0
	II	5	4	0	0	0	0
	III	8	5	9	8	6	5
<b>Distal phalanges</b>	0	0	0	0	0	0	0
	I	3	0	0	0	0	0
	II	7	5	0	0	0	0
	III	2	3	9	8	6	5

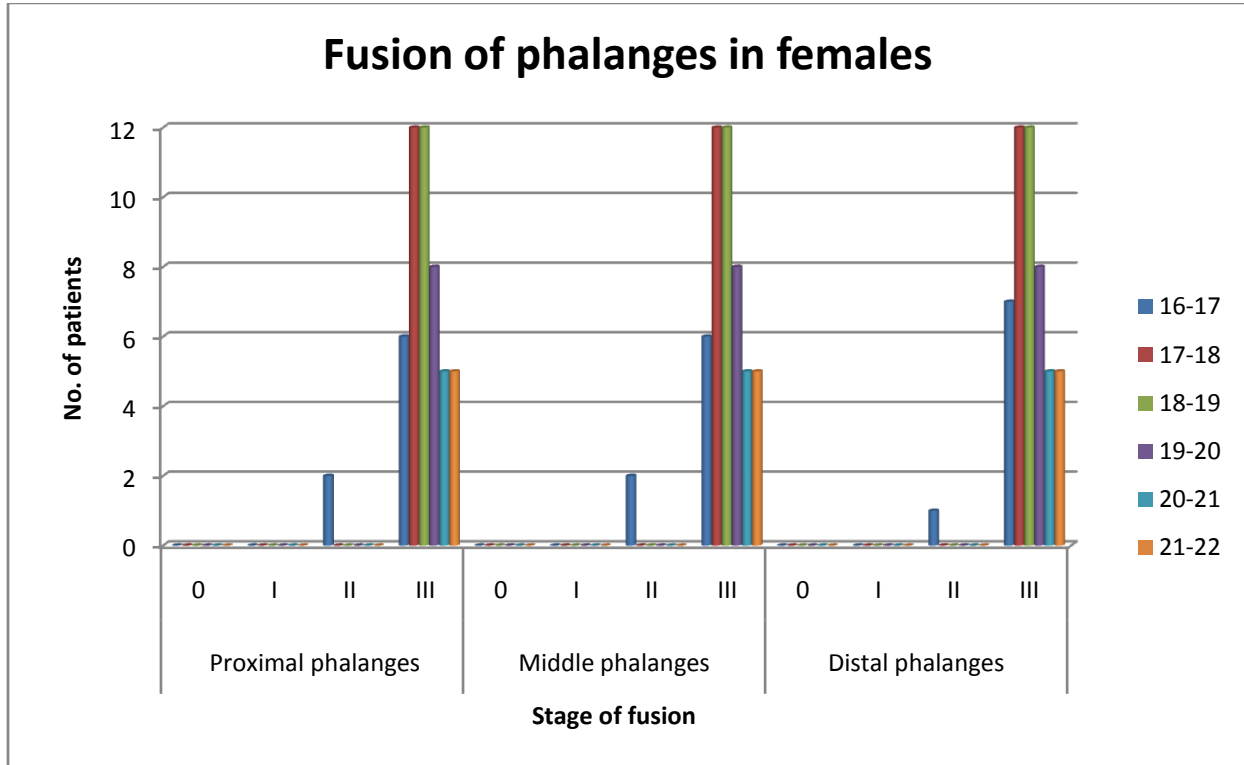


**Fusion of Phalanges in Females**

Present study showed that in females, fusion of phalanges of proximal row, In 16-17 years 25% cases showed grade II, 75% cases showed grade III fusion. Rest of the age groups 17-18, 18-19, 19-20, 20-21, 21-22 years showed 100% grade III fusion. Middle row: in 16-17 years, 22.2% samples showed grade II fusion and 77.77% showed grade III fusion. Rest of the age groups showed 100% grade III fusion. In Distal row, 16-17 years age group, 15% of the samples showed grade II fusion and 85% showed grade III fusion. Rest of the age groups showed 100% grade III fusion.

