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*Original article*

# Assessment of age in adolescents by Radiological examination of pelvis & hip joint

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## ABSTRACT

Age estimation is an important exercise undertaken in clinical forensic medicine for various civil & criminal purposes. In developing country like India, paucity of reliable documentary evidences like birth certificate, board certificates makes this job even more important. Non availability of reliable local data for estimation of age is an incriminating factor for miscarriage of justice. Hence this study was undertaken to assess the age of adolescents by radiography.

**KEYWORDS:** Radiological, age assessment, adolescents, pelvis

## INTRODUCTION

Estimation of age in adolescent is an important medico-legal task for forensic experts as criminal responsibility of an Indian citizen starts from the age 12 & children below the age of 18yrs are considered juvenile & hence dealt under special laws. This has achieved even more significance evident by a rise in juvenile delinquency of late in India[1]. In such cases of, alleged accused is brought to Govt. Hospital for estimation of age. Most preferred method of estimation of age is using eruption of teeth but after the age of 14yrs i.e. eruption of 2nd molars, there is no other

method to determine age except using X-ray either of teeth or bones. X-rays taken are interpreted from studies published in standard books, most of which are based on studies done abroad. Thus a need was felt to have a local regional data regarding radiological findings in adolescents.

Children in the age group of 13 to 19yrs are considered adolescents[2]. But considering medico-legal importance of age 12 to 18yrs, only this age group is studied.

**Objectives**

1. To find degree of appearance and/or fusion of epiphyseal centres of pelvis at certain age
2. Compare the findings of present study with other similar studies conducted

**MATERIALS AND METHODS**

The 300 subjects for the present study consist of 150 boys and 150 girls, selected by random sampling. The subjects were examined after obtaining informed consent.

*Inclusion Criteria*

Individuals with known date of birth with documentary evidences like municipal birth certificate, hospital birth certificate or school Certificate of the age

*Exclusion criteria*

Individuals with chronic illness or ill health at the time of study

Individuals with history of fracture around hip joint

*Method*

The X-rays of right hip joint were taken in antero-posterior view using a factor of 50 KVP and 8 MAS. The subjects were asked to lie down in supine position for X-ray. Adequate precautions were taken to avoid unnecessary X-ray exposure of subjects and staff.

The staging of epiphyseal union was done as follows :Sankhyan[3]

| Stage | Characteristics | Grade |
|---|---|---|
| Stage I | Center has not appeared | NA |
| Stage II | Center has appeared but there is no union | A |
| Stage III | Union has started but there is incomplete union | + |
| Stage IV | Recent union | ++ |
| Stage V | Old union | +++ |

## OBSERVATION:

The study was conducted in 300 study subjects in the age group of 12 to 18yrs. For ease of comparison and analysis, the study subjects were taken in equal proportion i.e. each age group had 50 members (25 males & 25 females). – Table:1

Stages of appearance and fusion of the various epiphyses of the pelvis and upper end of femur which were studied to estimate the age in this study are depicted in Table 2 & 3.

The triradiate cartilage was obliterated completely in females by the age 15-16yrs whereas in males it followed in the consecutive year. The ischial tuberosity & the iliac crest made their appearance on roentogenogram by 12-13yrs in both males & females but complete appearance in all subjects was evident by the age of 15-16yrs in females & 16-17yrs in males. Pubis appeared earlier than ischial tuberosity & iliac crest i.e. by 15-16yrs in both males & females.

Thus it can be inferred from the table 2 and 3 that appearance and fusion of the epiphyses occur earlier in females compared to males.

Table 1: Age and sex wise distribution of the subjects

| **Age Group** | **Male (No. = 150)** | | **Female (No. = 150)** | |
|---|---|---|---|---|
| | Number | Percentage | Number | Percentage |
| **12 – 13 years** | 25 | 50.00 | 25 | 50.00 |
| **13 – 14 years** | 25 | 50.00 | 25 | 50.00 |
| **14 – 15 years** | 25 | 50.00 | 25 | 50.00 |
| **15 – 16 years** | 25 | 50.00 | 25 | 50.00 |
| **16 – 17 years** | 25 | 50.00 | 25 | 50.00 |
| **17 – 18 years** | 25 | 50.00 | 25 | 50.00 |
| **Total** | 150 | 100.00 | 150 | 100.00 |

