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Original Article

Age Estimation in 14-20 Years of Age by Radiological Study of Wrist Joints and Pelvic Bones (A Jaipur-Based Study)

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ABSTRACT

Scientific estimation of age is required both in civil and in criminal cases. It is not only required in living subjects but is also required in dead bodies and even in skeletal remains to establish the identity. In living subjects, estimation of age is done by physical, dental and radiological examinations. As opinion on physical examination is inaccurate and eruption of teeth is also completed by 16 years of age (except the third molar teeth), much reliance is given to the radiological epiphyseal union of long bones. This study was carried out on 100 subjects (55 boys and 45 girls) at the S.M.S. Hospital, Jaipur. These subjects belonged to age group of 14-20 years. Their ages were confirmed by birth certificates and school records. Subjects were selected after ruling out any developmental, nutritional and endocrinal abnormalities, which affect skeletal growth. Data observed were analysed and compared with the previous studies in India and abroad.

Keywords: Age Estimation, Epiphyseal Union

INTRODUCTION

Estimation of a reasonably accurate age plays an important role in both civil and criminal cases like personal identification, fixing of criminal responsibility, judicial punishment, rape, kidnapping, employment, attainment of majority, marriage contract and pension settlement. Extensive studies have been carried out for age estimation by bony union in India and abroad. From these studies, it is found that there is a variation in the timing of union of epiphysis of bones and this is attributed to factors like climate, heredity, race, nutrition, dietary habit, gender and socioeconomic status of the population.

The Central Government appointed a Survey Committee[1], which recommended that regional data are important and zone-wise study should be conducted. Keeping in view the above facts, this study was undertaken to explore the pattern of diaphysis–epiphyseal union at the wrist joints and pelvic bones in the growing population of Jaipur region. It is presumed that such a study may aid in the degree of accuracy in the existing protocol by incorporating the data analysed in local circumstances.

AIMS AND OBJECTIVES

The aims and objectives of this study are as follows:

1. To access the general maturity for a known chronological age in both genders.
2. To study the average age of fusion of ossification centres around the wrist joints and pelvic bones.
3. To conduct a comparative study of fusion of ossification centres at the wrist joints and pelvic bones in boys and girls.
4. To conduct a comparative study of fusion of ossification centres at the wrist joints and pelvic bones in boys and girls with available data of previous works carried out in India.

5. To conduct a comparative study of fusion of ossification centres at the wrist joints and pelvic bones in boys and girls with previously available foreign data.

MATERIALS AND METHODS

This study was carried out at the Department of Forensic Medicine and Toxicology, S.M.S. Medical College and Hospital, Jaipur. Subjects were selected randomly from the S.M.S. Medical College, Nursing College and various schools of Jaipur.

Selection criteria for inclusion of persons in this study

For selection of subjects, the following facts were recorded and considered:

1. They should be living in Jaipur region for more than 5 years.
2. They should not have any physical disabilities or endocrinal disorders.
3. They must be with an accurate record of date of birth.
4. Informed verbal consent of all subjects was taken before proceeding to their physical, dental and radiological examinations.

The persons selected for study were grouped as per their stated age, *viz*. 14-15 years, 15-16 years, 16-17 years, 17-18 years, 18-19 years and 19-20 years.

Age, as stated by them, was further confirmed by their birth certificates, school records and secondary school certificates. Persons belonging to the above age groups were included in this study, irrespective of their socioeconomic, religious and educational status.

After obtaining their informed verbal consent for their clinical and radiological examinations, their physical examination was conducted at the Department of Forensic Medicine and X-ray examination for the wrist joints and pelvic bones was conducted at the Department of Radio-Diagnosis, S.M.S. Hospital, Jaipur.

Skiagrams were then studied in detail in reference to various ossification centres, their appearances, process of fusion and post-fusion scarring.

Radiological criteria for epiphyseal fusion

The union is taken as complete when:

1. The diaphysis–epiphyseal space is completely obliterated and becomes bony in architecture and density.
2. There is continuity of the periosteum between epiphysis and diaphysis with no notching at the periphery of the epiphyseal line.
3. The presence or absence of the epiphyseal scar (a white, transverse line) has been disregarded in this connection and is considered as a recent complete union.

