

Study of Ossification Centres Around the Elbow and Wrist of Adolescent Age Group 15-18 Years

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Abstract

Intoduction: Determination of age in both living and dead plays a pivotal role in medicolegal cases. There are various parameters to assess the age by physical characteristics, odontological development but the most valuable method seems to be the osteological changes observed by radiological examination i.e., the appearance and fusion of secondary ossification centres around respective joints The present study was conducted on 131 subjects out of which 110 were males and 21 were females. The main aim of the study was to find the age of fusion of secondary ossification centres around elbow and wrist joint, to compare the distribution of fusion of ossification centres between males and females

Methods: Firstly informed consent was taken. Preliminary details of each individual was noted that included general examination, physical examination, dental examination followed by taking X-ray AP view of elbow and wrist joint for radiological examination. The results were noted based on the degree of fusion as No Union (O), Beginning union(B), Recent union(R), Complete union(C).

Results: The present study showed among males, the fusion for each ossification centre around elbow joint started by 15-16 years and was completed by 18-19 years whereas in females it started fusion by 15-16 years but complete fusion occurred around 16-17 years itself . In wrist joint the fusion starts at 16-17 years in males but only fusion of lower end of ulna is completed by 18-19 years, however both lower end of radius and ulna are fused by 18-19 years in females.

Conclusion: Based on the analysis of fusion of ossification centres it shows that both thecentres around elbow and wrist joint fuses earlier in females by 1-2 years than males.

Keywords: Age, X-rays, ossification, fusion.

Introduction

Age estimation in the living is one of the most important tasks especially in developing countries where both birth records are often not available or

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not well maintained⁴.Despite the fact that there are a number of laws requiring registrations of births(Eg: Registration of Births and Deaths Act 1969) most births are not properly recorded. Though there are many general developmental factors in assessing the age, changes in bones specially time related appearance and fusion of different ossification centres in growing period are valuable indices for assessing the age⁴. The variation in the appearance and the fusion of ossification centres is mainly attributed to various factors like climate, hereditary,race,nutrition,dietary

habits and gender, socioeconomic status of the population⁸. Scientific estimation of age of an individual whether living or dead or from human remains is a vexing problem for medical jurist in both civil and criminal matters, Age estimation cases are often referred to forensic experts as it plays a vital role in deciding upon the quantum of punishment given to the accused and where to execute the same in a Reformation or juvenile court school or jail.. As the age between 15 to 17 years is very important medicolegally especially in the females, it is important to differentiate between 14-15 years in employment and 17-18 years in connection with Hindu Marriage Act. Amongst all the parameters of age determination, radiological examination of bones ends has shown accuracy and reliability acceptable to medical profession and legal fraternity. So the objective of this study is to find out the age of an individual from the fusion of secondary ossification centers around Elbow joint and Wrist joint, to compare the age of fusion of ossification centers around elbow and wrist joints between males and females .

Materials and Methods

The present study was conducted in Government Junior College, Nemmikal, Suryapet, Telanagna. The study was carried on a total of 131 subjects out of which 110 were males and 21 were females. Subjects with deformities of elbow and wrist joint, signs of malnutrition, congenital anomalies, infections and metabolic disorders were excluded. We obtained written consent for every individual subject for their radiological examination. The X-rays of AP view were taken in an outside lab. The persons selected for the study were grouped as per their stated age viz, 15-16 years, 16-17years, 17-18years & 18-19 years . Age as stated by them was further confirmed by birth certificate or entry in their school record .The Xerox copy of proof of birth certificate was collected. The persons belonging to the age group selected for either gender are included in the study irrespective of their socio- economic, religion. We prepared a proforma

with particulars containing Name, sex ,date of birth ,address, height, weight and Identification marks. In males the colour and growth of scalp hair, beard, moustache, axillary and pubic hair were examined and noted. In females, development of breast was noted and complete menstrual history was taken. Dental examination was done by noting the number of temporary and permanent teeth and a dental chart was prepared. Radiological assessment of various ossification centres, their appearance, process of fusion were noted. The observations were based on the following grades of stages of fusion.

