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IMPORTANCE OF RADIOLOGICAL AGE DETERMINATION IN THE SUBJECTS OF MAJOR AGE WITHOUT PROOF OF AGE IN CENTRAL INDIA

Radiodiagnosis

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ABSTRACT

The determination of the age of being a major (18 years or more) is required for the individual and the law enforcement agencies specially when the age of the person is doubtful or necessary documents are not available for confirmation of age and this becomes a task of considerable importance from the view-point of administration of justice. Radiographic changes during epiphyseal union of long bone ends are important means to determine the age of adolescent and young adults. Current radiological study mainly aims to establish whether the subject belongs to major age or not and also whether the age told by the subject corresponds to the age determined by this method or not. The study included AP radiographs of Right Shoulder, Elbow and Wrist regions of all the individuals. The study was carried out in 164 subjects including 32 (19.5%) males and 132 (80.5%) females, in the age group of 16 – 27 years who presented themselves for this purpose in L N Medical college and J K Hospital Bhopal (Central India).

Results show that the number of subjects in whom age told by them corresponds to the Radiological age is only 9.75 % while rest of the 90.25 % subjects show deviation to various extents between of age told by them and Radiological age. This shows the importance and utility of establishing age by Radiological method in subjects of age of majority who were not having the proof of age.

KEYWORDS

Epiphyseal union, Humerous, Radius, Ulna, Radiological age

INTRODUCTION :

The determination of the age of an individual is required for various purposes in India like exercising of certain privileges and restriction of certain acts and to decide various form and quantum of punishment. Unequivocal proof of age is needed for administration of justice including provision of free education to children and their protection from child labour under the provisions of fundamental rights as per constitution of India. Age of majority is very important under various Legislations in India for the purpose of entering into the marriage, entering into valid contract, getting employment, Protection of child under Juvenile Justice Act, exercise voting right, getting valid driving license etc.

Though there are various methods available for the determination of the age like Radiographic, Tooth morphology and Biochemistry, however these differ widely with respect to potential, limits and risks[1,2,3,4]. For determination of age in adolescent and young adults skeletal radiography specially that of long bones provide information about the timings of epiphyseal union. After puberty the process of growth in length of long bones stops at different ages in different parts of different long bones (except for flat bones) which is complete by the age of 20 - 22 years as described by various authors. The timing of epiphyseal union is fairly constant with minor variations among different study groups of different geographic areas [5,6,7] . Amongst all the methods of age determination, radiological examination of long bone ends has shown more accuracy, prevalence, reliability and authenticity which is not only acceptable to medical profession but also the legal fraternity[8]. For physiological and anthropological age determination the subject has to be present before examiner and even there can be a controversy and the case may need a referral for authenticity and under these circumstances again the subject has to be referred which is a tiring and expensive process while in Radiological method only the X ray images can be transmitted by any electronic media to any expert in the world and opinion can be sorted.

Present study was carried out retrospectively in the subjects who attended the department for the purpose of determination of age by radiological method. Our study aimed to determine the age by observing the status of epiphyseal fusion in the bones around shoulder, elbow and wrist in the subjects around the major age.

AIMS AND OBJECTIVES

- To assess the skeletal maturity by status of epiphyseal fusion in long bones around shoulder, elbow and wrist.
- To evaluate whether the subject belongs to major age or not by this method.
- To establish relationship in these three sites of ossification.
- To compare the age with the age told by the subject.
- To evaluate the incidence and pattern of difference in radiological age and age told by the subject in this region.

