Age estimation from the fusion of distal end of fibula epiphysis

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Abstract

The range of variation in epiphyseal fusion for the distal end of fibula epiphysis in Punjab, India populations has been studied in the present study. This study evaluates epiphyseal fusion of the distal fibula in 100 young individuals, 50 males, and 50 females with age range from 16-17 years to 24-25 years. Radiographs were performed at Rajindra Hospital, Patiala, Punjab, India with 10 cases from each age group in both males and females. Both AP and lateral views of X-ray were taken. Results indicate that complete fusion in males occur at the age of 18-19 age group and in females occurs at 16-17 year age group in the distal end of the fibula. Earliest union for males and females occur at 16 years.

Keywords- Epiphyseal fusion, x-ray, age estimation, fibula.

Introduction

Determination of age in Indian population is very important now a day due to changes in age for various crimes. Epiphysis of the bones unites at the particular age which is remarkably constant for a Particular epiphysis and this is helpful in age determination (1). Age is helpful in identification of an individual which in turn is helpful in both civil and criminal cases as per Sangma (2). Study of the epiphyseal union of bones is considered a reasonably accurate and accepted method for age determination by the law courts all over the world (3). According to Modi's textbook, due to variation in climatic, dietetic, hereditary and other factors affecting the people of the different states of India, it cannot be reasonably expected to formulate a uniform standard for the determination of the age of the union of epiphyses for the whole of India (4). Union of epiphysis in cartilaginous Bones takes place earlier in the females by about 2 years than in males except in the case of skull Sutures where obliteration sets in little later and proceeds more slowly in females than in males and Under tropical conditions ossification is observed earlier than in temperate areas (5). With the onset of decomposition, the identification becomes difficult and so one has to rely more and more on the scientific methods available (6). While There are a number of studies on morphological and metrical variation in the tibia (Wood 1920; Hanihara 1958; Steel 1972; Iscan and Miller Shaivitz 1984; Iscan et al. the fibula has been largely ignored (7).

In an American study, complete fusion of distal end of fibula occurred as early as 12 years in females and completed by 16 years, and as early as 14 years in females and completed in 19 years (8). This fusion can also be observed by ultrasonography as this process is radiation free and by this method, complete fusion was observed by 18 years (9).

To narrow the wide age range union of the epiphysis of bones in the present study is done with the help of fusion of epiphysis in the distal end of the fibula. Age of each individual studied was confirmed from

the birth certificate, service record, driving license, passport, ration card or voter's card etc.

Material and Methods

In the present study, 100 cases were studied including male and female differently. The cases studied were between the age group of 16-25 years that 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 Ankle joint-anteroposterior view for the distal end of the fibula.
Status of epiphyseal union was divided into following four stages:

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

Method for X- Ray examination

The 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.

The positioning of the epiphysis during X- ray examination- Clark's radiographic technique has been followed in this investigation.

AP view for Ankle joint -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 the pressure of the heels on the couch. The ankle is supported in dorsiflexion 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. 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.

Results

The incidence and extent of fusion of the distal end of the fibula in different age groups studied in the present investigation was as follows:

Table 1: Extent of fusion in different age groups in males

Extent of fusion	Age Group 16-17 years		Age Group 18-19 years		Age Group 20-21 years		Age Group 22-23 years		Age Group 24-25 years	
	Cases	%age	Cases	% age	Cases	% age	Cases	% age	Cases	% age
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

The above table show in the age group 16—17 years, in three cases (30 %) center appeared but no union occurred, in 2 cases (20 %) c union started but incomplete & in five cases (50%) complete union occurred.

In the age group 18—19 years, 20—21 years, 22—23 years & 24-25 years, in ten cases (100 %) complete union occurred.

Table 2: Extent of fusion in different age groups in females

Extent of fusion	Age Group 16-17 years		Age Group 18-19 years		Age Group 20-21 years		Age Group 22-23 years		Age Group 24-25 years	
	Cases	%age	Cases	% age	Cases	% age	Cases	% age	Cases	% age
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	1	10	0	0
Complete union	10	100	10	100	10	100	9	90	10	100

Table no. 2 shows in the age group 16—17 years, 18—19 years, 20—21 years & 24-25 years, in ten cases (100 %) complete union occurred.

In the age group 22—23 years, in one case (10 %) union started but incomplete & in nine cases (90%) complete union occurred.

Discussion

Table 3: Comparison of time of fusion findings (in years) shown by different authors

Author	Year	Race	Sex			Earliest Union(years)
			Male	Female	Mixed	Male/Female
Hepworth (10)	1929	Punjab (India)	-	-	17-18	
Pillay (11)	1936	Madrassies (Indian)	-	-	14-17	-
Galstaun (12)	1937	Bengalis (Indians)	14-16	13-15	-	-
Basu & Basu (13)	1938	Bengalis (Indians)	-	-	15	
Krogman (7)	1962	U.S.A.	-	-	15.6-16.6	-
Parikh (14)	1990	Indian	-	-	16-18	-
Krishan Vij (15)	2001	Indian	-	-	16-17	-
Dr.S.Patond et al (16)	2012	Indian	15-16	15-16		
Present	2004	Punjab (Indian)	18-19	16-17	-	M = 16 F = 16

Time of fusion of distal end of fibula: Findings are in confirmatory with Krishan Vij for females only. Findings are not in confirmatory with anyone for males.

Age of earliest Union: Stevenson gave 17 years for the earliest union, which was not in confirmatory

with the present study.

The Findings in the present study are closer to Hepworth (10) and Krogman (7).

Hepworth (10) and Vij (15) used male and female individuals (mixed).

Table 4: Age of incidence of complete union found to be as follows

Age Group (Years)	Total No. of cases examined	For Males No. of cases showing complete union	%age	For Females No. of cases showing complete union	%age
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	9	90
24-25	20	10	100	10	100

Table no. 4 shows for males in 16-17 years age group five cases (50%) show complete union, in 18-19, 20-21, 22-23 and in 24-25 years age group all ten cases (100%) show complete union.

Conclusions

Epiphysis of the distal end of fibula fused in the majority of cases at 18-19 years in males and 16-17 years for females. Earliest union occurred at 16 years in both male and female. Findings are in confirmatory with Vij (15) for females only. Stevenson gave 17 years for the earliest union, which was not in confirmatory with the present study.

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