DEGREE 0: A dark radiolucent line seen throughout the length of the epiphyseal and metaphyseal joining surface (Centre not appeared, union not commenced).

DEGREE 1: Radio opaque area is seen in the middle of or on either side of, but occupies less than half of, the epiphyseal and metaphyseal joining surface (Centre appeared but incomplete, union commenced).

DEGREE 2: Radio opaque area is seen in more than half of epiphyseal and metaphyseal joining surfaces, but the cortical shadow is not continuous (Union started but incomplete).

DEGREE 3: Radio opaque area is seen in the entire length of the epiphyseal and metaphyseal joining surface and the cortical surface is continuous without any notch (Complete union).

For tabulating the findings the stages of fusion were noted in the form of following abbreviations.

1. No union (O).
2. Beginning union (B).
3. Recent union (R).
4. Complete union(C).

Results

TABLE 1: COMPLETE FUSION OF OSSIFICATION CENTRES AROUND ELBOW JOINT IN MALES AND FEMALES

AGE	TROCHLEA		CAPITULUM		LATERAL EPICONDYLE		MEDIAL EPICONDYLE		UPPER END OF RADIUS		UPPER END OF ULNA	
	M	F	M	F	M	F	M	F	M	F	M	F
15-16	6(21.4%)	8 (80%)	10(25.7%)	2(20%)	12(42.8%)	2(20%)	8(28.5%)	3(30%)	10(35.7%)	7(70%)	12(42.8%)	5(50%)
16-17	12(37.5%)	4 (100%)	20(62.5%)	4(100%)	22(68.7%)	4(100%)	22(68.7%)	4(100%)	24(75%)	4(100%)	26(81.2%)	4(100%)
17-18	30(93.7%)	6(100%)	28(87.5%)	6(100%)	26(81.2%)	6(100%)	28(87.5%)	6(100%)	30(93.7%)	6(100%)	30(93.7%)	6 (100%)
18-19	18(100%)	1(100%)	18(100%)	1(100%)	18(100%)	1(100%)	18(100%)	1(100%)	18(100%)	1(100%)	18(100%)	1 (100%)

Table 1 shows that the complete fusion of ossification centres around elbow joint in males starts at the age of 15-16 years followed by individuals of 17-18 years showing complete fusion from a range of 80-90% and all the 18 subjects between 18-19 years

shows 100% complete fusion. In females it showed that the complete fusion of all ossification centres around elbow joint started at the age group of 15-16 years but was not complete and it was followed by appearance of 100% complete fusion in 16-19 years age group of individuals .

TABLE 2: COMPLETE FUSION OF OSSIFICATION CENTRES AROUND WRIST JOINT IN MALES AND FEMALES

AGE	LOWER END OF RADIUS		LOWER END OF ULNA	
	M	F	M	F
15-16	0(0%)	0(0%)	0(0%)	0(0%)
16-17	2(6.2%)	0(0%)	4(12.5%)	1(25%)
17-18	20(62.5%)	4(66.6%)	26(81.2%)	4(66.6%)
18-19	14(77.7%)	1(100%)	18(100%)	1(100%)

Table 2 shows that the complete fusion of lower end of radius and ulna in males starts by the age of 16-17 years. The age group of 18-19 years shows only 77.7% of complete fusion of lower end of radius but 100% complete fusion was seen only in lower end of ulna. It implies that the lower end of ulna fuses earlier, followed by the lower end of radius in males. Among females complete fusion of lower end of radius starts

at the age of 17-18 years and the lower end of ulna starts by 16-17 years. The age group of 18-19 years shows 100% complete fusion of both lower end of radius and lower end of ulna. It implies that the lower end of radius completely fuses in females earlier when compared to males but fuses in line at the same age for lower end of ulna.

