 DOI: 10.18231/2394-2126.2017.0090

Radiological assessment of elbow joint for skeletal maturity in Vidarbha Region

Ritika Gaddewar[1,*], MM Meshram[2]

[1]Tutor, Indira Gandhi Govt. Medical College, Nagpur, Maharashtra, [2]Professor & HOD, Dept. of Anatomy, Govt. Medical College, Chandrapur, Maharashtra

***Corresponding Author:**
Email: ritikagaddewar@yahoo.com

Abstract

Estimation of the skeletal age of an individual by radiological observation of the time of fusion of the ossification centers is a subject matter of great medicolegal and academic interest to anatomists and forensic experts.

Total 107 cases were studied for assessing epiphyseal fusion at Elbow joint. Epiphyseal fusion at Conjoint epiphysis of lower end of Humerus, Medial epicondyle of lower end of Humerus, Upper end of Radius are studied by radiography. It was observed that complete epiphyseal fusion of Composite epiphysis of Lower end of Humerus with shaft occurred at about 15 years in case of Males and 14 years in case of Females, epiphyseal fusion of the Medial epicondyle of Humerus with shaft at 20 years in case of Males and 19 years in case of Females and epiphyseal fusion of the Upper end of Radius with shaft occurred at about 16 years in case of Males and Females. Females showed early epiphyseal fusion than in males. Age of epiphyseal fusion was studied and compared with different studies carried out in different populations of India as well as other countries.

Keywords: Lower end of Humerus, Upper end of Radius, Radiology, Epiphyseal fusion, Medial epicondyle

Received: 27th January, 2017 **Accepted:** 26th April, 2017

Introduction

Determination of the age of an individual is one of important task for medicolegal persons specially in developing countries like India where birth records are not properly maintained. Among the various methods to determine age of an individual like eruption of teeth, height, weight, pubertal changes and ossification of bones, the last one is a reliable method.

During growth every bone undergoes a series of changes that can be seen radiologically. The sequence of changes is relatively constant for a given bone in every person but the timing of the changes varies because each person has his or her own biological clock.[(1)]

Different studies on the determination of age of epiphyseal fusion carried out in different states of India as well as abroad. Results of these studies have shown that there is difference in the age of epiphyseal fusion in India and abroad as well as in the different states of India. These differences may be due to varying genetic and epigenetic factors.

Findings from different studies also show that in females the fusion of epiphysis with metaphysis occurs earlier than in males though the difference is of 1-2 years only. This needs separate standards for males and females. So, this suggests to follow the latest data available for a particular place for estimation of the age of the population of that place.

Material and Method

Prospective observational study was undertaken in both males and females between the age group of 13-20 years with ethical committee's permission. The cases were collected from out door patients coming to Radiodiagnosis department at our institute of Government Medical College, Nagpur.

Accurate age, as far as possible, was determined in each case based on the statements of the subjects, supported by their school leaving certificates. For statistical analysis, the subjects were divided into eight groups as 13, 14, 15, 16, 17, 18, 19, 20 years according to their mean ages. The subjects of age ranging from 12 years 6 months to 13 years 5months were included in the mean age group 13 years and cases of age 13 years 6 months to 14 years 5 months taken into age group 14 years and so on upto 20 years.

Radiographs of the Left Elbow Joint was taken in antero-posterior view at the department of Radiodiagnosis, Government Medical College, Nagpur. The following epiphyses were examined

At the Elbow joint:

1. Conjoint epiphysis of lower end of Humerus
2. Medial epicondyle of lower end of Humerus
3. Upper end of Radius

Staging of the degree of fusion of the epiphysis around the Elbow joint was done according to Prasad RS et al[(2)] and were considered as criteria for epiphyseal fusion.

Degree 0: a dark radiolucent line seen throughout the length of the epiphyseal and metaphyseal joining surfaces (epiphyseal fusion not yet commenced).

Degree 1: radio-opaque area is seen in the middle or on either side of the epiphyseal and metaphyseal joining surfaces (epiphyseal fusion commenced).

Degree 2: radio-opaque area is more than half of the epiphyseal and metaphyseal joining surfaces (epiphyseal fusion incomplete).

Degree 3: radio-opaque area is seen in the entire length of the epiphyseal and metaphyseal joining surfaces (epiphyseal fusion complete).

Result

Total 107 cases were studied, out of which 54 were males and 53 were females.

