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Radiological study of epiphyseal union of the distal end of radius and ulna with the shaft of the left 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 access 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, 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: 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.

Keywords: epihyseal fusion, x-ray, age estimation, identification

1. 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.
Questions of juvenility are often a questions 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 access the development of a child, Age estimation is of paramount importance. Age estimation in the maturing skeleton is dependent upon three processes; the appearance of primary and secondary ossification centres, the growth of these centres and 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 [29]. 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 distal end of Radius and Ulna growing population of Western Rajasthan.

AIMS and Objectives

The present study is conducted in the Department of Anatomy, DR.S. N. Medical College, Jodhpur (Rajasthan) with following Aims and Objectives:-

1. To estimate age from epiphyseal fusion around wrist joint.
2. To assess age specific difference in epiphyseal fusion at wrist joint.
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 were 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). Ethical committee permission WAS 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 pro-forma 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. Chronological age, 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 rays of lower end of left hand in AP view were taken. 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. 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.

All 100 subjects of either sex were grouped into 4 age-groups as follow

1. Group I: 16-17 years
2. Group II: 17-18 years
3. Group III: 18-19 years
4. Group IV: 19-20 years
5. Group V: 20-21 years
6. Group VI: 21-22 years

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-(I)** Gap between diaphysis and epiphysis begins to decrease but complete un union does not occur.

3. Stage II: complete union with white dense line: (II) union between diaphysis and epiphysis is complete 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 pro-forma, tabulated, analyzed and compared with similar studies by different authors.

Observation & Results

The present study was carried out on 100 healthy students of MBBS (50 males&50 females). The subjects aged between 16-22 year of Dr. S.N. Medical College, Jodhpur (Rajasthan). Data is tabulated and statistically analysed below**.** The following table shows age & sex wise classification of the samples.

Table 1: Age and Sex wise classification

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

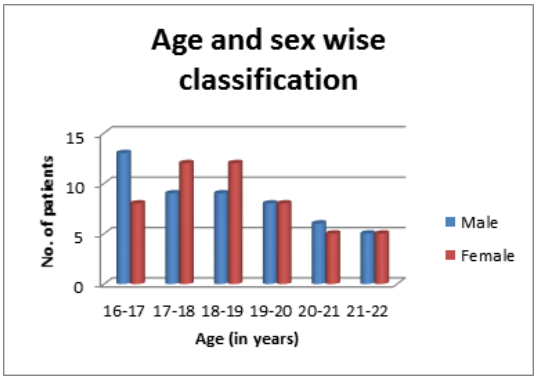

Fig 1

1. Epiphyseal fusion of distal end of Radius the with shaft in Males (Left Hand)

Present study showed that in males of Western Rajasthan, the epiphyseal fusion at lower end of Radius of left hand in age group 16-17 years, 03 out of 13 (26.07%) cases showed starting up process of epiphyseal union, whereas 8 out of 13 (61.53%) were of grade II fusion and 02 out of 13 (15.38%) were of grade III fusion. In 17-18 years age group, 01 out of 09(11.11%) cases were of grade I fusion,03 out of 09 (33.33%) were grade II fusion, 05 out of 09 (55.55%) were grade III fusion. In age groups 18-19 years 02 out of 9 (22.22%) were grade II and 07 out of 09 (77.77%) were grade III fusion. In rest of the age groups i.e 19-20 years (08 out of 08), 20-21 years(06 out of 06), 21-22 years(05 out of 05) were showing 100% grade III fusion. (Table 2).Our study showed that the epiphyseal union at lower end of Radius is completed by the age of 18-19 years.

2. Epiphyseal fusion of distal end of Ulna with the shaft in Males (Left Hand)

In this study lower end of Ulna of left hand of age group 16-17 years in male, 02 out of 13 (15.38%) were showing grade 0 epiphyseal fusion, 11 out of 13 (84.61%) showed grade I fusion. In 17-18 years age-group, 07 out of 09(77.77%) were showing grade I and 02 out of 09 (22.2%) grade II epiphyseal fusion. In age group 18-19 all samples (09) showed grade II fusion. In 19-20 (08), 20-21 (06), 21-22 (05) age groups all cases showing grade III complete fusion. (Table 3). Our study showed that process of epiphyseal fusion of lower end of Ulna is completed at the age of 19-20 years in males.

3. Epiphyseal fusion at distal end of Radius (Left hand) in Females

Our study showed that in females the epiphyseal fusion at lower end of Radius of left hand in age group16-17 years, 02 out of 08 (25%) x-rays were showing starting up process of epiphyseal union, whereas 06 out of 08 (75%) were showing grade II fusion. In 17-18 years age group, 02 out of 12 showed grade II and 10 out of 12
(83.33%) showed grade III fusion. In remaining age groups i.e. 18-19 years (12 out of 12), 19-20 years (08 out of 08), 20-21 years (5 out of 5),21-22 years(5 out of 5) were showing 100% grade III fusions. (Table 4) In the present study the epiphyseal union at lower end of Radius in females is completed by the age of 17-18 years.

