Original Research Paper

Epiphyseal Union at Lower End of Radius and Ulna in the Age Group of 16-20 Years in Jodhpur Region of Rajasthan

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Abstract

Among the variety of scientific procedure available in age assessment, there is wide agreement in methods based on sexual, skeletal, and dental maturity. However in age group 16-20 years X-ray of lower end of radius and ulna is most accurate method. The present study was undertaken on 100 individuals from Jodhpur region (52 males and 48 female) between the age group of 16 to 20 years.

Radiological examination of both wrist joints was done to study epiphyseal union at lower end of radius and ulna. The study showed that the processes of union start around 16 years in both male and female. Epiphyseal union 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 union of lower end of radius among the people of Jodhpur region is 17-18 year for both males and females. Average age for complete epiphyseal union of lower end of ulna among the people of Jodhpur region is for males 19-20 years and for females 18-19 years. The age for epiphyseal union of lower end of radius and ulna is bilaterally same.

Key Words: Epiphyseal fusion, X-ray, Age estimation, Identification

Introduction:

Verification or determination of age is prerequisite for personal identification in living as well as dead. Age estimation in living as well as dead is one of the most important tasks for a Forensic expert. In developing countries like India because of illiteracy the births are not registered or records of birth are not properly maintained. It is a prerequisite for personal identification and it is increasingly important in criminal and civil matters.

In fact, if doubt arises regarding the age of a person in any legal inquiry, forensic age estimation is promptly requested by authorities to ascertain whether the person concerned has reached the age of imputability.

Here, age estimation becomes a valuable tool to assist in administration of many civil and criminal procedure codes.

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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 complete by the age of 22 years as described by various authors. Further it is found that the age for the fusions is fairly constant with minor variations among different study groups of different geographic areas. Various studies have shown that the lower end (epiphysis) of radius and ulna fuses with their respective diaphysis within the age group of 16-20 years.

The minor differences in the age of fusion could be due to effects of changes in climate, economic, hereditary, dietetic conditions or involving some unknown factors. [8]

Materials and Methods:

The present prospective study is carried out at Forensic Medicine Department of Dr. S.N. Medical College, Jodhpur during the one year period from January to December 2013. The subjects were selected on cross-sectional basis from the students of Dr. S.N. Medical College and patients or their relatives at MGH/MDM Hospital, original native of Jodhpur region.

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.

A total 100 apparently healthy subjects, 52 males and 48 females, irrespective of caste and religion with known birth-date and from the age-group of 16-20 years were selected for the purpose of the study.

Preliminaries of the subjects including sex, age, height, weight, dietary habits were recorded. They were asked for the copy of any one proof of birth-date like identity card, driving license, school leaving certificate, birth registration certificate, aadhar card etc.

The chronological age of each subject was calculated using information on the certificate received for proof of birth-date and date of examination, therefore allowing calculation of exact age. Purpose was explained to the subjects and written informed consent was obtained for the X-ray.

X-ray of both wrist joints showing lower end of radius and ulna were taken in anterio-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**

The X-rays of these subjects were showing union of lower end of radius and ulna with their respective diaphysis at various stages. The findings of epiphyseal fusion are divided into 4 stages.

1. **Stage 0: Non-union**. A dark black radiolucent line seen between the area of diaphysis and epiphysis.
2. **Stage I: Union in progress**. Gap between diaphysis and epiphysis begins to decrease but complete union does not occur.
3. **Stage II: Complete union with white dense line**. 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**. Union between diaphysis and epiphysis completed and no white dense line visible at diphysio-epiphyseal junction.

The findings are recorded on a specially designed proforma, tabulated, analyzed and compared with similar studies by different authors.

Observation and Results:

Present study showed that in males the epiphyseal fusion at lower end of radius of both hands in age group 16-17 years, 02 out of 26 (7.69%) cases showed starting up process of epiphyseal union, whereas 20 out of 26 (76.92%) were of grade II fusion and 04 out of 26 (15.38%) were of grade III fusion. In 17-18 years age group100% cases were of grade III fusion. In remaining as groups i.e. 18-19 years (16 out of16) and 19-20 years (42 out of 42) were showing 100% grade III fusion. (Table 2)

Our study showed that the epiphyseal union at lower end of radius in males starts about 16 years of age and completed by the age of 17-18 years.

It also showed that there was no difference in the timing of the epiphyseal fusion at lower end of radius whether it is right hand or left hand. Thus the epiphyseal fusion at lower end of radius goes bilaterally symmetrical in males. (Table 2)

In this study the epiphyseal fusion at lower end of ulna of both hands at age group 16-17 years, 06 out of 26 (23.07%) were showing epiphyseal fusion in 0 grade, 20 out of 26 (76.92%) in stage I in males.