Table 1 shows age of epiphyseal fusion of the Composite epiphysis of Lower end of Humerus with shaft. It was observed that complete epiphyseal fusion was seen upto 15 years in case of Males and 14 years in case of Females. Table 2 shows age of epiphyseal fusion of the Medial epicondyle of Humerus with shaft. It was observed that complete epiphyseal fusion was seen upto 20 years in case of Males and 19 years in case of Females. Table 3 shows age of epiphyseal fusion of the Upper end of Radius with shaft. It was observed that complete epiphyseal fusion was seen upto16 years in case of Males and Females.

Table 1: Showing age of epiphyseal fusion of the Composite epiphysis of Lower end of Humerus with shaft

Mean Age In years	Sex	Total no.of cases	Degree of Epiphyseal fusion							
			Degree 0	%	Degree 1	%	Degree 2	%	Degree 3	%
13	M	3	0	0	0	0	3	100	0	0
	F	4	0	0	0	0	1	25	3	75
14	M	6	0	0	0	0	3	50	3	50
	F	4	0	0	0	0	0	0	4	100
15	M	7	0	0	0	0	0	0	7	100
	F	6	0	0	0	0	0	0	6	100
16	M	2	0	0	0	0	0	0	2	100
	F	5	0	0	0	0	0	0	5	100
17	M	5	0	0	0	0	0	0	5	100
	F	6	0	0	0	0	0	0	6	100
18	M	12	0	0	0	0	0	0	12	100
	F	11	0	0	0	0	0	0	11	100
19	M	9	0	0	0	0	0	0	9	100
	F	9	0	0	0	0	0	0	9	100
20	M	10	0	0	0	0	0	0	10	100
	F	8	0	0	0	0	0	0	8	100

Table 2: Showing age of epiphyseal fusion of the Medial epicondyle of Humerus with shaft

Mean Age In years	Sex	Total no.of cases	Degree of Epiphyseal fusion							
			Degree 0	%	Degree 1	%	Degree 2	%	Degree 3	%
13	M	3	0	0	2	67	1	33	0	0
	F	4	0	0	0	0	4	100	0	0
14	M	6	0	0	0	0	6	100	0	0
	F	4	0	0	0	0	4	100	0	0
15	M	7	0	0	0	0	7	100	0	0
	F	6	0	0	0	0	6	100	0	0
16	M	2	0	0	0	0	2	100	0	0
	F	5	0	0	0	0	5	100	0	0
17	M	5	0	0	0	0	5	100	0	0
	F	6	0	0	0	0	2	33	4	67
18	M	12	0	0	0	0	6	50	6	50
	F	11	0	0	0	0	1	9	10	91
19	M	9	0	0	0	0	1	11	8	89
	F	9	0	0	0	0	0	0	9	100
20	M	10	0	0	0	0	0	0	10	100
	F	8	0	0	0	0	0	0	8	100

Table 3: Showing age of epiphyseal fusion of the Upper end of Radius with shaft

Mean Age In years	Sex	Total no.of cases	Degree of Epiphyseal fusion							
			Degree 0	%	Degree 1	%	Degree 2	%	Degree 3	%
13	M	3	0	0	0	0	3	100	0	0
	F	4	0	0	0	0	4	100	0	0
14	M	6	0	0	0	0	5	83	1	17
	F	4	0	0	0	0	3	75	1	25
15	M	7	0	0	0	0	3	43	4	57
	F	6	0	0	0	0	2	33	4	67
16	M	2	0	0	0	0	0	0	2	100
	F	5	0	0	0	0	0	0	5	100
17	M	5	0	0	0	0	0	0	5	100
	F	6	0	0	0	0	0	0	6	100
18	M	12	0	0	0	0	0	0	12	100
	F	11	0	0	0	0	0	0	11	100
19	M	9	0	0	0	0	0	0	9	100
	F	9	0	0	0	0	0	0	9	100
20	M	10	0	0	0	0	0	0	10	100
	F	8	0	0	0	0	0	0	8	100

Table 4: Showing comparison of age (in years) of epiphysial fusion around Elbow joint given by various workers in India with findings of present study

