

Original Research Paper

Age Estimation from Distal End of Tibia Epiphysis

*Pardeep Singh, **Virendar Pal Singh, ***R.K. Gorea, ****S.S. Oberoi, *****S. Asawa

Abstract

Identification of an individual, whether living or dead can be done by many techniques. Age estimation of living is one of the most important issues for the courts as well as for the medicolegal experts. The identification of a living person is based on known finger prints, birth marks, characteristic gestures, movements, shape and other features of the teeth, eyes, hair or voice but these are susceptible to mistakes. Photographs and handwriting may also help in the identification of a living person. This significant oversight can lead to exclusion of persons of interest in a Forensic investigation.

The range of variation in epiphyseal fusion in Punjabi population has not been sufficiently established. The present study was undertaken on 100 individuals from Punjab (50 males and 50 females) between the age group of 16 to 25 years. Radiological examination of ankle joint was done to know the age at which epiphyseal fusion of the distal end of tibia takes place. The study showed that in males in age group 16-17 years, the centre appeared but no union occurred in three cases (30%), and in five cases (50%) complete union occurred. In all other age groups studied, complete union occurred in 100 % of the cases. In females, complete union of the epiphyses at distal end of tibia and fibula occurred in all the age groups studied.

Key Words: Epiphyseal fusion, X- ray, Age Estimation, Identification

Introduction:

The establishment of any person's identity, whether living or dead has been a challenging task since ages. More effective and accurate methods of personal identification are constantly being sought. The initial methods of personal identification involved verbal description of suspects and criminals.

It is claimed that the ancient Egyptians and some early Chinese civilizations applied painstaking approaches for describing the physical characteristics of wanted criminals and prisoners. The practice of branding some convicted criminal offenders was widespread in Europe, Asia and the Americans in the past centuries as means of permanent identification e.g. the rod 'A' was sometimes used to brand adulterer in colonial times.

The first scientific method of criminal identification was developed by Alphonse Bertillon of the Paris criminal investigations department in 1880. [1] The identification of a dead body is required in cases of fires, explosions, accidents, foul play etc.

Identification of a dead body victim often enables the police to trace the victim's movements, discover his background, talk to his friends and uncover his enemies. [2]

To narrow the wide age range union of epiphysis of bones in present study is done with the help of fusion of epiphysis in distal end of tibia. Age of each individual studied was confirmed from birth certificate, service record, driving license, passport, ration card or voter's card etc.

Material and Methods:

In present study, 100 cases were studied including both males and females. The cases studied were between age group of 16-25 years who were exposed to x-ray at Rajindra Hospital, Patiala.

Male and Female individuals were studied with age interval of two years and ten cases from each age interval were taken.

The cases were studied with the help of X-ray of ankle joint- antero-posterior view for distal end of tibia. Status of epiphyseal union was divided into following four stages (Table A)

Corresponding Author:

**Associate Professor,
Department of Forensic Medicine
Dayanand Medical College, Ludhiana, Punjab
E-mail:singhvp@gmail.com
*Assoc. Prof, People's College of Medical Sciences,
Bhopal
***Director Principal,
Guru Nanak Mission Medical College & Hospital,
Dhahan Kaleran, Distt SBS Nagar, Punjab 144505
****Adl. Prof, GMC, Patiala
*****Prof & HOD, PCMS, Bhopal
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Table A: Stages of Epiphyseal Union

| Stage | Appearance and fusion | Grade |
|-------|------------------------------|-------|
| I | Centre not appeared | A |
| II | Centre appeared but no union | + |
| III | Union started but incomplete | ++ |
| IV | Complete union | +++ |

Study has been carried out by Roentgenographic technique. The technique included standardization of -

1. Time of exposure
2. Positioning of the part
3. Distance of film from X- Ray tube and
4. Processing and time of developing the films.

Positioning of the Epiphysis during X- Ray:

Clark's radiographic technique (3) has been followed in this investigation

AP view for Ankle joint-

1. Positioning of Patient and Film: The patient should be lying supine or seated with support and with a small sandbag under the knees to allow slight flexion for comfort. A non-opaque pad under the tendo-calcaneus serves to prevent discomfort due to pressure of the heels on the couch.

The ankle is supported in dorsi-flexion and the limb rotated medially until the medial and lateral malleoli are equidistant from the film thus ensuring a clear joint space on the radiograph between tibia fibula and talus. A 90 degree angle block supported by sandbags is used to maintain the foot in position.

The film size should be large enough to include the lower third of the leg. The foot is placed so that its plantar aspect is at level with the lower edge of the cassette.

2. Direction and Centering of the X- ray Beam: Centre midway between the malleoli with the central ray at right angles to an imaginary line joining the malleoli.