Table 2: Stages of appearance and fusion of Triradiate cartilage & Ischial tuberosity

| | 12-13Yrs (n=50) | | 13-14Yrs (n=50) | | 14-15Yrs (n=50) | | 15-16Yrs (n=50) | | 16-17Yrs (n=50) | | 17-18Yrs (n=50) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **M** | **F** | **M** | **F** | **M** | **F** | **M** | **F** | **M** | **F** | **M** | **F** |
| **Triradiate cartilage** | | | | | | | | | | | | |
| NF | 10 | 0 | 9 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| + | 9 | 13 | 9 | 3 | 12 | 7 | 8 | 0 | 0 | 0 | 0 | 0 |
| ++ | 6 | 12 | 3 | 22 | 6 | 10 | 7 | 10 | 6 | 2 | 0 | 0 |
| +++ | 0 | 0 | 4 | 0 | 4 | 8 | 10 | 15 | 19 | 23 | 25 | 25 |
| **Ischial tuberosity** | | | | | | | | | | | | |
| NA | 22 | 16 | 22 | 13 | 15 | 8 | 7 | 0 | 0 | 0 | 0 | 0 |
| A | 3 | 9 | 3 | 12 | 10 | 17 | 18 | 21 | 22 | 16 | 13 | 3 |
| + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 3 | 9 | 8 | 13 |
| ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 7 |
| +++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |

Table 3: Stages of appearance and fusion of Iliac crest & Pubis

| | 12-13Yrs (n=50) | | 13-14Yrs (n=50) | | 14-15Yrs (n=50) | | 15-16Yrs (n=50) | | 16-17Yrs (n=50) | | 17-18Yrs (n=50) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **M** | **F** | **M** | **F** | **M** | **F** | **M** | **F** | **M** | **F** | **M** | **F** |
| **Iliac crest** | | | | | | | | | | | | |
| NA | 22 | 16 | 19 | 6 | 12 | 2 | 4 | 0 | 0 | 0 | 0 | 0 |
| A | 3 | 9 | 6 | 19 | 13 | 23 | 21 | 20 | 23 | 17 | 2 | 3 |
| + | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 2 | 8 | 18 | 11 |
| ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 8 |
| +++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 |
| **Pubis** | | | | | | | | | | | | |
| NA | 19 | 9 | 16 | 9 | 6 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| A | 6 | 16 | 9 | 16 | 19 | 22 | 24 | 19 | 18 | 12 | 13 | 1 |
| + | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 6 | 7 | 11 | 8 | 14 |
| ++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 6 |
| +++ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |

## DISCUSSION

In the present study, the age of appearance or fusion of an epiphyseal center can be ascertained as follows

| Ossification Centre | Males | Females |
|---|---|---|
| Triradiate cartilage | F: 16-17yrs | F: 15-16yrs |
| Ischial tuberosity | A: 16-17yrs | A: 15-16yrs |
| Iliac crest | A: 16-17yrs | A: 15-16yrs |
| Pubis | A: 15-16yrs | A: 15-16yrs |

On comparison with other similar studies by Indian authors, (Table:4) it is evident that the findings of the present study were more or less in agreement with findings of Sankhyan[3](1993), Alok Kumar[4](2004) & Shilajiya[5](2011) but was far from near to the findings of Galstaun[6](1930), Pillai[7](1963) & Singh[8](2011).

Table 4: Comparison of present study with other Indian studies

| **Ossification centres** | **Present Study (Karnataka)** | | **Galstaun (WB)** | | **Pillai (South India)** | **Sankyan (HP)** | | **Alok Kumar (UP)** | | **Shilajiya (Gujarat)** | | **Singh (Pune)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M | F | M | F | | M | F | M | F | M | F | F |
| **Triradiate cartilage** | F:16-17yrs | F: 15-16yrs | F: 15-16yrs | F: 14yrs | F: 11-14yrs | F: 15.5-17.5yrs | F: 13.5-15.5yrs | F: 15-16yrs | F: 15-16yrs | F: 16-17yrs | F: 14-15yrs | |
| **Ischial tuberosity** | A: 16-17yrs | A: 15-16yrs | A: 16-18yrs | A:14-16yrs | | | | A: 17-18yrs | A: 15-16yrs | | | |
| **Iliac crest** | A: 16-17yrs | A: 15-16yrs | A: 17yrs | A:14yrs | A:14-18yrs | | | A: 16-17yrs | A: 15-16yrs | | | F: 17yrs |
| **Pubis** | A: 15-16yrs | A: 15-16yrs | | | | | | | | | | |

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