MATERIALS AND METHODS:

The study was carried out in L. N. Medical college and J K Hospital Bhopal in the subjects of central India region with the objective to assess the major age with the help of status of ossification at shoulder joint, elbow joint and wrist joint of right side during the period from 01.01.2015 to 30.06.2017. Total 164 subjects including 32 (19.5 %) males and 132 (80.5%) females between the age of 16 – 27 years reported for this purpose. The age as told by them was noted to establish the difference between this and Radiological age. It is generally accepted that there was no difference in the stage of union of various epiphysis between right and left sides, which indicates that epiphyseal union appears to occur at the same time on both sides9. AP radiographs of right shoulder, elbow and wrist were obtained in the department of Radiodiagnosis on sophisticated 100, 300 and 500 and 630 Ma machines with standard protocols. It is not possible to make a hard and fast rule for the age determination from this union for whole India because India is composed of areas which differ in climatic, dietetic and disease factors which affect skeletal growth 10. It is very important to understand that long bone epiphyseal union is not the

event what the people in general think, but it is a process for which each and every radiologist and forensic expert must give full attention assigned for the job. The epiphyseal status at the long bone ends around joints were observed and different phases of fusion were graded according to Dr William Sangma et al and Mckern and Stewart 5 stages as follows.

Stage 1 (F1): Non union-when the epiphyseal cartilage did not begin to decrease in thickness
Stage 2 (F2): Commence of union – when the thickness of epiphyseal cartilage was found to be reduced appreciably (1/4th united)
Stage 3 (F3) : Incomplete union – when the epiphysis has begun to fuse with shaft and complete union was well underway (1/2 united)
Stage 4 (F4): Complete union – when the epiphyseal cartilage was bony in architecture and its density indistinguishable from the epiphysis and diaphysis in its neighbor-hood but an epiphyseal line called epiphyseal scar could still be distinguished. (3/4 united)
Stage 5 (F5) : Complete union – with absence of epiphyseal scar.

Age told by the subject was not revealed however sex of the subject was revealed and the skeletal maturity was evaluated radiologically studying the various centers of ossification around shoulder, elbow and wrist joint and age was determined by doing comparision with the previous known standard studies conducted with special reference in central India and nearby regions in which these ossification centers were considered for age determination. [1,5,6,7,10,12,13,14].

Age of stage-wise fusion at these locations in males and females are well described in textbooks and previous documented studies including those done in central India and in Mumbai region which considered various locations of epiphyseal union. The study done by Saxena J S and Vyas S K included Epiphyseal union at the wrist, knee and iliac crest in residents of Madhya Pradesh [12], another study done previously in Mumbai region by Homi S. Mehta 1, yet another by S.S.Bhise , B G Chinchalkar, S D Nanandkar and G S Chavan [5] who studied Union around wrist joint and hand and yet another by S S Bhise and S D Nanandkar 10 who included fusion around elbow joint . These textbooks and studies were available and considered in our study. The well established fact that all the centers in females mature 1-2 years earlier than males was also considered1, [7.] Evaluation of proximal humeral epiphysis closure is important after closure of hand and wrist bone epiphysis just before evaluation of iliac crest and ischion apophyses [15]. In our study three areas of epiphyseal union of upper limb were included to achieve more accuracy and lesser chances of error. In our study the status of epiphyseal fusion at proximal end of humerous, bones around elbow and lower ends of radius and ulna were considered [16].

In most of the studies done in India previously following trend of fusion of epiphysis was observed and our observations were made on their basis:

At elbow the complete union of epiphysis is seen by 16-17 years in males and 15-16 years in females. In our study complete union of epiphysis is seen in all the subjects as lowest radiological age of a female in our series was 16 years and that of male was 16.5 years.

Similarly fusion of distal end of ulna is reported to be in stage of near fusion in males the age group of 16-17 and 17-18 where as in age group of 17-18 and 18-19 and onwards majority of subjects show complete fusion.

Fusion of distal end of ulna is reported to be in stage of near fusion in females the age group of 15-16 and 16-17 where as in age group of 16-17 and 17-18 and onwards majority of subjects show complete fusion.

Distal end of radius showed near fusion in males in age group of 15-16 and 16-17 where as in age group of 16-17 and 17-18 and onwards show complete fusion. Distal end of radius showed near fusion in females in age group of 15-16 and 16-17 where as in age group of 17-18 onwards show complete fusion.

It is suggested that if the humeral epiphysis is fused the bone age will be [19]. However in females this time is about one year earlier.