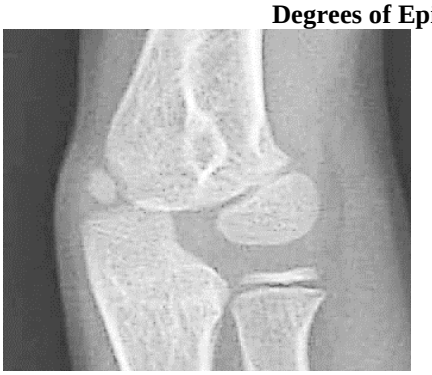
Author	Composite epiphysis of Humerus		Medial epicondyle of Humerus		Upper end of Radius	
	Male	Female	Male	Female	Male	Female
Hepworth SM[3] 1929(Punjab)	14-15		-	-	14-15	
Aggrawal ML and Pathak IC[17] 1957(Punjab)	-	-	-	15-15.5	-	-
Lall R and Townsend RS[7] 1939 (U.P)	-	15	-	15	-	16
Das Gupta et al[8] 1974(U.P.)	16-17	17-18	18-19	17-18	16-17	17-18
Singh B[9] 2007(Manipur)	-	18	-	18	-	18
Sangma WB[10] 2007(North-east India)	-	16	-	16	-	16
Sahni D and Jit I[16] 1995(North West India)	-	-	-	16	-	16
Pillai MJS[4] 1936(South India)	14		17		17	
Jnanesh RS[11] 2011(Karnataka)	16-17	12-13	18-19	16-17	-	-
Galstun G[5] 1937(Bengal)	16	14	16	14	16-17	14-15
Bhise SS[6] 2011(Mumbai)	15-17	14-15	16-17	14-16	16-17	14-16
Present study 2012(Vidarbha, M.S.)	15 (14.6-15.5)	14 (13.6-14.5)	20 (19.6-20.5)	19 (18.6-19.5)	16 (15.6-16.5)	16 (15.6-16.5)

Table 5: Showing comparison of age (in years) of epiphysial fusion around Elbow joint given by various workers in other countries with findings of present study

Author	Composite epiphysis of Humerus		Medial epicondyle of Humerus		Upper end of Radius	
	Male	Female	Male	Female	Male	Female
Paterson RS[14] 1929 (English)	19	14-15	18-21	14-15	18-19	14-15
Sidhom G and Derry DE[15] 1931(Egypt)	16-17	-	19-20	-	19-20	-

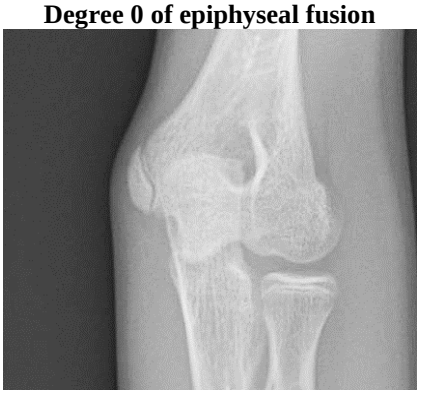
Barrett JH[12] 1936 (Burma)		15		16		16
Ledger LK and Wasson TC[13] 1941(Peshawar)	14-15	14-15	17-18	14-15	17-18	14-15
Present study 2012 (Vidarbha, M.S.)	15 (14.6-15.5)	14 (13.6-14.5)	20 (19.6-20.5)	19 (18.6-19.5)	16 (15.6-16.5)	16 (15.6-16.5)

Degrees of Epiphyseal Fusion at Elbow Joint

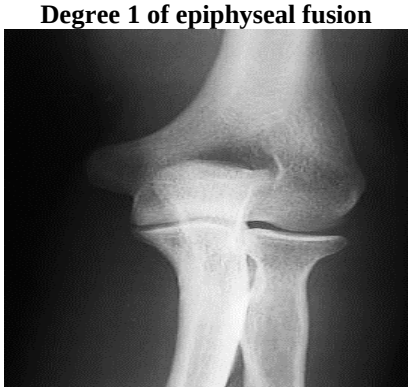


Degree 0 of epiphyseal fusion

Degree 1 of epiphyseal fusion



Degree 2 of epiphyseal fusion



Degree 3 of epiphyseal fusion

Discussion

In present study the epiphyseal fusion of Composite epiphysis of Humerus with shaft has been studied by radiology and fusion is seen in 100% cases in males at 15 years and in females at 14 years. Age of fusion was found to be same for females in Punjab,[3] South India,[4] Bengal[5] and Mumbai,[6] Uttar Pradesh[7] region as in present study, whereas age of fusion was found to be 2-3 years years later in females of Uttar Pradesh,[8] Manipur[9] and North-East[10] region. While in Karnataka[11] females fusion found to be 1-2 years earlier. In case of males age of fusion found to be same as in present study for Punjab[3] and Mumbai[6] region whereas in Uttar Pradesh,[8] Karnataka[11] and Bengali[5] males it is found to be 1-2 years later. (Table 4)

Findings of the present study correlates with results of studies on Burmis[12] and Pakistani[13] population whereas fusion occurs 2-3 years later in English[14] and Egyptian[15] population. (Table 5)