**Table 7: Fusion of Phalanges in Females**

	Stage of fusion	Age (in years)					
		16-17	17-18	18-19	19-20	20-21	21-22
<b>Proximal phalanges</b>	0	0	0	0	0	0	0
	I	0	0	0	0	0	0
	II	2	0	0	0	0	0
	III	6	12	12	8	5	5
<b>Middle phalanges</b>	0	0	0	0	0	0	0
	I	0	0	0	0	0	0
	II	2	0	0	0	0	0
	III	6	12	12	8	5	5
<b>Distal phalanges</b>	0	0	0	0	0	0	0
	I	0	0	0	0	0	0
	II	1	0	0	0	0	0
	III	7	12	12	8	5	5



**Fusion of base of the first Metacarpals**

It is clear from table-6 that in male subjects in majority of cases in age group 16-17, and 17-18 show near fusion (grade II), where as in age groups 16-17, 17-18 and onwards majority of cases showed complete fusion (grade III) It is clear from table-6 that in female subjects in majority of cases in age group 16-17 show near fusion (grade II), where as in age groups 17-18 and onwards majority of cases showed complete fusion (grade III)

Grade of Metacarpal	Stage of fusion	Sex	Age (in years)					
			16-17	17-18	18-19	20-21	20-21	21-22
I	III	M	8	2	0	0	0	0
		F	5	0	0	0	0	0
	IV	M	5	7	9	8	6	5
		F	3	12	12	8	5	5

**Table 3: Fusion of the base of the Metacarpals**

Parameters	(Mean±SD)		SEM		p value	r value
	Male	Female	Male	Female		
Radius	18.78±1.47	18.57±1.33	0.256	0.211	0.520	0.92
Ulna	19.84±0.83	18.69±1.39	0.191	0.231	0.001	0.69
Proximal phalanges	18.85±1.32	18.18±1.51	0.227	0.218	0.042	0.93
Middle phalanges	18.34±1.65	18.18±1.51	0.258	0.218	0.647	0.94
Distal phalanges	18.84±1.41	18.14±1.52	0.246	0.218	0.037	0.89
I metacarpal	18.45±1.56	18.33±1.44	0.247	0.215	0.722	0.94

## DISCUSSION

In the present study it is observed that fusion of lower end of radius in males complete in 18-19 years and 18-19 years in females.

Galstaun G<sup>14</sup> from his study on Bengalese males opined that the complete union occurred at 16 years which is about 1-2 years earlier with the results of this study. As per Yogesh Sharma<sup>21</sup>, the age of fusion is 18-19 years in U.P. males which are about one year later than this study.

Bajaj<sup>3</sup> recorded the age of fusion to be 16.4 years in Delhi males. Hepworth<sup>17</sup> opined that the age of fusion in Punjabi males is 16 -17 years which are on an average one year earlier than the present study.

In the present study it is observed that fusion of lower end of ulna in males complete in 19-20 years. These observations are similar to the observation done by Lall & Nat. Observations are differing from the following observation by different authors.

In the present study it is observed that fusion of lower end of ulna in females complete in 18-19 years. These observations are similar to the observation done by others. Observations of present study were different from the Galstaun, S. M. Hepworth, Pryor, Sharma Yogesh, Goel MR & Dutta Sumanta observations, which showed early age of fusion at lower end of ulna.

In the Present study it is observed that fusion of the base of the metacarpals complete in 16-17 years in females and 17-18 years in females. In current study it is observed that fusion of phalanges of proximal row completes in 18-19 years in females and 18-19 years in males, middle row complete in 18-19 years in females and in male complete in 18-19 years, in distal phalanges fusion complete in 18-19 years in females and 18-19 years in females.

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