(The present study shows that the fusion at given centers show relatively earlier fusion about 1 year in Muslims as compared to Hindu population which can be attributed to the dietary habits.)

RESULTS: TABLE 1: AGE DISTRIBUTION OF THE SUBJECTS (Considered age told by the subjects)

AGE	16	17	18	19	20	21	22	23	24	25	26	27
NUMBER	1	1	34	38	34	26	16	6	5	1	1	1

The distribution of age of the subject as told by them who reported is shown in table 1 which reveals that the youngest subject was of 16 years of age while oldest was 27 years of age. Maximum number of subjects who reported for this purpose were in the age group of 18 – 22, 148 (90.24%).

TABLE 2: SEX AND RELIGION DISTRIBUTION OF SUBJECTS

	HINDU	MUSLIM	TOTAL
MALES	032 (19.5 %)	0	032 (19.5 %)
FEMALES	126 (76.82 %)	6 (3.65 %)	132 (80.5 %)
GRAND TOTAL	158 (96.34%)	6 (3.65 %)	164

The distribution of sex and religion of the subjects in our study is shown in table 2 which reveals that out of total 164 subjects 32 (19.5 %) where males and all where Hindu. 132 (80.5 %) where females out of which 126 (76.82 %) where Hindu and 6 (3.65 %) where Muslim. In our study no Muslim male reported for this purpose.

TABLE 3 :STATE-WISE DISTRIBUTION OF SUBJECTS IN CENTRAL INDIA

STATE	MADHYA PRADESH	MAHARASHTRA	UTTAR PRADESH	TOTAL
NUMBER	146 (89.02%)	6 (3.65 %)	12 (7.3%)	164

Our study covered the subjects from central India and table 3 depicts the distribution of subjects reported from various parts of central India. It reveals that 146 (89.02 %) subjects were from Madhya Pradesh, 12 (7.3 %) from adjacent parts of Uttar Pradesh and 6 (3.65 %) from adjacent parts of Maharashtra.

TABLE 4: DEVIATION OF RADIOLOGICAL AGE IN CORRELATION WITH AGE TOLD BY THE SUBJECT

SEX AND RELIGION AGE DIFFERENCE	MALES		FEMALES		TOTAL
	HINDU	MUSLIM	HINDU	MUSLIM	
RAD. AGE SAME AS TOLD BY SUBJECT	5 (3.04%)	0	10 (10.08%)	1 (0.6%)	16 (9.75%)
RAD. AGE 6 MONTHS MORE THAN TOLD BY SUBJECT	0	0	15 (9.14%)	0	15 (9.14%)
RAD. AGE 1 YR MORE THAN TOLD BY SUBJECT	3 (1.82%)	0	11 (6.7%)	0	14 (8.53%)
RAD. AGE 6 MONTHS LESS THAN TOLD BY SUBJECT	5 (3.04%)	0	34 (20.73%)	2 (1.21%)	41 (25%)
RAD. AGE 1 YEAR MORE THAN TOLD BY SUBJECT	6 (3.65%)	0	12 (7.3%)	1 (0.6%)	19 (11.58%)
RAD. AGE 1.5 YEAR MORE THAN TOLD BY SUBJECT	2 (1.21%)	0	12 (7.3 %)	2 (1.21 %)	16 (9.75 %)
RAD. AGE 2 YEAR MORE THAN TOLD BY SUBJECT	12 (7.3%)	0	31 (18.9 %)	0	43 (26.21%)

There are various types and ranges of deviation observed between the radiological age determined by our study and the age told by the subjects. This is depicted in table [4].

In our study it was observed that there was no difference in the age told

by the subject and the Radiological age in 16 (9.75%) subjects. Out of this 5 (3.04%) were Hindu males, 10 (6.09 %) were Hindu females and 1 (0.6%) was Muslim female.

15 (9.14 %) subjects were 6 months more by radiological age as compared to the age told by them and all of them were Hindu females. 14 (8.53%) subjects were 1 year more by radiological age as compared to age told by them. Out of this 3 (1.82%) were Hindu males and 11 (6.7 %) were Hindu females.

