

# Radiographic Estimation of Age Using Epiphyseal Fusion at Elbow Joint in Boys & Girls of 13-17 Years in Gadap Town

Radiographic Estimation of Age Using Epiphyseal Fusion

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## ABSTRACT

**Objective:** To determine the radiographic age of 13–17-year-old boys and girls by examining epiphyseal fusion in the elbow joint. to examine the age at which the various elbow epiphyses fused in both sexes. to compare the age at which the different bones in the elbow joint have fused epiphyseally between boys and girls.

**Study Design:** Prospective observational study

**Place and Duration of Study:** This study was conducted at the Department of Radiology, Fatima Hospital, Karachi from January 2021 to January 2022.

**Materials and Methods:** Participants' ages were verified by verbal agreements, birth certificates, and school records. An expert radiologist in the department of radiology at the same institution took radiographs of the left elbow joint. According to Prasad et al. (2016), the degree of fusion was assessed for the secondary ossification sites including the capitulum, radial head, internal (medial) epicondyle, trochlea, olecranon, and exterior (lateral) epicondyle. Age (in years) and gender (male or female)-based data collection and analysis were utilized to gather and analyze the data. Chi-square test was performed to determine association and significant difference for categorical variables.

**Results:** According to the study's findings, male participants did not experience medial epicondyle fusion until they were 17 years old, whilst female participants did not experience it until they were 16 years old. The age of fusion for the conjoint epiphysis lateral epicondyle of the humerus was 17 years in females and 16 years in men. Last but not least, the findings demonstrated that full fusion of the upper ends of the radius and ulna in both genders happened at the age of 17. The study also showed that females often showed an earlier stage of fusion of these ossification sites than did men.

**Conclusion:** According to the present study, full epiphyseal fusion of the medial epicondyle at the lower humerus end was seen in 17-year-olds in 95% of females and 5% of males. The conjoint epiphysis lateral epicondyle of the lower end of the humerus was completely fused in 86% of the female participants and 0% of the male participants by the time they were 17 years old. While the Upper end of the radius and ulna had 100% complete epiphyseal fusion at the age of 17 in both gender groups. According to the study's findings, boys and girls between the ages of 13 and 17 in Gadap Town may be reliably identified by radiographic age estimate utilizing epiphyseal fusion at the elbow joint.

**Key Words:** Age estimation, medial epicondyle, conjoint epiphysis, radiographic epiphyseal fusion

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## INTRODUCTION

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One of the crucial factors in establishing a person's identification that is necessary in civil and criminal lawsuits both during life and after death is their age. It is particularly crucial in underdeveloped nations when birth records are not kept up to date.<sup>1</sup> (2017) Maqsood et al. Bone is a mineralized, unusual connective tissue that is vascular, alive, and continually changing. Its growth process is exceptional<sup>2</sup> (2017) Choudhary et al. The timing of epiphyseal lines may be used to determine age since different epiphyses emerge and fuse in a certain sequence. There are known differences between genders in the development of the epiphysis.<sup>3</sup> Siddiqui and colleagues 2017 The little variations in age of fusion may also be brought on by variations in geographic distribution, socioeconomic position, environment, metabolism, diet, genetics, or just a lack of conventional procedures.<sup>4</sup> 2018 (Aljuaid and El-

Ghamry). Worldwide, the examination of epiphyseal union of bones is regarded as a fair scientific and recognized technique for age determination.<sup>5</sup> 2018 (Dere et al.).

The elbow joint is a synovial hinge joint that connects the proximal ends of the radius and ulna to the distal end of the humerus. The capitulum of the humerus articulates with the fovea on the head of the radius, and the trochlea of the humerus is received into the semilunar notch of the ulna. At various points, they are visible on a simple elbow radiograph: the capitulum is two years old, the radial head is four, the internal (medial) epicondyle is six, the trochlea is eight, the olecranon is ten, and the exterior (lateral) epicondyle is twelve. A single epiphysis forms when the capitulum, trochlea, and lateral epicondyle join together. The location of bone lengthening is represented by the epiphyseal plate. According to Alwabhany et al. (2017), the secondary ossification centers are crucial for determining skeletal age from elbow radiographs during the second year of the pubertal growth spurt, which occurs between the ages of 11 and 13 for girls and 13 and 15 for males.<sup>6</sup> After puberty, the process of long bone development terminates at various ages and in various bone regions. The date of epiphyseal union varies very little across study groups from various geographical regions. Radiological assessment of long bone ends has shown greater accuracy, prevalence, dependability, and authenticity among all techniques of age estimation, which is acceptable to clinicians as well as the legal community<sup>7</sup> (Mishra et al., 2017) 2017 (Gaddewar and Meshram). According to study done on 100 people in the Bikander area of India between the ages of 10 and 20 years, fusion of the various ossification centers took place one year sooner in the female participants than in the male ones. The results of the study showed that both men and female adolescents between the ages of 14 and 16 may have their ages estimated using the epiphyseal union around the elbow joint<sup>8</sup> (2016) Sharma et al.

