

Determination of age of sixteen years by radiology in boy's and girl's of Hyderabad Karnataka area Gulbargha

K T Shivkumar¹, Naveen Kumar B D^{2*}, Manjunth C S³

{¹Assistant Professor, Department of Forensic Medicine} {²Tutor, ³Assistant Professor, Department of Anatomy}
Hassan institute of Medical Sciences, Hassan, Karnataka, INDIA.

Email: dr.nvngowda@gmail.com

Abstract

Introduction: The different organs of the system in the body grow or develop in different rates. Various physical changes associated with the growth and development of particular organ system predominate mainly one phase of growing period. So the study by radiological examination to fix the age should be supplemented by the physical and dental examination. Study of dentition, epiphyseal union or the order of appearance of puberty sings will be helpful for assessment of 15-17 years age. Complete study of all these systems is therefore necessary to establish useful criteria for the assessment of correct age. **Result:** The results are tabulated and findings are compared with results of other workers. it is noticed that gulbargha(karnataka) boy's and girl's are advanced in appearance and fusion of epiphysis when compared to other parts of our country. **Materials and Methods:** 50 students 25 boys and 25 girls were selected for the study from different schools in Gulbarga city. Students studying in S.S.L.C and 1st P.U.C. were selected giving importance to the reliable date of birth. These students were examined during 1990-91 and 1991-92. The subjects belonged to different groups. The cases were selected based on the date of birth in obtained from parents. Only such cases were selected for study and those failing short of this standard were discarded. **Conclusions:** By radiological examination of 50 subjects in the age group of 15-17 years, it is possible to determine the age of 16 years. Vegetarian and mixed group subjects do not show any difference in their physical growth and epiphyseal union. No reliance can be placed on height, weight and build for the determination of age.

Keywords: Age, epiphysis, radiology, medico-legal.

*Address for Correspondence:

Dr. Naveen Kumar B D, Tutor, Department of Anatomy, Hassan institute of Medical Sciences, Hassan, Karnataka, INDIA.

Email: dr.nvngowda@gmail.com

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INTRODUCTION

The determination of age of 16 years is very important in medico-legal work. It is of considerable importance and comes up frequently in connection with the questions of criminal responsibility, rape, kidnapping, and awarding of judicial punishment, etc. Determination of age is even more important in murder cases, where only skeletal

remains are available for analysis due to, attempts made to dispose of the body by mutilation, by dismemberment, by the use of corrosives, by the action of fire or in cases where murder was committed long ago. It is necessary sometimes to identify persons in mass disasters like fire accidents, air crash accidents and traffic accidents, railway accident, etc. In short the forensic specialist takes over after the most established means of identifications have become doubtful or impossible. Height, weight, the appearance of teeth, ossification centres, epiphyseal union, etc. which are the principal means in the assessment of age with fair degree of accuracy has been collected in our country in the past. It is however not certain whether the data thus collected in the course of few sporadic and piecemeal endeavours are universally applicable to the diverse segments of population living in this sub-continent. The study of ossification centres that has been carried out so far in India indicates that there is a

divergence in the pattern of their appearance in the various regions of our country and in different socio-economic groups. So it was felt that this problem should be studied extensively in all its aspects and adequate data collected for different regions, based on sufficiently comprehensive observations. India is a very vast country with multiple religions, diversity in social customs and dietary habits; India is a developing country with majority of people living in the rural areas. Most of them is illiterate. Their main diet is cereals, due to the ignorance of nutritive value of food stuffs their diet is poor in essential constituents. Poverty is another big problem in our country. The other problem is with regard to the paucity of correct record of their birth dates, etc. majority are illiterate and they do not keep any birth records. Municipalities and village officials are entrusted with the work of maintaining such records, still people fail to give correct information to such authorities. In civilised and western countries this problem is less because the Christianity is the dominant religion, the church authorities maintain birth records and issue birth certificate, which is given due value in the court. Birth records of the "gurukulas" do not have any value in the court. So our courts have depend much upon the expert for assessment of correct age. The different organs of the system in the body grow or develop in different rates. Various physical changes associated with the growth and development of particular organ system predominate mainly one phase of growing period. So the study by radiological examination to fix the age should be supplemented by the physical and dental examination. Study of dentition, epiphyseal union or the order of appearance of puberty signs will be helpful for assessment of 15-17 years age. Complete study of all these systems is therefore necessary to establish useful criteria for the assessment of correct age. Even in normal individuals, there is however a wide range in the time intervals at which any particular landmark or event becomes recognizable. It is thus difficult to delimit the age to narrow ranges. To narrow the age all the systems physical, dental, and radiological should be studied simultaneously and not in separate components at different places. Hence this is the study of 50 cases of boys and girls, (25 boys and 25 girls) in the age group 15-17 years in the Gulbarga region in Hyderabad Karnataka area. This study is done to fix the age of 16 years. In addition to x-ray examination of elbow joint, metacarpals, phalanges, pelvis, including hip, other physical changes in the boys and girls are also studied elaborately and simultaneously.