4) Epiphyseal fusion at lower end of Ulna in Females (Left Hand)

Present study showed that in females, epiphyseal fusion at lower end of ulna of left hand in age group 16-17 years, 02 out of 08 (25%) x-rays showed grade I fusion whereas 04 out of 08 (50%) showed grade II fusion,02 out of 08 (25%) showed grade III fusion. In 17-18 years age group 08 out of 12 (66.66%) showed grade II fusion and 04 out of 12 showed grade III fusion. In remaining age groups i.e. 18-19 (12 out of 12) years, 19-20 (8 out of 8), 20-21(05 out 05), 21-22(05 out 05)years were showing 100% grade III fusion. (Table 5). Therefore,Our study showed that the epiphyseal union at lower end of ulna in females is completed by the age of 18-19 years.

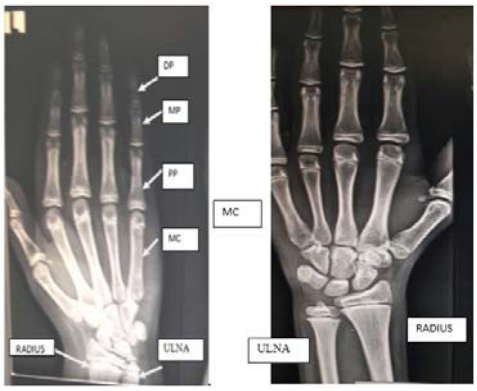

Fig 2
Hand-wrist radiograph of 16 year old male & of female showing epiphyseal union at stage I
*MC- Metacarpals, PP-proximal phalanges, MP- middle phalanges, DP-distal phalanges

A **B**

Fig 3

A. Radiograph of wrist joint of 17 year old male showing lower end of Radius and Ulna at stage II of epiphyseal Fusion. B. Hand-wrist Radiograph of 18 year old female showing complete fusion of distal end of Radius and Ulna

Table 2

Age (in years)	Stage of fusion				Total
	0	**I**	**II**	**III**	
16-17	0	3	8	2	13
17-18	0	1	3	5	9
18-19	0	0	2	7	9
19-20	0	0	0	8	8
20-21	0	0	0	6	6
21-22	0	0	0	5	5

Table 3

Age (in years)	Stage of fusion				Total
	0	I	II	III	
16-17	2	11	0	0	13
17-18	0	7	2	0	9
18-19	0	0	9	0	9
19-20	0	0	0	8	8
20-21	0	0	0	6	6
21-22	0	0	0	5	5

TABLE 2&3: Epiphyseal fusion of distal end of Radius with &Ulna with the shaft in Males (Left Hand)

Table 5

Age (in years)	Stage of fusion				Total
	0	I	II	III	
16-17	0	2	4	2	8
17-18	0	0	8	4	12
18-19	0	0	0	12	12
19-20	0	0	0	8	8
20-21	0	0	0	5	5
21-22	0	0	0	5	5

Table 6

Age (in years)	Stage of fusion				Total
	0	I	II	III	
16-17	0	2	6	0	8
17-18	0	0	2	10	12
18-19	0	0	0	12	12
19-20	0	0	0	8	8
20-21	0	0	0	5	5
21-22	0	0	0	5	5

Table 5&6 Epiphyseal fusion at distal end of Radius & Ulna with the shaft (left hand) in Females