Age determination is crucial in the medicolegal area since it's required for marriage, criminal investigations, and identification. In developing and undeveloped nations where basic paperwork is often inadequate and unavailable, identifying people may be difficult. When comprehensive certified papers are not available, it is necessary to confirm if a person is a minor or an adult.<sup>9</sup> (Ebeye et al., 2016) before determining their exact age. The ages of appearance and the union of the epiphyses and diaphyses as seen radiologically are among the different ways of age determination, and they are often the sole approach used by medico-legal professionals.<sup>10</sup> (Nemade et al., 2014).

## MATERIALS AND METHODS

A random sample size of 204 cases were examined in the current study. With the approval of the ethics

committee, a prospective observational study was conducted on boys and girls between the ages of 13 and 17. The cases were gathered from patients who visited at Department of Radiology, Fatima Hospital, Karachi. On the basis of the subjects' testimonies and the documentation of their birth certificates, and school certificates, accurate ages were ascertained in each instance. According to their mean ages, the individuals were split into five groups of 13, 14, 15, 16 and 17 years for statistical analysis. Subjects between the ages of 12 and 6 months and 13 and 5 months were included in the mean age group of 13, while those between the ages of 13 and 6 months and 14 and 5 months were included in the mean age group of 14, and so on up to 17 years. Antero-posterior radiographs of the left elbow joint were obtained at Department of Radiology, Fatima Hospital, Karachi. These epiphyses were looked at: A joint at the elbow: 1. Conjoint epiphysis lateral epicondyle of lower end of humerus 2. Medial epicondyle of lower end of humerus 3. Upper end of radius & ulna. According to Prasad RS et al<sup>2</sup>, epiphyseal fusion criteria were staged based on how much of the epiphysis around the elbow joint had fused. "Degree 0: A dark radiolucent line seen throughout the length of the epiphyseal and metaphyseal joining surfaces (epiphyseal fusion not yet commenced). Degree 1: Epiphyseal surface area is visualized as an opaque area in radiographs (epiphyseal fusion initiated). Degree 2: opaque area around epiphyseal is more than 50% in radiographs (epiphyseal fusion partial). Degree 3: metaphyseal and epiphyseal joining surfaces are entirely radio opaque (epiphyseal fusion widespread)".

Data was analyzed using software SPSS 21. For quantitative variables such as age, mean and standard deviation was calculated and for qualitative variables such as sex percentages was calculated. Chi-square test was used to estimate association and significant difference for categorical variables. P-value <0.05 was considered significant.

## RESULTS

Total 204 cases were studied, among them 100 were males and 104 were females. It was observed in 95% of female and 5% male that complete epiphyseal fusion was seen in 17 year. In 16 year females 76% while 16 year males 0% fusion of the Medial epicondyle of lower end of humerus were recorded. 10% males and females shown complete fusion of the Medial epicondyle of lower end of humerus in the age barcket of 15 years. In case of 12 and 13 year of age both the male and female showed 0% fusion of the Medial epicondyle of lower end of humerus. (Table 1)

The complete epiphyseal fusion of the conjoint epiphysis lateral epicondyle of lower end of humerus was observed in 86% of female and 0% male in 17 years of age group. Among them 66% females in the

age of 16 and 40% males showed complete epiphyseal fusion of the conjoint epiphysis lateral epicondyle of lower end of humerus. In the age group of 15 years 45% males and 9% females showed complete epiphyseal fusion of the conjoint epiphysis lateral epicondyle of lower end of humerus. In the age group of 14 years 45% females and 0% males showed epiphyseal fusion of the conjoint epiphysis lateral epicondyle of lower end of humerus. While in case of

the age group of 13 neither male nor female showed complete fusion of the above said bone. (Table 2)  
 The age groups from 13-15 showed 0% complete fusion of epiphyseal fusion of the Upper end of radius & ulna. In the age group of 16 year 53% females while 0% males showed complete epiphyseal fusion of the Upper end of radius & ulna. While in the age group of 17 year 100% complete epiphyseal fusion of the Upper end of radius & ulna was recorded in both gender groups. (Table 3)