Next category is of those subjects who had shown radiological age lesser than the age told by them. In 41 (25 %) subjects the radiological age was 6 months less than the age told by them which includes 5 (3.04 %) Hindu males, 34 (20.73 %) Hindu females and 2 (1.21 %) Muslim females.

In 19 (11.58 %) subjects the radiological age was 1 year less than the age told by them which includes 6 (3.65 %) Hindu males, 12 (7.3%) Hindu females and 1 (0.6 %) Muslim female.

In 16 (9.75 %) subjects the radiological age was 1.5 years less than the age told by them which includes 2 (1.21 %) Hindu males, 12 (7.3 %) Hindu females and 2 (1.21 %) Muslim female.

In 43 (26.21 %) subjects the radiological age was 2 years (or more) less than the age told by them which includes 12 (7.3 %) Hindu males and 31 (18.9%) Hindu females.

DISSCUSION :

In India many provisions are there in the Constitution and many Legislations are also there which require proof of age for the age of majority – 18 years.

In Constitution of India as per amended Article 21, 21A the minimum compulsory age of education is fixed as 14 years. Another fundamental right is prohibition of employment of Children in Factories: No child below the age of fourteen years shall be employed to work in any factory or mine or engaged in any other hazardous employment.

Child labour and contract act, 1872: Employing children below 18 is basically against the fundamentals of general contrast Act. Employment of a child is a contract and the child is not capable of entering into contract until he/she did not attain age of majority, 18 years according to Section 11 of Indian Contract Act, 1872.

Age of Majority: According to Section 3, Indian Majority Act, 1875, "every person domiciled in India shall be deemed to have attained his majority when he shall have completed his age of eighteen years and not before. Same section provides that where a guardian is appointed for the property of the minor, the minor is deemed to have attained majority when he shall have completed his age of twenty one and not before.

Contracts for Necessaries: Under the Common Law an infant was a person under 21 years of the age. By the Family Law Reform Act, 1969, every person under `eighteen years of age` is a minor.

Age of capacity to marry: The age of capacity to contract a marriage is 18 years for a girl and 21 years for a boy, for all communities. The child Marriage Restraint Act , 1929, defines a child as a person who, if male, has not completed 21 years of age, and is a female, has not completed 18 years of age. Under section 5 of this Act whoever performs, conducts or directs any child marriage shall be punishable.

Infancy and Criminal liability: According to Criminal law under Indian Penal Code, section 82, considers that the child up-to 12 is not capable of commuting an offence while section 83 says nothing is an offence which is done by a child who has not attained sufficient maturity of understanding to judge the nature and consequence of his conduct on that occasion. Thus there is total immunity from criminal responsibility up to the age of 7 and from 7 to 12 years the liability depends upon the capacity of understanding of the child. From 12 to 18 years, though the liability is not conditional, the Juvenile Justice Act provides for a care and protection of the rights of child in conflict with Law.

Age of consent for Sexual Acts: Section 375 Indian Penal Code considers age of 16 years as the right age of consent to decide the criminality of the offence of rape. In the case of marriage, sex with a female of 16 years or younger is considered rape under this Section 375 except in the Territory of Manipur where this age is [14].

Voting and Expression: In India the age of Voting is 18 years at which a child can vote in government elections. Even if children are too young to vote, they have right to have opinions. With reference to expression of opinion and giving evidence, there is no incapacity prescribed based on infancy. According to section 118 of Indian Evidence Act, all persons shall be competent to testify unless the court considers that they are not capable of understanding the questions because of tenderness of age etc. Law did not prescribe any age limitation but provides entire discretion to the judge to evaluate the capacity of each person based on the tenderness of age.

If the documents or the proof of the age are not available, poorly maintained or records are deliberately manipulated, it is not possible to rely upon the age told by the individual or on presented age document. There is also a possibility that the lawyers under pressure of winning the case can exploit the condition of the age to favour his client, ignoring the dispensation of justice. Under these circumstances a proven and reliable method for age determination is required. Radiological study of the bones to observe their ossification activity has long been used by various authors, throughout the globe for age estimation with promising results[11].