Epiphyseal fusion of medial epicondyle of Humerus with shaft found to be at age of 20 years in males and 19 years in Females which coincides with results of Das Gupta[8] on Uttar Pradesh population while studies on Punjab,[3] Manipur,[9] South India,[4] Karnataka,[11] Mumbai[6] and North-East[10] region shows epiphyseal fusion 1-2 years earlier. Results of studies on Punjab,[17] Uttar Pradesh,[7] North-West,[16] Bengal[5] region shows epiphyseal fusion 3-4 years earlier when compared to present study. (Table 4)

Studies on English[14] and Egyptian[15] population shows similar results as present study whereas in Pakistani[13] and Burmis[12] population fusion found to be 2-3 years earlier. (Table 5)

Age of epiphyseal fusion of Upper end of Radius with shaft is found to be at 16 years for both males and females. Studies on Uttar Pradesh[7] (Lall), Punjab,[3] North-East,[10] Manipur,[9] Karnataka,[11] Bengal[5] and Mumbai[6] shows similar results. In Uttar Pradesh[8] (Das Gupta) and South India[4] age of fusion found to be 1-2 years later. (Table 4)

Burmis[12] population showed similar results as present study. While studies on English,[14] Egyptian[15] and Pakistani[13] population shows 1-2 years earlier fusion in females and 1-2 years late fusion in males when compared to present study. (Table 5)

Conclusion

1. Radiological analysis of Conjoint epiphysis of Lower end of Humerus, Medial epicondyle of Lower end of Humerus and Upper end of Radius can be used for estimation of age.
2. Epiphyseal fusion for all three epiphysis in present study found to be earlier in Females than Males.
3. Comparison of age of epiphyseal fusion found in present study with studies on various regions of India showed considerable variation.
4. Also considerable difference found in age of epiphyseal fusion found in present study when compared with studies on population of different countries.

References

1. Hassel B, Farman AG. Skeletal maturation evaluation using cervical vertebrae. Am J Orthod Dentofac Orthop 1995;107:58-66.
2. Prasad RS, Srivastava KP and Lala JK. Radiological study of some long bones to determine the age of consent in females of Oraon and Munda tribes. J Indian M A 1979;72:4.
3. Hepworth S.M. On the determination of age in Indians from a study of the ossification of the epiphyses of the long bones. Int Med Gaz. 1929:128-131.
4. Pillai MJS. The study of epiphyseal union for determining the age of South Indians. Indian J Med Res 1936;23(45):1015-1017
5. Galstaun G. A study of ossification as observed in Indian subjects. Indians J Med Res 1937;25(1):267-324
6. Bhise SS, Nanandkar SD. Age determination from radiological study of epiphysial appearance and fusion around Elbow joint. J of Forensic Medicine Science and Law. 2011;Vol.20(1):23-31
7. Lal R and Townsend RS. Ages of epiphyseal union at the Elbow and wrist joints amongst Indian Girls. Indian Med Gaz 1939 Oct:614-615.
8. Das Gupta SM, Prasad V, Singh S. A roentgenologic study of epiphyseal union around Elbow, wrist and knee joints and pelvis in Boys and Girls of Uttar Pradesh. J Indian M A 1974;62:10-12.
9. Singh B. Determination of age of majority of Manipuri girls from the radiological examination of the joints. Indmedica-Medico-Legal update.2007-04 - 2007-06;Vol. 7(2).
10. Sangama WB, Marak FK, Singh MS, Kharrubon B. Age determination in girls of North –Eastern region of India. JIAFM 2007;29(4):102-108.
11. Jnanesh RS, Thomas ST, Gowd HS. Estimation of age by roentgenologic study of epiphyseal union at the lower end of Humerus in Karnataka. Anatomica Karnataka. 2011;5(1):6-10.
12. Barrett JH. The union of certain epiphyses in a mixed female population in Rangoon. J Anat 1936;70:432-434.
13. Ledger LK and Wasson TC. Ages of epiphyseal union at the Elbow and wrist joints amongst 238 children in North – West frontier province. Ind Med Gaz 1941;76:81–84.
14. Paterson RS. Radiological investigation of the epiphyses of the long bones. J Anat 1929;64(1):28–46.
15. Sidhom G. and Derry D.E. Dates of union of some epiphyses in Egyptian from X-ray photographs. J Anat 1931:65(2):196 – 211.
16. Sahni D and Jit I. Time of fusion of epiphyses at the Elbow and wrist joints in girls of northwest India. Forensic Sci Int. 1995;74(1):47-55.
17. Aggrwal MI and Pathak IC. Roentgenologic study of epiphyseal union in Punjabi girls for determination of age. Indian J med Res 1957;45(2):283-289.