TABLE 3: DISTRIBUTION OF FUSION OF OSSIFICATION CENTRE AROUND ELBOW JOINT IN MALES AND FEMALES

AGE	TROCHLEA		CAPITULUM		LATERAL EPICONDYLE		MEDIAL EPICONDYLE		UPPER END OF RADIUS		UPPER END OF ULNA	
	M	F	M	F	M	F	M	F	M	F	M	F
15-16	6	8	10	2	12	2	8	3	10	7	12	5
16-17	12	4	20	4	22	4	22	4	24	4	26	4
17-18	30	6	28	6	26	6	28	6	30	6	30	6
18-19	18	1	18	1	18	1	18	1	18	1	18	1
p value	0.049	0.050	0.014	0.061	0.007	0.061	0.020	0.044	0.017	0.042	0.013	0.034

TABLE 4: DISTRIBUTION OF FUSION OF OSSIFICATION CENTRE AROUND WRIST JOINT IN MALES

AGE	LOWER END OF RADIUS		LOWER END OF ULNA	
	M	F	M	F
15-16	0	0	0	0
16-17	2	0	4	1
17-18	20	4	26	4
18-19	14	1	18	1
p value	0.157	0.278	0.142	0.182

FIGURE 1:



Figure 1 depicts X-ray AP view of elbow and wrist joint of 17 years male showing complete fusion of all ossification centres around elbow joint and beginning of fusion in lower end of radius and ulna in the wrist joint.

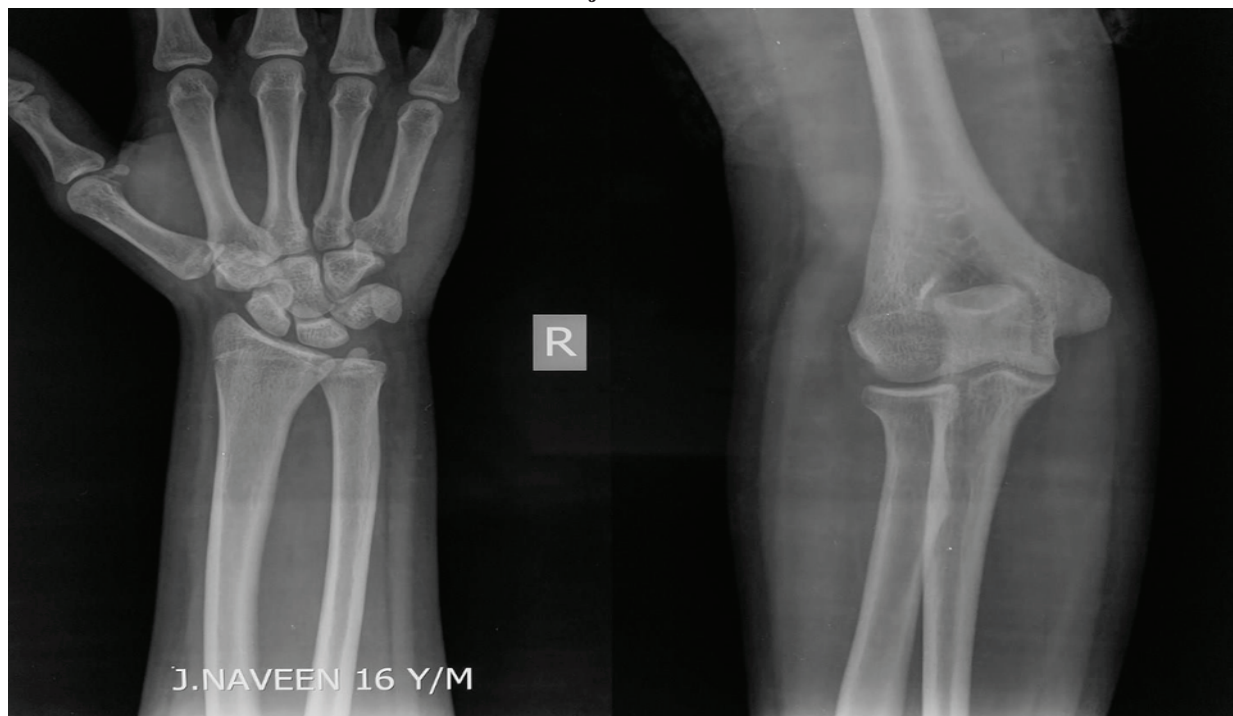


FIGURE 2:

Figure 2 depicts X-ray AP view of wrist and elbow joint of 16 years female showing complete fusion of all ossification centres around elbow joint and recent fusion of lower end of radius and ulna in the wrist joint.