In 17-18 years age-group all samples were showing grade I epiphyseal fusion, 20 out of 20. In age group 18-19 all samples (16) showed grade II fusion. In 19-20 age groups all cases (42) showing grade III complete fusion. (Table 4)

Our study showed that process of epiphyseal fusion of lower end of ulna starts about the age of 16-17 years and completed at the age of 19-20 years in males.

There was no difference in the timing of the epiphyseal fusion at lower end of ulna whether it is of right hand or left hand. Thus the epiphyseal fusion at lower end of ulna goes bilaterally symmetrical in males. (Table 4)

Our study showed that in females the epiphyseal fusion at lower end of radius of both hands in age group16-17 years, 12 out of 56 (21.42%) x-rays were showing starting up process of epiphyseal union, whereas 44 out of 56 (78.57%) were showing grade II fusion.

In 17-18 years age group all showed grade III fusion. In remaining age groups i.e. 18-19 years (20 out of 20) and 19-20 years (10 out of 10) years were showing 100% grade III fusions. (Table 6)

In this study the epiphyseal union at lower end of radius in females starts about 16 years of age and completed by the age of 17-18 years and there was no difference in the timing of the epiphyseal fusion at lower end of radius whether it is of right hand or left hand.

Thus the epiphyseal fusion at lower end of radius goes bilaterally symmetrical in females. (Table 6) Present study showed that epiphyseal fusion at lower end of ulna of both hands in age group 16-17 years, 10 out of 56 (17.85%) x-rays showed grade 0 fusion whereas 46 out of 56

(82.14%) showed grade I fusion. In 17-18 years age group all (10) showed grade II fusion. In remaining age groups i.e. 18-19 (20 out of 20) years and 19-20 (10 out of 10) years were showing 100% grade III fusion. (Table 8)

Our study showed that the epiphyseal union at lower end of ulna in females starts about 16-17 years of age and completed by the age of 18-19 years and there was no difference in the timing of the epiphyseal fusion at lower end of ulna whether it is of right hand or left hand. Thus the epiphyseal fusion at lower end of ulna goes bilaterally symmetrical in females. (Table 8)

Discussion:

In the present study it is observed that fusion of lower end of radius in males complete in 17-18 years. These observations are similar to the observation done by Galstaun [2], Kothari [4], Goel, M.R [3], Dutta Sumanta. [1]

Observations of present study are differ from the following observation by different authors Lall & Natt [5], Loomba [6], Pryor [8] and Sharma Yogesh [10], showed late age of fusion at lower end of radius.

S. M. Hepworth study [9] showed early age of fusion at lower end of radius. (Table 3)

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. [5]

Observations are differing from the following observation by different authors. Galstaun [2], Hepworth [9], Kothari [4], Sharma Yogesh [10], Goel MR [3], Dutta Sumanta [1] studies showed early age of fusion at lower end of ulna while Loomba [6] study showed late age of fusion. (Table 5)

In the present study it is observed that fusion of lower end of radius in females complete in 17-18 years. These observations are similar to the observation done by Kothari [4], Sharma Yogesh [10], Goel MR [3], Dutta Sumanta. [1]

Observations of present study are different from the observation by different authors. Loomba [6], Pryor [8] showed late age of fusion at lower end of radius. Galstaun [2], S.M.Hepworth [9], showed early age of fusion at lower end of radius in their study. (Table 7)

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. [4, 6]

Observations of present study were different from the Galstaun [2], S. M. Hepworth [9], Pryor [8], Sharma Yogesh [10], Goel MR [3] & Dutta Sumanta [1] observations, which showed early age of fusion at lower end of ulna. (Table 9)

Conclusion:

Epiphyseal union at lower end of radius and ulna:

- The processes of union start around 16 years 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 Jodhpur region is 17-18 year for both males and females
- Average age for complete epiphyseal fusion of lower end of ulna among the people of Jodhpur region is for males 19-20 years and for females 18-19 years.

Bilatrality:

- The age for epiphyseal fusion of lower end of radius and ulna is bilaterally similar, i.e. it occurs at the same age in both hands.

Sex:

No age difference is seen as far as the epiphyseal fusion of the lower end of radius is concerned however in lower end of ulna it occurs earlier by about one year in females as compared to males.