Observations:

Present study showed that in males age group 16-17 years, in three cases (30%) centre appeared but no union occurred, in two cases (20%) union started but incomplete & in five cases (50%) complete union occurred. In age group 18-19 years, 20-21 years, 22-23 years, 24-25 years, in ten cases (100%) complete union occurred. (Table 1)

Our study showed that in females in age group 16-17 years, 18-19 years, 20-21 years, 22-23 years, 24-25 years, in ten cases (100%) complete union occurred. (Table 2)

Discussion:

Findings are close to Stewart [4] for epiphyseal union of distal end of tibia in males only while other studies are not in confirmatory with present study for male and female while KrishanVij [5] gave 16-17 years for both male and female individuals but in present study it is in confirmatory for females only. Age of earliest union findings are not in confirmatory with any other study. (Table 3)

In our study for males in 16-17 years age group five cases (50%) show complete union, in 18-19, 20-21, 22-23 & in 24-25 years age group ten cases (100%) show complete union. For females in all age groups 16-25 years all ten cases (100%) show complete union. (Table 4)

Conclusions:

Epiphysis of distal end of tibia fused in majority of cases at 16-17 years in both male and females. Earliest union occurred at 16 years in both male and female. Our findings are close to Stewart [4] for epiphyseal union of distal end of tibia in males only while other studies are not in confirmatory with present study for male and female while KrishanVij [5] gave 16-17 years for both male and female individuals but in present study it is in confirmatory for females only.

In case of age of earliest union, the findings are not in confirmatory with any other study compared with.

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Table 4: Age of Incidence of Complete Union

| Agegrps(yrs) | Case Examined | Complete union (%) | |
|--------------|---------------|--------------------|---------|
| | | Males | Females |
| 16-17 | 20 | 5(50) | 10(100) |
| 18-19 | 20 | 10(100) | 10(100) |
| 20-21 | 20 | 10(100) | 10(100) |
| 22-23 | 20 | 10(100) | 10(100) |
| 24-25 | 20 | 10(100) | 10(100) |

Table 1
Incidence and Extent of Fusion of Distal End of Tibia in Different Age Groups for Males

| Extent of fusion | Age Group (Yrs.) | | | | |
|------------------------------|------------------|-----------|-----------|-----------|-----------|
| | 16-17 | 18-19 | 20-21 | 22-23 | 24-25 |
| | Cases (%) | Cases (%) | Cases (%) | Cases (%) | Cases (%) |
| Centre not appeared | 0(0) | 0(0) | 0(0) | 0(0) | 0(0) |
| Centre appeared but no union | 3(30) | 0(0) | 0(0) | 0(0) | 0(0) |
| Union started but incomplete | 2(20) | 0(0) | 0(0) | 0(0) | 0(0) |
| Complete union | 5(50) | 10(100) | 10(100) | 10(100) | 10(100) |

Table 2
Incidence and Extent of Fusion of Distal End of Tibia in Different Age Groups for Females

| Extent of fusion | Age Group (Yrs.) | | | | |
|------------------------------|------------------|-----------|-----------|-----------|-----------|
| | 16-17 | 18-19 | 20-21 | 22-23 | 24-25 |
| | Cases (%) | Cases (%) | Cases (%) | Cases (%) | Cases (%) |
| Centre not appeared | 0(0) | 0(0) | 0(0) | 0(0) | 0(0) |
| Centre appeared but no union | 0(0) | 0(0) | 0(0) | 0(0) | 0(0) |
| Union started but incomplete | 0(0) | 0(0) | 0(0) | 0(0) | 0(0) |
| Complete union | 10(100) | 10(100) | 10(100) | 10(100) | 10(100) |

Table 3
Comparison of Time of Fusion (in years) with other Authors [1, 4-8]

| Author | Year | Race | Gender | | | Earliest Union(years) |
|-----------------|------|---------------------|----------|-----------|-----------|-----------------------|
| | | | Male | Female | Mixed | Male/Female |
| Hepworth (7) | 1929 | Punjab (India) | - | - | 16.5-17.5 | |
| Pillay V.V. (8) | 1936 | Madrassies (Indian) | - | - | 14-17 | - |
| Galstaun (6) | 1937 | Bengalis (Indians) | 16 | 14.1-14.4 | - | - |
| Stewart (4) | 1973 | U.S.A. | Above 18 | - | - | - |
| Parikh (1) | 1990 | Indian | - | - | 16-18 | - |
| KrishanVij (5) | 2001 | Indian | - | - | 16-17 | - |
| Present study | 2001 | Punjab (Indian) | 18-19 | 16-17 | - | M = 16, F = 16 |