Current study which is performed in central India revealed that the number of female 132 (80.5%) subjects reporting for this purpose were significantly higher (about four times) as compared to males 32 (19.5 %). The maximum number of subjects reported between the age of 18 – 22 years, which where 148 (90.24%). 16 (9.75%) subjects shown no deviation in the age told by the subject and that established by this radiological method while age of 15 (9.14%) subjects was 6 months more than the age told by them and age of 14 (8.53%) subjects was about 1 year more than the age told by them. 41 (24 %) subjects shown radiological age 6 months less than the age told by them, 19 (11.58%) subjects shown age 1 year less than the age told by them, 16 (9.75%) subjects shown age 1.5 years less than age told by them and 43 (26.21 %) subjects shown age 2 years (or more) less than the age told by them.

Study clearly depicts that in only a small number of subjects (9.75 %) the radiological age was consistent with the age told by the subjects while in 90.25 % subjects there was a difference to various extents in radiological age and age told by them. Radiological age of 17.67 % subjects was 6 months to one year more than the age told by the subjects while Radiological age of 62.19 % subjects was 6 months (or more) lesser than the age told by the subjects. 33 % subjects showed a difference of 6 months on either side between the Radiological age and age told by them while 57.25 % subjects showed a difference of one year or more on either side between the Radiological age and age told by them. It is also observed that out of 96.34 % Hindu subjects female subjects (76.82 %) were many times more than the males (19.5%). Similarly out of 3.65 % Muslim subjects all were females and no Muslim male reported for this purpose.

CONCLUSION :

The purpose of the determination of age in this study was to establish the age of being major (18 years) in the subjects without having the proof of age. Radiographs of upper end of humerous bones around elbow and lower ends of radius and ulna were considered for this purpose and observed for the status of epiphyseal fusion to get more accuracy. Considering the standard studies done before, the Radiological age of the subjects was determined which shows that only a small number of subject told the correct age (9.95 %) while in rest of the 90.25 % of the subjects there was a difference to various extents in Radiological age and age told by them. which is statistically significant finding. 33 % subjects showed a Difference of 6 months of age on either side between the Radiological age and age told by subjects while 57.25 % subjects showed a difference of one year or more on either side between the Radiological age and age told by them which is also significant from the statistical point of view. Surprisingly majority of subjects were females from Hindu population and males were less while no Muslim male reported for this purpose. This is probably due to attitude of the society.

After the observations the conclusion was made and results strongly suggested that radiographic age determination in this age group is of great value in context to provisions under the constitution of India and

various legislations for various purposes related to age in India.

The observations and results of this study would be helpful not only to the Medical professionals but also Law enforcement agencies, Bar, Bench and even the public at large.

SHOULDER AP - NO FUSION

SHOLDER AP – PARTIAL FUSION

SHOLDER AP PARTIAL FUSION

VARIOUS STAGES OF FUSION OF EPIPHYSIS AT PROXIMAL END OF HUMEROUS

SHOLDER AP – FUSION LINE SEEN

SHOLDER AP – FAINT FUSION LINE

SHOULDER – COMPLETE FUSION

VARIOUS STAGES OF FUSION OF EPIPHYSIS AT PROXIMAL END OF HUMEROUS

SHOLDER AP – COMPLETE FUSION - NO FUSION LINE

ELBOW – COPMLETE FUSION

ELBOW COMPLTE FUSION

EPIPHYSES AT ELBOW SHOW COMPLETE FUSION IN ALL SUBJECTS

WRIST - PARTIAL FUSION

WRIST – NO FUSION

VARIOUS STAGES OF FUSION OF EPIPHYSIS AT DISTAL ENDS OF RADIUS AND ULNA

WRIST NEAR COMPLETE FUSION

WRIST COMPLETE FUSION

WRIST COMPLETE FUSION

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