MATERIALS AND METHODS

50 students 25 boys and 25 girls were selected for the study from different schools in Gulbarga city. Students studying in S.S.L.C and 1 P.U.C. were selected giving importance to the reliable date of birth. These students were examined during 1990-91 and 1991-92. The subjects belonged to different groups. the cases were selected based on the date of birth in obtained from parents. Only such cases were selected for study and those failing short of this standard were discarded. Every day 5-6 students were brought to our department, For every student particulars like name, age as alleged by student, sex, address and total family income per year etc. were recorded in the respective proformas. The height, weight, chest expansion, abdominal girth were measured with the help of axillary hairs, pubic hairs, breasts in females were also examined. The different systems like cardiovascular, respiratory, central nervous system etc. were examined thoroughly to rule out any disease, students are suffering. Every day student were taken to Gulbarga general hospital for x-rays of elbow, metacarpals, phalanges and pelvis including hip. X-rays were collected next day, results were recorded in performa and tables prepared.

Subjects were divided into four age groups.

1. 15 - 15 ½ years
2. 15 ½ - 16 years
3. 16 - 16 ½ years
4. 16 ½ - 17 years.

A multilateral assessment of the age of those subjects was made. The study consisted of three methods, i.e., physical, dental and radiological giving more importance to the radiological examination. The height and weight of the subjects were recorded and rates of development of hair growth and secondary sexual characters were noted as also the nutritional status. Teeth also were studied noting at the same time presence of third molar teeth and in its absence, the space for the same.

X-rays of following 3 joints were taken for all subjects

1. Elbow joint.
2. Metacarpals and phalanges.
3. Pelvis, including hip joint.

For recording observations of radiological union of long bones, Bajaj's (1961) classification of fusion was adopted. Mckern and Stewart (1957) method was followed for iliac crest and ischial tuberosity.

The method of classification of fusion used for epiphysis of long bones divided into six stages.

1. There is no union or surface adaptation between epiphysis and diaphysis. Here the epiphyseal end does not cap the diaphyseal end.
2. In this stage there are no changes in the diaphyseo-epiphyseal space. There is no

indication of union between epiphysis and diaphysis.

3. This stage is beginning of union. In this stage obliteration of diaphyseo-epiphyseal space has started. The space is traversed by wavy lines. appearance of this gives indication of beginning union.
4. This stage is represented by recent union. Here the diaphyseo-epiphyseal plate is obliterated but at the periphery of the space some notching, still persists, when seen from antero-posterior and lateral view.
5. Here there is complete union between epiphysis and diaphysis. There is notching or epiphyseal scar, and there is uninterrupted continuity of periosteum between epiphysis and diaphysis.
6. In this stage there is complete union between epiphysis and diaphysis. At the site of diaphyseo-epiphyseal space, a white line persists. This is called epiphyseal scar. The disappearance time of epiphyseal scar is not uniform. The epiphyseal union is assumed to be complete even if the epiphyseal scar is present.

The method of classification of fusion used for epiphysis of iliac crest is divided in to five stages

Satge-0: No union.

Stage-1: Union starts at the anterior iliac spine.

Stage-2: Fused in anterior $\frac{1}{2}$,occasionally posterior $\frac{1}{4}$,and sometimes only in middle $\frac{1}{3}$.

Stage-3: Ununited only at a point just above the junction of the iliac fossa and articular area.

Stage-4: Complete union – fissures of stage 3 often persists as shallow grooves.

