

# Study on Epiphyseal Union at the Wrist Joint among the Adolescents of Eastern Odisha

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## ABSTRACT

**BACKGROUND:** Age is regarded as an important factor in various medical examination related to criminal procedures such as assault, sexual offence, kidnapping and in civil matters like succession of property, marriage, employment and so on. Fusion of epiphyses of bones is considered as one of the methods for age estimation.

**AIMS:** To study the stages of epiphyseal union of radius and ulna at the wrist joint in males and females.

**MATERIAL AND METHODS:** The present radiological study was carried out in a tertiary health care centre in coastal Odisha over a period of two years. The epiphyseal union at the wrist joint among 124 subjects (70 males and 54 females) among the adolescent population between 13 to 19 years have been studied to assess the skeletal maturity.

**RESULTS:** Our study concluded that complete epiphyseal union of lower end of radius in case of males occurs at 18-19 yrs. The complete epiphyseal union of lower end of radius in case of females occurs at 17-18 yrs. The complete epiphyseal union of lower end of ulna in both the sexes occurs at 18-19 yrs. The epiphyseal union around the wrist joint occurs earlier in females than males among the adolescents.

**CONCLUSION:** It is recommended to have separate age chart for different geographic regions as many factors like nutrition, genetic, climatic conditions etc. may affect the process of epiphyseal union.

**KEYWORDS:** Radiological study; Epiphyseal union; Wrist joint.

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## INTRODUCTION

Age is one of the primary data of identification. Determination of age is required not only for identification purpose but also in both civil as well as criminal cases like attainment of majority, marriage, inheritance of property, criminal responsibility, rape, kidnapping etc. Age is likewise significant

in sports mainly in the design of competitions according to age groups to guarantee equal chances.<sup>7</sup> In criminal or civil cases age of a person is determined by medical officer on requisition from proper authority. Physical, dental and radiological examination are required to determine the age of an individual. Appearance and fusion of different secondary epiphyses follows a definite pattern which is utilized for estimation of age. The fusion of epiphyses varies in different individuals as it depends upon gender, health, hereditary factors, nutritional status, endocrinal status, physical activity, climatic conditions etc. Estimation of age from epiphyseal union of long bones is also possible in dead and decomposed bodies, as the bones resist putrefaction and mutilation for long time. Ossification and the union of epiphyses gives relatively reliable results with less minimal error and is therefore more appropriate and acceptable to both medical and legal personnel.<sup>13</sup> Now a days, the number of false age related documents have increased and therefore it becomes essential on the part of forensic expert to determine the actual age of the individual in medico legal as well as civil cases.

#### MATERIALS AND METHODS

The present cross sectional descriptive study was carried out in the department of Forensic Medicine and Toxicology of a tertiary care centre in coastal Odisha over a period of two years. A total of 124 subjects (70 males and 54 females) between the age group 13 to 19 years coming to department for medicolegal examination and age estimation purposes were selected for this study. Age was confirmed from history and other documents suggesting date of birth. Subjects showing evidence of nutritional and vitamin deficiency and endocrine disorder, congenital abnormalities, hereditary diseases and cases with trauma to the wrist joint showing gross physical deformity have been eliminated from the study. Radiological examination of wrist joints were done and different stages of epiphyseal union were studied.

#### Criteria for Union

The different phases of epiphyseal union will be graded into five stages according to McKern and Stewart.<sup>10</sup>

- i. **Non-union:** When the epiphyseal cartilage does not begin to decrease in thickness (0 degree union).

- ii. **Beginning union:** When the thickness of the epiphyseal cartilages is reduced (1st degree union).
- iii. **Incomplete union (Active union):** When the epiphyses begin to fuse with the shaft (2nd degree union).
- iv. **Recent union:** When the epiphyseal cartilage is bony in architecture and its density indistinguishable from the epiphyses and diaphysis in its neighbourhood, but the epiphyseal scar is still distinguished (3rd degree union).
- v. **Complete union with absence of epiphyseal scar (4<sup>th</sup> degree union).**

#### RESULTS

Stage-1 epiphyseal union of lower end of radius was observed at 14-15 years of age in 22.2% of cases. It is also observed that stage-4 epiphyseal union was seen in 64.7% of cases in the age group 17-18 years while 100% of males showed stage-4 epiphyseal union at 18-19 years (Table 1).

**Table 1:** Stages of epiphyseal union of lower end of radius in males

Age Group	Number of Cases	Stages of Epiphyseal union				
		0	1	2	3	4
13-14	2	2	0	0	0	0
		100%				
14-15	9	3	2	4	0	0
		33.4%	22.2%	44.4%		
15-16	12	0	2	6	4	0
			16.7%	50%	33.3%	
16-17	14	0	3	0	4	7
			21.4%		28.6%	50%
17-18	17	0	0	0	6	11
					35.3%	64.7%
18-19	16	0	0	0	0	16
						100%

Stage-1 epiphyseal union of lower end of radius was observed at 14-15 years of age in 15.4% of cases. It is also observed that stage-4 epiphyseal union was seen in 60% of cases in the age group 16-17 years while 100% of females showed stage-4 epiphyseal union at 17-18 years (Table 2).

