



# **Radiological assessment of age of adolescents from wrist joint: A prospective study of 151 cases**

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**How to cite this article:** Sivakkumar Shanmugasundaram, K. Thangaraj, O. Gambhir Singh. Radiological assessment of age of adolescents from wrist joint: A prospective study of 151 cases. IAIM, 2015; 2(1): 95-99.

**Available online at [www.iaimjournal.com](http://www.iaimjournal.com)**

**Received on:** 05-12-2014

**Accepted on:** 18-12-2014

## **Abstract**

It is a prospective, radiological study of age assessment of 151 cases of young adolescents (Boy = 70; Girl = 81) in the age range of 14-17 years by taking A-P view X-rays of their right wrist including hands. This study had resulted in considerable narrowing of the range of radiological age assessed using the X-ray of the hand, from 15 years – 19 years to 14 years – 17 years in both boys and girls. Our finding was also consistent with the age from the available date of birth certificates of these students.

## **Key words**

Epiphyses, Radius, Ulna, Metacarpal, Carpal, X-ray, Ossification.

## **Introduction**

Age is an important parameter for medico-legal cases. Many times doctors are called upon to

give opinion about age of a person. For this, objective methods of age determination are required. Age of epiphyseal union is an objective important method of age determination. But

these ages varies with racial, geographic, climatic and various other factors [1, 2]. These variations have suggested the need of separate standards of ossification for separate regions. The present study was carried out to study the epiphyseal union at the wrist joint including metacarpals in the age group of 14 to 17 years in a Higher Secondary School, Chennai, Tamil Nadu, India.

## Material and methods

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Present study was conducted among students from mixed socio-economic status in a higher secondary school; North Chennai, Tamil Nadu, India. We selected 151 students (Male = 70; Female = 81) in the age range of 14-17 years and A-P view X-rays of their right wrist including hands were taken by an expert radiologist after explaining the whole procedure and absence of risk factors, etc. to the students, teachers and parents.

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.

The criteria for fusion were: (a) There should be no gap (or) defect in the epiphyseo-diaphyseal region of the bone. (b) There should be no discontinuity in the outline of the bone. (c) Presence of Epiphyseal scar is considered as 'Fused'. (d) While considering the fusion of secondary ossification centres of phalanges and heads of second, third, fourth and fifth metacarpals fusion was considered only if the fusion has been observed in respective phalanges of all fingers and in all the heads of metacarpals. We selected only those cases

where there was complete fusion of epiphyses. **(Photo – 1)** Then accurate age, as far as possible, was determined in each case based on the radiological findings which was supported by their statement and school leaving certificates. All findings were tabulated for easy study and comparison with the works of other authors.

**Photo – 1:** Fusion of epiphysis at lower ends of radius and ulna.



## Observation

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In the present study, we observed that the fusion of lower end of ulna is earlier in girls as compared with that of boys. There was not a single case of fusion of lower end of ulna in male under the age of 14 years as per **Table - 1**. Fusion of lower end of radius was late in both sexes and we didn't find any fusion in boys up to the 16 years of age as per **Table - 2**.

Age of fusion of base of the 1<sup>st</sup> Metacarpal was as per **Table - 3**. In boys, in majority of cases, head of the 2<sup>nd</sup> to 5<sup>th</sup> Metacarpal bones fused by the age of 16-17 years as per **Table - 4** but in

girls majority of the cases showed fusion by the age of 14 years. As per **Table – 5**, in girl subjects, for proximal row of phalanges in majority of cases in age group 14-15 years, 15-16 years, and 16-17 years showed near fusion, whereas in age groups 15-16 years, 16-17 years and onwards, majority of cases showed complete fusion. In cases of boys, the middle phalanges in majority of cases in age group of 16-17 years, 17-18 years and onwards showed complete fusion as per **Table - 6**. For terminal phalanges, in majority of cases in the age group of 16-17 years, 17-18 years and onwards there was complete fusion as per **Table - 7**.