Method of classification of fusion used for epiphysis of ischial tuberosity

This is divided into five stages.

Stage-0: No union.

Stage-1: Union just commenced.

Stage-2: Union is complete in first half of epiphysis.

Stage-3: Union is complete in $\frac{3}{4}$ of epiphysis.

Stage-4: Complete union.

Classification of fusion of epiphyses at heads of metacarpals and bases of phalanges

This is divided into five stages.

Stage-0: No union.

Stage-1: Union just commenced.

Stage-2: Incomplete union.

Stage-3: Complete union with presence of epiphyseal scar.

Stage-4: Complete union without scar.

Based on this staging of union of epiphysis the tables are prepared.

RESULTS



Figure.1: X-rays of pelvis and hip(females)



Figure.2: X-rays of elbow and hand(females)



Figure.3: X-rays of pelvis and hip(males)



Figure 4: X-rays of elbow and hand (males)

Table 1: Showing union of epiphysis of head of radius with shaft

Age group (years)	Total No of cases	Sex	Different stages of epiphysial union						% of cases showing complete union (including 5 and 6 stages)
			1	2	3	4	5	6	
15 - 15 1/2	10	M 10	1	-	5	2	2	-	20%
		F 00	-	-	-	-	-	-	-
15 1/2 - 16	10	M 04	-	-	1	-	1	2	75%
		F 06	-	-	-	-	2	4	100%
16 - 16 1/2	17	M 07	1	2	1	-	2	1	42.6%
		F 10	-	-	-	-	1	9	100%
16 1/2 - 17	13	M 04	-	-	-	-	4	-	100%
		F 09	-	-	-	-	-	9	100%

Table 2: Showing union of upper end of ulna with shaft

Age group (years)	Total No of cases	Sex	Different stages of epiphysial union						% of cases showing complete union (including 5 and 6 stages)
			1	2	3	4	5	6	
15 - 15 1/2	10	M 10	2	8	-	-	-	-	Nil
		F 00	-	-	-	-	-	-	-
15 1/2 - 16	10	M 04	-	-	2	2	-	-	Nil
		F 06	-	-	2	4	-	-	Nil
16 - 16 1/2	17	M 07	-	-	2	5	-	-	Nil
		F 10	-	-	-	2	8	-	80%
16 1/2 - 17	13	M 04	-	-	-	-	2	2	100%
		F 09	-	-	-	2	3	6	100%

Table 3: Showing union of epiphysis lower end of humerus with shaft

Age group (years)	Total No of cases	sex	Different stages of epiphysial union						% of cases showing complete union (including 5 and 6 stages)
			1	2	3	4	5	6	
15 - 15 1/2	10	M 10	-	-	8	-	2	-	20%
		F 00	-	-	-	-	-	-	-
15 1/2 - 16	10	M 04	-	-	1	1	1	1	50%
		F 06	-	-	-	-	1	5	100%
16 - 16 1/2	17	M 07	-	-	-	-	-	1	14.2%
		F 10	-	-	-	-	-	10	100%
16 1/2 - 17	13	M 04	-	-	2	-	-	2	50%
		F 09	-	-	-	-	-	9	100%

Table 4: Showing union of 1st metacarpal, other four metacarpal and proximal phalanges

Age group (years)	Total No. of cases	sex	Fusion of 1 st metacarpal	% of fusion	Fusion in other 4 metacarpal	% of fusion	Fusion in proximal phalanges	% of fusion
15 – 15 ½	10	M 10	1	10%	6	60%	1	10%
		F 00	-	-	-	-	-	-
15 ½ – 16	10	M 04	1	25%	4	100%	1	25%
		F 06	6	100%	6	100%	5	79%
16 – 16 ½	17	M 07	1	14.2%	6	85.2%	-	-
		F 10	10	100%	10	100%	10	100%
16 ½ - 17	13	M 04	3	75%	4	100%	3	75%
		F 09	8	88.8%	8	88.8%	7	77.7%