**Table No. 1: Displaying age of epiphyseal fusion of the Medial epicondyle of lower end of humerus**

Mean age in years	Gender	Total No. of cases	Degree of Epiphyseal fusion							
			Degree 0	%	Degree 1	%	Degree 2	%	Degree 3	%
13	M	20	14	70	7	35	0	0	0	0
	F	21	15	71	05	23	0	0	0	0
14	M	20	02	10	14	70	03	15	0	0
	F	21	01	4.7	15	71	03	14	0	0
15	M	20	02	10	9	45	06	30	2	10
	F	21	0	0	8	38	10	47	02	9
16	M	20	0	0	0	0	1	5	0	0
	F	21	0	0	0	0	4	19	16	76
17	M	20	0	0	0	0	0	0	1	5
	F	20	0	0	0	0	0	0	19	95

**Table No. 2: Displaying age of epiphyseal fusion of the conjoint epiphysis lateral epicondyle of lower end of humerus**

Mean age in years	Gender	Total No. of cases	Degree of Epiphyseal fusion							
			Degree 0	%	Degree 1	%	Degree 2	%	Degree 3	%
13	M	20	8	40	12	60	0	0	0	0
	F	21	21	100	0	0	0	0	0	0
14	M	20	4	20	12	60	05	25	9	45
	F	21	2	9.5	17	81	1	4.7	0	0
15	M	20	0	0	1	5	13	65	9	45
	F	21	0	0	7	33.3	12	57	2	9
16	M	20	0	0	0	0	0	0	8	40
	F	21	0	0	1	4.7	6	28.5	14	66.6
17	M	20	0	0	0	0	0	0	0	0
	F	22	0	0	0	0	1	4.5	19	86.4

**Table No. 3: Displaying age of epiphyseal fusion of the Upper end of radius & ulna**

Mean age in years	Gender	Total No. of cases	Degree of Epiphyseal fusion							
			Degree 0	%	Degree 1	%	Degree 2	%	Degree 3	%
13	M	20	11	55	9	45	0	0	0	0
	F	21	21	100	0	0	0	0	0	0
14	M	20	0	0	13	65	0	0	0	0
	F	21	10	47.7	11	52.3	0	0	0	0
15	M	20	2	10	11	55	7	35	0	0
	F	21	0	0	6	28.5	15	71.5	0	0
16	M	20	0	0	3	15	17	85	0	0
	F	21	0	0	0	0	10	47.7	11	52.3
17	M	20	0	0	0	0	0	0	20	100
	F	22	0	0	0	0	0	0	22	100

## DISCUSSION

The present study was carried to access the age of males and females among the age of 13-17 years by radiographic method using elbow joint epiphyseal fusion as a age marker. The current study covered 204 cases 100 males and 104 females. Epiphyseal fusion of the Medial epicondyle of lower end of humerus. It was observed in 95% of female and 5% male that complete epiphyseal fusion was seen in 17 year. In 16 year females 76% while 16 year males 0% fusion of the Medial epicondyle of lower end of humerus were recorded. It depicts that among females this bone showed maximum fusion in 17 years and the ratio of complete fusion reduced with decrease in age. These findings are in accordance with Das Gupta et al and Singh B 2007<sup>11</sup>. Jnanesh 2011 also get similar kind of radiographic patterns in his study<sup>12</sup>.

The current study maximum epiphyseal fusion of the conjoint epiphysis lateral epicondyle of lower end of humerus was recorded in the females of age group of 17 years. While 45% of males showed this in the age of 14 to 15 years. These results are somehow similar with the studies carried by Hepworth SM 1929, and Jnanesh<sup>12</sup> RS 2011.

The present study showed that 100% of both male and female in the age of 17 possess complete epiphyseal fusion of the Upper end of radius & ulna. While in case of 16 Years of age almost 52% of females and 0 % males showed complete epiphyseal fusion of the Upper end of radius & ulna. The current study is in accordance to the study conducted by Das Gupta et al 1974. Singh B<sup>11</sup> 2007 also noted similar results in his study.

## CONCLUSION

Radiological analysis of Conjoint epiphysis lateral epicondyle of lower end of humerus, Medial epicondyle of lower end of humerus and Upper end of radius & ulna can be used as age markers among both boys and girls especially teenagers. Epiphyseal fusion in present study usually found to be earlier in females than males.

### Author's Contribution:

Concept & Design of Study:	Rafay Ahmed Siddiqui
Drafting:	Jan-e-Alam, Hari Ram
Data Analysis:	Mir Ghulam Ali Talpur, Farzana Azam Khan, Ayesha Muzzamil
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Final Approval of version:	Rafay Ahmed Siddiqui

**Conflict of Interest:** The study has no conflict of interest to declare by any author.

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