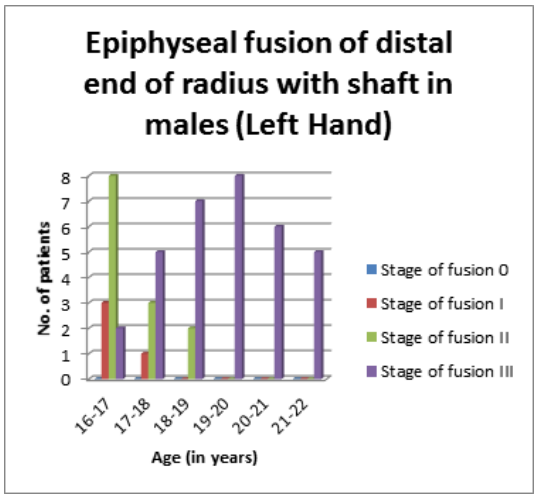

Fig 4

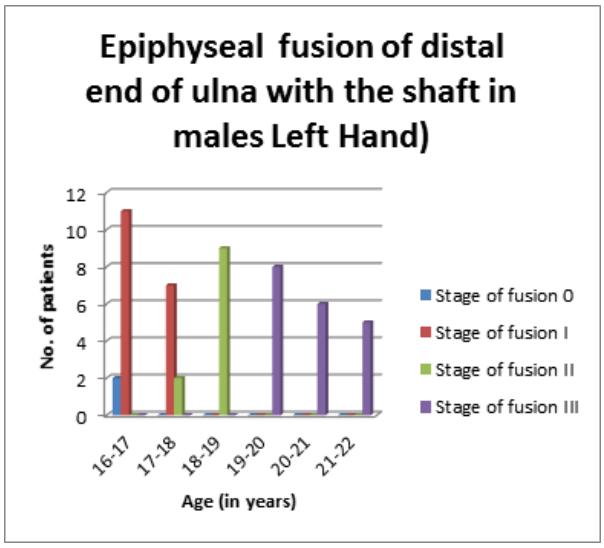

Fig 5

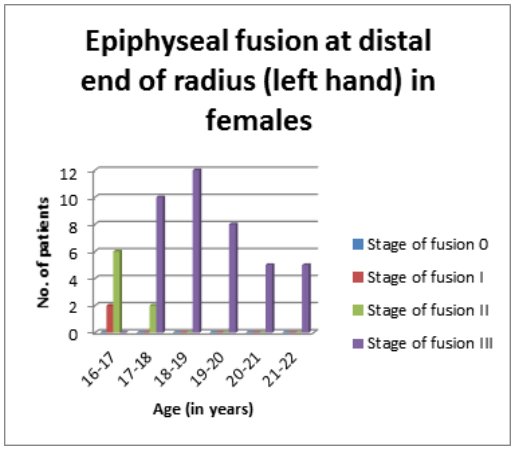

Fig 6

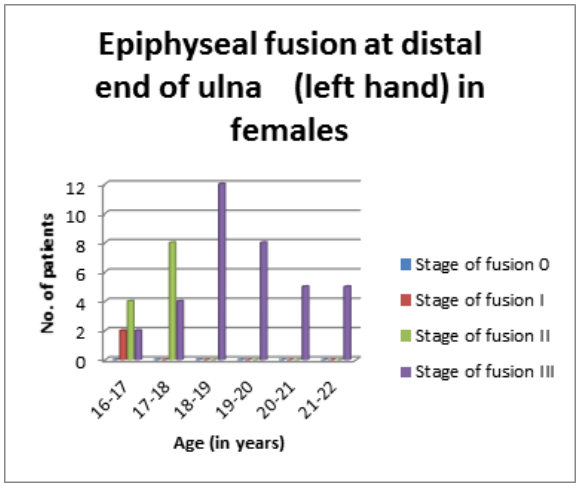

Fig 7

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 [13] 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. Apurba Nandy recorded the latest time of fusion as 15 -16 years which are at least 2 years earlier than this study. As per Yogesh Sharma [19], the age of fusion is 18-19 years in U.P. males which are about one year later than this study.

Bajaj [3] recorded the age of fusion to be 16.4 years in Delhi males. Hepworth [17] 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. M.J.S Pillai (1936) (SOUTH INDIA) recorded 18 years of age in males and females. Banerjee aggarwal (1998)U.P opined 19-20 Years age of fusion in males and 18-19 years in females.

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. Galstaun [13], Hepworth [17], Sharma Yogesh [19], Goel MR, Dutta Sumanta [15] studies showed early age of fusion at lower end of ulna while Loomba study showed late age of fusion.

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.

Conclusion

To establish exact identity of an individual age determination is essential not only in cases of living but also for the dead too. Age has to be determined not only for identification purpose but also for various civil and criminal purposes. Determination of age

presents a task of considerable importance from the view point of the administration of justice. It is not possible to enunciate a hard and fast rule for age determination from this union for the whole India because India is composed of areas which differ in climatic, dietetic and disease factors which affect skeletal growth. Age Determination of an individual from appearance & fusion of ossification centers is a well-accepted fact. Age can be established by rontgenography of skeleton from the time of its appearance about the 20 week of gestation until early adulthood with considerable accuracy. As we all know that earliest centers of ossification appear at the end of 2nd month of pregnancy. At the 11th intra-uterine week there are 806 centers of bone growth which is reduced to 450 centres at birth & ultimately an adult has a total of 206 bones. The epiphyseal union during age periods is remarkably constant for particular epiphyses.

Estimation of skeletal age from radiographs is a matter of everyday occurrence in every part of the world. According to the present study epiphyseal fusion at lower end of Radius occurs in advance of the lower end of ulna and the difference is about one year. According to the present study: The Mean age for complete epiphyseal fusion of lower end of Radius among the people of Western Rajasthan is 18.78±1.47years for Males and 18.57±1.33 years in Females. Mean age for complete epiphyseal fusion of lower end of Ulna in Males 19.84±0.83 years and for Females 18.69±1.39 years (p value<0.05).