For generalisation, fusion in more than 75% cases is considered complete.

Data Collection

Radiological data of appearance and fusion of various ossification centres were reduced to tables of various age groups along with other physical data noted previously. These data were once again examined by experts in forensic medicine and radio-diagnosis. Data thus obtained finally were analysed and compared with the published Indian and foreign works.

OBSERVATION AND DISCUSSION

This study was conducted on 100 subjects (55 boys and 45 girls) falling in the age group of 14-20 years. In school-going cases, age was confirmed from school records and for students of college age, age was verified by secondary school certificates. All subjects were bona fide residents of Rajasthan and were residing in Jaipur for more than 5 years and were also free from physical and mental illnesses, disabilities and endocrinal disturbances.

Physical and dental examinations were conducted at the Department of Forensic Medicine and radiological examination was conducted in the Radio-Diagnosis Department of S.M.S. Medical College Hospital, Jaipur.

Findings of the same were recorded in the Master Chart.

Table 1 shows that in males, the fusion of epiphysis of the lower end of radius occurs in the 18-19 years age group. These findings are in accordance with those of Flecker[2], Kothari[3] and Reddy[4] and not in accordance with the findings of Paterson[5], Galstaun[6], Davies and Parsons[7], Lall and Nath[8] and Nandy[9].

Table 2 shows that in females, the fusion of epiphysis of the lower end of radius occurs in the 17-18 years age group. These findings are in accordance with those of Flecker[2], Franklin[10], Kothari[3] and Saxena and Vyas[11], whereas these findings are not in accordance with those of Hepworth[12], Galstaun[6], Basu and Basu[13], Paterson[5], Davies and Parsons[7] and Sidhom and Derry[14].

Table 1 shows that in males, the fusion of epiphysis of the lower end of ulna occurs in the 18-19 years age group. These findings are in accordance with those of Flecker[2], Kothari[3], Reddy[4], Nandy[9] and Galstaun[6] and not in accordance with those of Paterson[5], Davies and Parsons[7], Lall and Nath[8] and Das Gupta *et al*.[15].

Table 2 shows that in females, the fusion of epiphysis of the lower end of ulna occurs in the 17-18 years age group. These findings are in accordance with those of Flecker[2], Franklin[10], Kothari[3], Saxena and Vyas[11], Nandy[9] and Galstaun[6], whereas these findings are not in accordance with those of Basu and Basu[13], Paterson[5], Davies and Parsons[7] and Lall and Townsend [16].

Table 3 shows that in males, the centre of ossification of the Iliac crest appears in the 14-17 years age group and the fusion at the iliac crest occurs at the age of 19-20 years. These findings are consistent with those of Galstaun[6] and Nandy[9], whereas these findings are not in accordance with those of Flecker[2], Davies and Parsons[7] and Das Gupta *et al*.[15].

Table 4 shows that in females, the centre of ossification of the Iliac crest appears in the 14-17 years age group and the fusion at the iliac crest occurs at the age of 18-19 years. These findings are consistent with those of Galstaun[6] and Nandy[9], whereas these findings are not in accordance with those of Flecker[2], Davies and Parsons[7], Das Gupta *et al*.[15] and Pillai[17].

Table 3 shows that in males, the centre of ossification of the ischial tuberosity appears in the 16-17 years age group and the fusion at ischial tuberosity occurs at the age of 19-20 years. These findings are consistent with those of Galstaun[6], Flecker[2] and Nandy[9].

Table 4 shows that in females, the centre of ossification

Table 1: Progress of Epiphyseal Union at the Wrist Joints in Boys

Name of Epiphysis	Different age group showing percentage fusion					
	14-15 years	15-16 years	16-17 years	17-18 years	18-19 years	19-20 years
Distal end of radius	0	0	30	50	100	100
Distal end of ulna	0	10	60	60	100	100

Table 2: Progress of Epiphyseal Union at the Wrist Joints in Girls

Name of Epiphysis	Different age group showing percentage fusion					
	14-15 years	15-16 years	16-17 years	17-18 years	18-19 years	19-20 years
Distal end of radius	0	0	43	100	100	100
Distal end of ulna	0	0	43	100	100	100