**Table 2:** Stages of epiphyseal union of lower end of radius in females

Age group	Number of cases	Stages of epiphyseal union				
		0	1	2	3	4
13-14	5	5	0	0	0	0
		100%				
14-15	13	8	2	2	1	0
		61.5%	15.4%	15.4%	7.7%	
15-16	14	0	5	7	1	1
			35.8%	50%	7.1%	7.1%
16-17	10	0	0	2	2	6
				20%	20%	60%
17-18	7	0	0	0	0	7
						100%
18-19	5	0	0	0	0	5
						100%

Stage-1 epiphyseal union of lower end of ulna was observed at 14-15 years of age in 22.2% of cases. It is also observed that stage-4 epiphyseal union was seen in 64.7% of cases in the age group 17-18 years while 100% of males showed stage-4 epiphyseal union at 18-19 years (Table 3).

**Table 3:** Stages of epiphyseal union of lower end of ulna in males

Age group	Number of cases	Stages of epiphyseal union				
		0	1	2	3	4
13-14	2	2	0	0	0	0
		100%				
14-15	9	3	2	4	0	0
		33.3%	22.2%	44.5%		
15-16	12	0	2	6	4	0
			16.7%	50%	33.3%	
16-17	14	0	3	0	6	5
			21.4%		42.8%	35.8%
17-18	17	0	0	0	6	11
					35.3%	64.7%
18-19	16	0	0	0	0	16
						100%

Stage-1 epiphyseal union of lower end of ulna was observed at 14-15 years of age in 15.4% of cases. It is also observed that stage-4 epiphyseal union was seen in 71.4% of cases in the age group 17-18 years while 100% of females showed stage-4

epiphyseal union at 18-19 years (Table 4).

**Table 4:** Stages of epiphyseal union of lower end of ulna in females

Age group	Number of cases	Stages of epiphyseal union				
		0	1	2	3	4
13-14	5	5	0	0	0	0
		100%				
14-15	13	8	2	2	1	0
		61.5%	15.4%	15.4%	7.7%	
15-16	14	5	0	7	2	0
		35.8%		50%	14.2%	
16-17	10	4	0	0	4	2
		40%			40%	20%
17-18	7	0	0	0	2	5
					28.6%	71.4%
18-19	5	0	0	0	0	5
						100%

**Table 5:** Gender wise comparison of epiphyseal fusion of lower end of radius and ulna with its shaft with previous studies

Author	Distal end of radius		Distal end of ulna	
	Male	Female	Male	Female
Aiman Al-Qtaitat et al.	20-21	18-19	20-21	18-19
Arun M	18-19	-	17-18	-
Dere C et al.	-	17-18	-	17-18
Gaddewar R	19	18	19	18
Godswill OO et al.	18	18	19	19
Jaybhaye PL et al.	-	-	>16	-
Krishnamoorthy et al.	18-19	17-18	18-19	17-18
Kumar R et al.	18-20	18-20	18-20	18-20
Nemade KS	20-21	19-20	19-20	19-20
Ominde BS et al.	18-19	17-18	19-20	18-19
Shabnum N et al.	18-19	17-18	18-19	18-19
Singh M et al.	20-21	19-20	19-20	18-19
Singh OG	17	17	17	17
Present study	18-19	17-18	18-19	18-19

**DISCUSSION**

In the present study, epiphyseal fusion of the lower end of radius and ulna in the males and females of coastal region of Odisha were analysed and the results were compared with the previous

studies. Our study reveals that complete fusion of lower end of radius was seen in 100% of cases in the age group of 18-19 years in males while in case of females it was observed in the age group 17-18 years. Complete epiphyseal union of lower end of ulna (100% of cases) in case of both males and females were noticed in the age group 18-19 years. Our observation in relation to fusion of lower end of radius in males is in line with studies done by other researchers<sup>2,5,8,9,12,13</sup> while in case of females it is similar with other authors.<sup>3,8,12,13</sup> The result of this study in relation to fusion of lower end of ulna in males is in agreement with studies done by<sup>8,12</sup> while in females it is in line with.<sup>1,12-14</sup> Present study reveals early union of epiphyses of radius by one year in females than males which is similar with most of the authors<sup>4,8,11-14</sup> except Godswill OO who observed the age of fusion of distal ends of radius is 18 years in both sex while in case of ulna it is 19 years in both the sex. Our study reveals complete epiphyseal union of lower end of ulna is 18-19 years in both males as well as females which is in

agreement with Shabnum N *et al.*

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#### CONCLUSION

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The current study is an effort to study the process of epiphyseal union at the wrist joint among the adolescents of eastern Odisha. The completion of epiphyseal union in this population for the lower end of radius is 18-19 years and 17-18 for males and females respectively. Epiphyseal union in case of lower end of ulna is 18-19 years in both the sexes. The union of epiphyses varies according to different geographic locations around the world. Therefore, it is recommended to gather more data from different parts of the country in future studies to have a standard chart for the age estimation. It is also suggested to include more number of epiphyses for accurate age estimation in both civil as well as criminal cases.

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