Table 5: Showing union of epiphysis of greater trochanter with shaft

Age group (years)	Total No of cases	sex	Different stages of epiphysial union						% of cases showing complete union (including 5 and 6 stages)
			1	2	3	4	5	6	
15 - 15 ½	10	M 10	-	1	5	4	-	-	Nil
		F 00	-	-	-	-	-	-	Nil
15 ½ - 16	10	M 04	-	-	2	1	-	1	25%
		F 06	-	-	1	-	1	4	79%
16 - 16 ½	17	M 07	-	-	4	3	-	-	Nil
		F 10	-	-	-	-	1	9	100%
16 ½ - 17	13	M 04	-	-	-	-	1	3	100%
		F 09	-	-	-	-	1	8	100%

Table 6: Showing appearance and fusion of epiphysis of iliac crest

Age group (years)	Total No of cases	sex	No. of cases non appearance	% of non appear-ance	Different stages of epiphysial union					% of fusion
					0	1	2	3	4	
15 - 15 ½	10	M 10	5	50%	5	-	-	-	-	Nil
		F 00	Nil	Nil	-	-	-	-	-	Nil
15 ½ - 16	10	M 04	Nil	Nil	1	2	1	-	-	Nil
		F 06	Nil	Nil	-	-	3	3	-	Nil
16 - 16 ½	17	M 07	Nil	Nil	6	1	-	-	-	Nil
		F 10	Nil	Nil	-	-	-	7	-	Nil
16 ½ - 17	13	M 04	Nil	Nil	-	4	-	-	-	Nil
		F 09	Nil	Nil	-	-	6	3	-	Nil

Table 7: Showing appearance and fusion of epiphysis of ischial tuberosity

Age group (years)	Total No of cases	sex	No of cases non appearance	% of non appear-ance	Different stages of epiphysial union					% of fusion
					0	1	2	3	4	
15 - 15 ½	10	M 10	10	100%	-	-	-	-	-	Nil
		F 00	Nil	Nil	-	-	-	-	-	Nil
15 ½ - 16	10	M 04	02	50%	-	2	-	-	-	Nil
		F 06	Nil	Nil	-	-	2	4	-	Nil
16 - 16 ½	17	M 07	01	14.2%	1	5	-	-	-	Nil
		F 10	Nil	Nil	-	1	3	6	-	Nil
16 ½ - 17	13	M 04	Nil	Nil	-	1	3	-	-	Nil
		F 09	Nil	Nil	-	-	-	9	-	Nil

Table 8: Showing height, weight, build and breast development

Age group (years)	Total.No of cases	sex	Average height	Average weight (kgs)	Build			Breast development in females		
					weak	Mod	Rob-ust	I	II	III
15 - 15 ½	10	M 10	5'3"	39.9	-	10	-	-	-	-
		F 00	-	-	-	-	-	-	-	-
15 ½ - 16	10	M 04	5'2"	40.7	-	4	-	-	-	-
		F 06	4'8"	37.5	1	5	-	-	6	-
16 -16 ½	17	M 07	4'11"	38.7	1	6	-	-	-	-
		F 10	4'8"	38.2	-	10	-	-	10	-
16 ½ - 17	13	M 04	5'2"	39.6	-	4	-	-	-	-
		F 09	4'9"	39.2	1	8	-	-	3	6

Stage-I: Infantile, Stage-II: Intermediate, Stage-III: Adult pattern

DISCUSSION

Table 9: Showing ages of epiphyseal union in boys and girls according to different workers

workers	Subjects	Lateral epicondyle		Trochlea		Conjoint epiphysis		Medial epicondyle		Olecrenon		Head of radius	
		F	M	F	M	F	M	F	M	F	M	F	M
Paterson	English	14-15	17-18	14-15	14-15	14-15	18	14	19-21	14	19	14	18-19
Siddom	Egyptian	-	-	-	-	17	17	16-18	-	-	-	16	-
Hepworth	Panjabi	-	-	-	-	14	15	14 ½	14 ½	-	-	14	15
Pillai	Madrasi	14	14	-	-	14	14	17	17	16	16	17	17
Galstun	Bengali	10-12	10-12	09-13	11-15	09-13	11-15	14	17	15	17	14	16
LallandNat	U.P	-	-	-	-	-	16-17	-	16-17	-	16	-	17
Basuandbasu	Bengali	12-13	12-13	12-13	-	12-13	-	14	-	13-14	-	13-14	-
Loomba	Bengali	-	-	-	-	-	-	-	-	-	-	-	-
Franklin	Maharastri-an	13-14	13-14	13-14	-	13-14	-	14-15	-	13-14	-	13-14	-
Present work	Karnataka (Gulbarga)	-	-	-	-	-	-	-	-	16-16½	16½-17	15 ½ -17	15-17