Table 3: Progress of Epiphyseal Union around the Pelvis in Boys

Name of Epiphysis	Different age group showing percentage fusion					
	14-15 years	15-16 years	16-17 years	17-18 years	18-19 years	19-20 years
Iliac crest	66(A)	**100 (A)**	**100 (A)**	30 (F)	63 (F)	100 (F)
Ischial tuberosity	NA	40 (A)	70 (A)	90 (A)	63 (F)	88 (F)

NA= Not Appeared, A = Appeared, F = Fused

Table 4: **Progress of Epiphyseal Union around the Pelvis in Girls**

Name of Epiphysis	Different age group showing percentage fusion					
	14-15 years	15-16 years	16-17 years	17-18 years	18-19 years	19-20 years
Iliac crest	66(A)	**100 (A)**	**100 (A)**	25 (F)	78 (F)	100 (F)
Ischial tuberosity	33 A	71 (A)	100 (A)	100 (A)	33 (F)	75 (F)

A = Appeared, F = Fused

of ischial tuberosity appears in the 15-16 years age group and the fusion at ischial tuberosity occurs at the age of 19-20 years. These findings are consistent with those of Galstaun[6] and Nandy[9].

CONCLUSIONS

On the basis of observation and discussion of this study, it is found that in females, the fusion occurs earlier as compared with males by about 1 year at the wrist joints and pelvis. It is also found that as compared with European studies, this study shows the earlier fusion of epiphysis around the wrist joints and pelvis. As compared with studies conducted in other states of India, it is found that in this study, fusion occurs earlier in U.P. and later in Bengal and Punjab.

Hence, it is recommended that more and more zone-wise studies should be conducted as such studies may aid in the degree of accuracy by incorporation of the data analysed under local circumstances.

REFERENCES

1. Survey Committee. Survey Committee report on medico-legal practice in India. Ministry of Health 1964; 63.
2. Flecke H. Roentgenographic observations of the time of appearance of the epiphyses and their fusion with diaphyses. J Anat 1933; 67: 118-164
3. Kothari DR. Age of epiphyseal union at the elbow and wrist joint in Marwar region of Rajasthan. J Indian Med Asso 1974; 63: 8-16
4. Reddy KSN. Identification. The Essential of Forensic Medicine and Toxicology, Edition 24th K. Sugna Devi, Hyderabad 2007; p- 54-66.
5. Paterson RS. Radiological investigation of the epiphyses of long bones. J Anat 1929; 64: 28-46.
6. Galstaun GA. Study of ossification as observed in Indian subjects. Indian J Med Research 1937; 25: 267-324.
7. Davies DA, Parsons FG. The age order of the appearance and union of normal epiphyses as seen by X – rays. J Anat 1972; 62: 58-71.
8. Lall R, Nath BS. Ages of epiphyseal union at the Elbow and Wrist joint amongst Indians. Indian J Med Research 1934; 4: 683-687.
9. Nandy A. Principles of Forensic Medicine and Toxicology., Edition 2nd New Central Book Agency (P) Ltd, Calcutta, 2005; p-58-73.
10. Franklin CA. Age estimation from epiphyseal union at wrist and elbow in females of Vidarbha, Thesis for M D (Forensic Medicine) KG Medical College, Lucknow, 1962.
11. Saxena JS, Vyas, SK. Epiphyseal union at wrist, knee and Iliac crest in residents of M.P. J Indian Med Asso 1969; 53: 67-68.
12. Hepworth SM. Determination of age in Indians from study of ossification of long bones. Indian Med Gazette 1929; 64: 128.
13. Basu SK, Basu S. The age order of epiphyseal union in Bangali girls. J Indian Med Asso 1938; 571.
14. Sidhom G, Derry DE. Dates of union of some epiphyses in Egyptian from X–ray photographs. J Anat 1931; 65: 196-211.
15. Das Gupta et al. A roentgenologic study of epiphyseal union around elbow, wrist, knee joints and pelvis in boys and girls of U.P. J Indian Med Asso 1974; 62: 10-12.
16. Lall R, Townsand RS. Ages of epiphyseal union at the elbow and wrist joints amongst Indian girls. Indian Med Gazette 1939; 74: 614.
17. Pillai MJS. The study of epiphyseal union for determining the age of South Indians. Indian J Med Research 1936; 23: 1015-1018.