**Table - 1:** Case distribution according to fusion of lower end of ulna.

Age	Boys	Girls
14 years	0%	29.17%
15 years	10.53%	40.91%
16 years	5.56%	50%
17 years	33.3%	61.54%

**Table – 2:** Cases distribution according to fusion of lower end of radius.

Age	Boys	Girls
14 years	0%	0%
15 years	0%	9.09%
16 years	0%	13.64%
17 years	16.67%	38.46%

**Table - 3:** Cases distribution according to fusion of base of 1<sup>st</sup> metacarpal.

Age	Boys	Girls
14 years	7.41%	83.33%
15 years	15.79%	95.45%
16 years	55.56%	100
17 years	100%	100

**Table - 4:** Cases distribution according to fusion of heads of 2<sup>nd</sup> to 5<sup>th</sup> metacarpals.

Age	Boys	Girls
14 years	7.41%	62.50%
15 years	5.26%	86.36%
16 years	44.44%	95.45%
17 years	66.67%	100%

**Table - 5:** Cases distribution according to fusion of base of proximal phalanges.

Age	Boys	Girls
14 years	7.41%	66.67%
15 years	5.26%	86.36%
16 years	38.89%	100%
17 years	83.33%	100%

**Table - 6:** Cases distribution according to fusion of base of middle phalanges.

Age	Boys	Girls
14 years	7.41%	66.67%
15 years	5.26%	86.36%
16 years	38.89%	100%
17 years	83.33%	100%

**Table - 7:** Cases distribution according to fusion of base of distal phalanges.

Age	Boys	Girls
14 years	11.11%	87.50%
15 years	15.79%	100%
16 years	55.56%	100%
17 years	100%	100%

## Discussion

In the present study of 151 adolescents, there were 70 boys and 81 girls with a boy to girl ratio of 1: 1.15. This almost equal distribution of cases in both boys and girls obviates the gender discrimination in age assessment apart from



enabling to narrow down the range of radiological age assessment using x-ray of the metacarpals and phalanges of the hand. In the available literature, there is no mention about the gender variation in the fusion of secondary ossification centres of the metacarpals and phalanges though some textbook quoted the fusion of secondary ossification centres in girls would occur one to two years prior to boys.

In this study, at the age of 14 years, the fusion of secondary ossification centres for lower end of ulna had occurred only in 29.17% of cases in girls, whereas in boys there was no fusion of lower end of ulna in any of them. At the age of 15 years, the fusion of secondary ossification centres of lower end of ulna had occurred only in 40.91% of cases in girls and in boys it was only 10.53%. Our findings were also consistent with the works of S.S. Bhise, et al. [3], Loobma [4] and Wankhade, et al. [5].

At the age of 16 years, the fusion of secondary ossification centres of the lower end of ulna had occurred in 50% of cases in girls, whereas in boys it was only in 5.56% of cases the fusion had occurred.

The age of fusion of base and head of metacarpals and phalanges ranged from 15 to 19 years which was also consistent with most of the available literature. Some of the Indian text books quoted that the average age range of fusion of the 4<sup>th</sup> and the 5<sup>th</sup> metacarpals would range from 15 to 17 years in girls whereas in boys fusion of those secondary ossification centres would occur between 17 to 18 years.

In this study, at the age of 14 years, the secondary ossification centres of the lower end of radius had not fused in any of the cases in both sexes. At the age of 16 years, the fusion of secondary ossification centres for lower end of radius had occurred only in 13.64% of cases in

girls, whereas in boys there was no fusion of lower end of radius in any of the cases.

In girls, the bases of distal phalanges were found fused in 87.50% of cases at the age of 14 years. In girls, the secondary ossification centres of the head of the 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> metacarpal, bases of proximal and middle phalanges were found fused in 86.33% of cases at the age of 15 years which was also consistent with the works of S.S. Bhise, et al. [3] and Ajay Balachandran, et al. [6].

In cases of boys, the secondary ossification centres of base of first metacarpal and bases of phalanges were found to have fused in more than 80% cases at the age of 17 years. The secondary ossification centres of base of first metacarpal and bases of distal phalanges were found to have been fused in 100% cases at the age of 17 years. But the second, third, fourth and fifth metacarpals were found to have fused only in 66.67% of cases at the age of 17 years. In this regard also the present study was in agreement with the previous works of other authors [7, 8, 9, 10, 11].

## Conclusion

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The present study emphatically revealed that an adolescent either boy or girl whose secondary ossification centres of base of first metacarpal, heads of second, third, fourth and fifth metacarpals, bases of phalanges had fused could have attained the age of 17 years. And if the individual's secondary ossification centres of metacarpals and phalanges have not fused then those individuals are definitely below the age of 17 years.

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**Source of support:** Nil

**Conflict of interest:** None declared.