Table 7: Comparison of ages (years) of union of epiphyses around wrist joint given by various workers in India with findings of present study

Authors	Lower end of Radius		Lower end of ulna	
	Male	Female	Male	Female
Loomba S.D. (1958) (U.P.)	20-21 yrs	18-19 yrs	20-21 yrs	18-19 yrs
Gupta *et al* (1974) (U.P.)	20-21 yrs	19-20 yrs	20-21 yrs	20-21 yrs
Banerjee and Agrawal (1998)	19-20 yrs	18-19 yrs	19-20 yrs	18-19 yrs
Galstaun (1937) (Bengal)	18 yrs	16.5 yrs	18.5 yrs	17 yrs
M.J.S. Pillai (1936) (South India)	18 yrs	18 yrs	18 yrs	18 yrs
Saksena and Vyas (1969) (Punjab)	< 18 yrs	-	<18 yrs	-
Sahni and Jit (1995) (Punjab)	-	>16 yrs	-	>16 yrs
Present study	18-19	18-19	19-20	18-19

References

1. Acheson RM. Studies in the Reliability of Assessing Skeletal Maturity from Xrays, 1966.
2. Barnes GT. Radiographic mottle, a comprehensive theory, Medical Physics. 1982; 9(5)-667.
3. Bajaj ID, Bharadwaj OP, Bhardwaj. Appearance and fusion of important ossification centres: A study in Delhi population, 1967.
4. Bull RK, PD Edwards PM, Kemp S, Fry, Hughes IA, Bone age assessment: a large scale comparison of the Greulich and Pyle, and Tanner and Whitehouse (TW2) methods, Archives of Disease in Childhood, 1999; 81:172-173.
5. Burr DB, Allen MR, (eds) Basic and Applied Bone Biology, Elsevier, London, 2013.
6. Cole AJL, Webb L, Cole TJ, Bone age estimation, a comparison ofmethods, British Journal of Radiology, 1988; 61:683-686,
7. Cox LA, Tanner-Whitehouse method of assessing skeletal maturity: Problems and common errors, Hormone Research, 1996; 45(2):53-55.
8. Dinesh MS, Bhanuprakash AR. Vision system for bone measurements from digital hand radiograph, in Proc. RC-IEEE-EMBS 14th BMESI, 1995, 9-10.
9. Dutta Sumanta**.** Thesis for MD Forensic Medicine and toxicology titled Medico-Legal Age Estimation in Residents of Jaipur in the Age Of 17-21 Years by Study of Ossification in Pelvis and Wrist Joint Bones. Submitted to the University of Rajasthan, Jaipur, 2000.
10. Flecker 1932 1942; Girdany and Golden, 1952; Noback, 1954; Pryor, 1907; 1923; Scheuer and Black, 2000b; Stuart *et al*., 1962. 2. Black *et al.*, 2010; Cameron, 1982.
11. Frisch H, Riedl S, Waldh T. or Computer-aided estimation of skeletal age and comparison with bone age evaluations by the method of Greulich-Pyle andTanner-Whitehouse, *Pediatric Radiology*, 1996; 26:226-231.
12. Garn SM, Rohmann CG, Variability in the order of ossification of the bony centers of the hand and wrist, American Journal of Physical Anthropology, 1960; 18:219-30.
13. Galstaun G. A study of ossification as observed in Indian subjects, Ind. J. Med. Res. 1937, 25:267.
14. Gertych A, Zhang A, Sayre J, Pospiech-Kurkowska S, Huang HK. Bone age assessment of children using a digital hand atlas, ComputerizedMedical Imaging and Graphics, 2007; 31(4-5):322-331.
15. Gilsanz V, Ratib O. Hand Bone Age: A Digital Atlas of Skeletal Maturity, 2005
16. Goel M.R. Manual of Medico-legal practice Ist ed. pp 109-110. Unique books opposite H.P.O. Ajmer, Greulich-Pyle Atlas and Tanner-Whitehouse Method Contrasted', *Human Biology*, 1996; 38(3):204-218.
17. Hepworth SM. Determination of age in Indians from a study of ossification of the epiphysis of long bones Ind. Med. Gaz.:1939; 74:614-616.
18. Pryor JW. Time of ossification of the bones of the hand of male and female and union of epiphyses with diaphyses, Am J. Phy. Anth. 1925; 8(4):401-410.
19. Sharma Yogesh. Thesis for MD Forensic Medicine titled a Roentgenologic prospective study of epiphyseal union around elbow and wrist joint and pelvis in boys and girls of Mewar region of Rajasthan. Submitted to the University of Rajasthan, Jaipur, 1994.