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Table 1: Age and Sex Wise Classification

Age groups (yrs)	Male	Female	Total
16-17	13	28	41
17-18	10	05	15
18-19	08	10	18
19-20	21	05	26
Total	52	48	100

Table 3: Comparison between Different Authors Studies on Age of Epiphyseal Fusion at Lower End of Radius in Male

S.N	Authors	Subjects	Radius(Yrs)
1	Galstaun[2]	India –Bengal	18
2	Hepworth[9]	Indian –Punjab	16-17
3	Kothari[4]	India –Rajasthan-Marwar	17-18
4	Lall & Nat[5]	India –U.P.	19
5	Loomba[6]	India –U.P.	20-21
6	Pryor[8]	American	20
7	Goel M.R.[3]	India-Rajasthan	18-19
8	Dutta Sumanta[1]	India-Rajasthan-Jaipur	17-18
9	Sharma Yogesh[10]	India-Rajasthan-Mewar	19-20
10	Present study	India –Rajasthan-Jodhpur	17-18

Table 9: Comparison between Different Authors Studies on Age of Epiphyseal Fusion at Lower End of Ulna in Female

S.N.	Authors	Subjects	Ulna
1	Galstaun[2]	India –Bengal	17
2	Hepworth[9]	Indian –Punjab	16-17
3	Kothari[4]	India -Rajasthan	18-19
4	Loomba[6]	India –U.P.	18-19
5	Pryor[8]	American	16
6	Sharma Yogesh[10]	India –Rajasthan-Mewar	16-17
7	Goel M.R[3]	Goel M.R	17-18
8	Dutta Sumanta[1]	India-Rajasthan-Jaipur	16.6-17
9	Present study	India–Rajasthan-Jodhpur	18-19

Table 5: Comparison between Different Authors Studies on Age of Epiphyseal Fusion at Lower End of Ulna in Male

S.N	Authors	Subjects (India)	Ulna
1	Galstaun[2]	India –Bengal	18
2	Hepworth[9]	Indian –Punjab	16-17
3	Kothari[4]	India–Rajasthan-Marwar	18-19
4	Lall & Nat[5]	India –U.P.	19
5	Loomba[6]	India –U.P.	20-21
6	Pryor[8]	American	19
7	Sharma Yogesh[10]	India-Rajasthan-Mewar	18-19
8	Goel M.R.[3]	India-Rajasthan	18-19
9	Dutta Sumanta[1]	India-Rajasthan-Jaipur	18-19
10	Present study	India–Rajasthan-Jodhpur	19-20

Table 7: Comparison between Different Authors Studies on Age of Epiphyseal Fusion at Lower End of Radius in Female

S.N.	Authors	Subjects	Radius
1	Galstaun[2]	India –Bengal	16-17
2	Hepworth[9]	Indian –Punjab	16-17
3	Kothari[4]	India -Rajasthan	17-18
4	Loomba[6]	India –U.P.	18-19
5	Pryor[8]	American	19
6	Sharma Yogesh[10]	India –Rajasthan-Mewar	17-18
7	Goel M.R[3]	India-Rajasthan	17-18
8	Dutta Sumanta[1]	India-Rajasthan-Jaipur	16.5-17

Table 2
Epiphyseal Fusion at Lower End of Radius of Both Hands in Male

Age grps (yrs)	Various degree of epiphyseal fusion at lower end of radius of both hand in Male (cases)								Total Cases
	0		I		II		III		
	R	L	R	L	R	L	R	L	
16-17	00	00	01	01	10	10	02	02	26
17-18	00	00	00	00	00	00	10	10	20
18-19	00	00	00	00	00	00	08	08	16
19-20	00	00	00	00	00	00	21	21	42
Total	00	00	01	01	10	10	41	41	104

Table 4
Epiphyseal Fusion at Lower End of Ulna of Both Hands in Male

Age grps (yrs)	Various degree of epiphyseal fusion at lower end of ulna of both hands in male (Cases)								Total Cases
	0		I		II		III		
	R	L	R	L	R	L	R	L	
16-17	03	03	10	10	00	00	00	00	26
17-18	00	00	10	10	00	00	00	00	20
18-19	00	00	00	00	08	08	00	00	16
19-20	00	00	00	00	00	00	21	21	42
Total	03	03	20	20	08	08	21	21	104

Table 6
Epiphyseal Fusion at Lower End of Radius of Both Hands in Female

Age grps (yrs)	Various degree of epiphyseal fusion in lower end of radius of both hand in female (Cases)								Total Cases
	0		I		II		III		
	R	L	R	L	R	L	R	L	
16-17	00	00	06	06	22	22	00	00	56
17-18	00	00	00	00	00	00	05	05	10
18-19	00	00	00	00	00	00	10	10	20
19-20	00	00	00	00	00	00	05	05	10
Total	00	00	06	06	22	22	20	20	96

Table 8
Epiphyseal Fusion at Lower End of Ulna of Both Hands in Female

Age grps (yrs)	Various degree of epiphyseal fusion in lower end of ulna of both hands in female (Cases)								Total Cases
	0		I		II		III		
	R	L	R	L	R	L	R	L	
16-17	05	05	23	23	00	00	00	00	56
17-18	00	00	00	00	05	05	00	00	10
18-19	00	00	00	00	00	00	10	10	20
19-20	00	00	00	00	00	00	05	05	10
Total	05	05	23	23	05	05	15	15	96