Table 10: Showing the age in years of appearance and fusion of some epiphysis as observed by different authors

		Galstaun		Basuand basu	Hepworth	Lalland townsend	LallandNat	Pillai	Flecker		Karnataka (Gulbarga)	
		F	M						F	M	F	M
Humerus trochlea	App	10	12	-	-	-	-	-	-	-	-	-
	Fusion	10-12	11-16	12-13	14-15	-	-	13-14	13	13	-	-
Medial epicondyle	App	5	7	-	-	-	-	-	-	6	-	-
	Fusion	14	15	13-14	14 ½	14-15	15-17	14-17	15	16	-	-
Head of radius	App	6	8	-	-	-	-	-	4	5	-	-
	Fusion	14	16	13-14	14-15	16	17	14-17	14	16	-	-
Olecrenon	App	09-12	11-13	-	-	-	-	-	08	10	-	-
	Fusion	15	17	13-14	-	15	16	14-16	15	16	16-16 1/2	16 ½-17
Crest of ilium	App	14	17	-	-	-	-	-	14	-	15-15 ½	15 ½-16
	Fusion	17-19	19-20	-	-	-	-	14-18	15-16	18	-	-
Ischium	Fusion	8 ½	8 ½	-	-	-	-	-	7	9	-	-
Acetabulum of triradiate cartilage	Dis-appearance	14	15-16	-	-	-	-	11-14	13	15	-	-
Ischial	App	14-16	16-18	-	-	-	-	-	16	19	15 ½ -16	15 ½ -16

tuberosity	Fusion	20	20	-	-	-	-	-	-	20	-	-
	App	1	1	-	-	-	-	-	-	-	-	-
Head of femur	Fusion	14-15	16-17	13-14	15 ½ -17	-	-	14-15	14	17	-	-
	App	-	-	-	-	-	-	-	05	05	-	-
Greater trochanter	Fusion	14	17	14	16-17	-	-	14-17	14	17	15 ½ -16	15 ½ -16
Lesser trochanter	App	-	-	-	-	-	-	-	14	-	-	-
	Fusion	15-17	15-17	13	-	-	-	14-17	-	-	-	-
	App	03	04	-	-	-	-	-	02	02	-	-
1 st metacarpal	Fusion	14-15	16-18	-	-	-	-	14-17	16	18	15 ½ -16	15-15 ½
	App	3	4	-	-	-	-	-	02	02	-	-
2,3,4,5 th metacarpals	Fusion	14-15	16-18	-	-	-	-	14-17	16	18	15 ½ -16	15-15 ½
	App	1 ½	2-4	-	-	-	-	-	-	-	-	-
Proximal row	Fusion	14-15	17-18	-	-	-	-	14-17	16	17-18	15 ½ -16	16-16 ½

CONCLUSIONS

1. By radiological examination of 50 subjects in the age group of 15-17 years, it is possible to determine the age of 16 years.
2. Vegetarian and mixed group subjects do not show any difference in their physical growth and epiphyseal union.
3. No reliance can be placed on height, weight and build for the determination of age.
4. Epiphysis of iliac crest appeared between 15-15 ½ years in males and 15 ½ -16 years in females.
5. Epiphysis for ischial tuberosity appeared between 15 ½ -16 years in males and females.
6. The lowest age showing union of epiphysis of head of radius with shaft is 15 – 15 ½ years in males. In this age group no females are included in present work.
7. The epiphysis of lower end of humerus fuses early in females i.e., 15 ½ – 16 years and 16 ½ - 17 years in males.
8. Epiphysis of upper end of ulna (olecranon) fuses with shaft early in females i.e., 16 – 16 ½ years and 16 ½ - 17 years in males.
9. Fusion occurs earlier in females in epiphyses of metacarpals and proximal phalanges, when compared to males.

Females Males

First metacarpal 15 ½ - 16 years 16 ½ - 17 years. Other four metacarpals 15 ½ - 16 years 15 ½ - 16 years. Proximal phalanges 16 – 16 ½ years 16 ½ - 17 years. These observations apply to Gulbarga (Karnataka).

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