FIGURE 3:



Figure 3 depicts X-ray AP view of wrist and elbow joint of 17 years female showing complete fusion of all ossification centres around elbow joint and recent fusion of lower end of radius and ulna in the wrist joint.

Discussion:

Age determination is important in law of attaining maturity and in criminal case where the disposal of body is done by dismembering the body parts by using various methods or when only skeletal remains is available for examination. Whereas in living it helps in solving medicolegal cases comprising civil cases like those related to employment, education, sports and in criminal cases like robbery, sexual assaults, abduction or kidnapping etc .,

The present study was conducted on 131 subjects out of which 110 were males and 21 were females. It shows that fusion of trochlea in age group of 15-16 years the complete fusion is seen only 21% rest population shows recent fusion in males and in age group 17-18 years 93% were completely fused. In females age group of 15-16 years 8% completely fused. Fusion of capitulum in age group 15-16 years

the complete fusion is seen only 35% rest population shows recent fusion in males and in age group 17-18 years 87% completely fused whereas In females of the age group 16-17 years 100% was completely fused.

The fusion of lateral epicondyle in the age group 15-16 years complete fusion is seen only in 42% and rest of population shows recent fusion in males, in age group 17-18 years ,81% completely fused whereas in females the age group 16-17 years completely fused . The fusion of medial epicondyle in age group 15-16 years the complete fusion is seen only in 28% rest population shows recent fusion in males and in age group 17-18 years, 87.5% completely fused whereas in females of age group 16-17 years ,100% was completely fused.

Fusion of upper end of radius in age group of 15-16 years complete fusion is seen in only 35% rest of the population shows recent fusion in males and in

the age group 17-18 years 93% was completely fused however in females the age group of 16-17 years showed 100% complete fusion. Fusion of upper end of ulna in age group of 15-16 years, the complete fusion is seen only 42% rest of the population shows recent fusion in males and in age group 17-18 years, 93% was completely fused whereas in female age group of 16-17 years, 100% complete fusion was seen.

Ossification centres around lower end of radius in males in the age group of 16-17 years shows only 6% complete fusion, in 18-19 years 77% shows complete fusion. In females the age group of 18-19 years shows 100% complete fusion. Ossification centres around lower end of ulna in males in the age group of 16-17 years shows only 12% complete fusion, in 18-19 years only 81% shows complete fusion. In females the age group of 18-19 years shows 100% complete fusion.

The olecranon centre showed a tendency to ossify earlier than trochlea in girls and boys in this study similar results were observed by the study conducted by Cesar Satosh, Miyazaki Daniel et al in November 2017¹. The fusion of epiphyseal centre of medial epicondyle with the shaft was seen between 15-17 years in males which were concordant with the study conducted by Umesh Choudary et al in March 2017³. The fusion of lower end of radius and ulna shows complete fusion in 100% population at 18-19 year group individuals which were similar to the results of the study done by Hassan Noor et al in June 2016².

It is observed that the ossification centres in females fuse earlier than males in both elbow and wrist joint. With reference to the theory of null hypothesis considering $p=0.05$ as the statistical significant value. The age of fusion of ossification centres around elbow and wrist joint between males and females were observed and it showed that the p value calculated for females was >0.05 when compared to males which were <0.05 (0.013-0.020) and is the probability that the null hypothesis is true.

Conclusion:

It shows that the complete fusion of ossification centres around elbow and wrist joint in females occurs earlier than in males by 1-2 years. 100% complete fusion around elbow joint in females occurs at 16-17 years whereas in males it is seen at 18-19 years. 100% complete fusion around wrist joint is seen in females of age group 18-19 years whereas only lower end of ulna shows complete fusion in males at 18-19 years.

Conflicts of Interest: Nil.

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Ethical Clearance: Institute ethical committee, Osmania medical college.

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