

Original Research Paper

Age Determination from Clavicle: A Radiological Study in Mumbai Region

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Abstract

The bones of human skeletons develop from separate ossification centres. From these centers ossification progresses till the bone is completely formed. These changes can be studied by means of X-rays and these changes are age related. It is therefore possible to determine the approximate age of an individual by radiological examination of bones till ossification is complete.

This radiological study was carried out with the objective to assess the general skeletal maturity around Medial end of clavicle, of subjects in Mumbai region. 131 males between age group of 9-25 years and 68 females between age group of 3-23 years attending the outpatient department of this hospital were selected. Age confirmed from history and noting the birth dates from driving license, passport, rations card or voter's card. The cases were selected after ruling out the nutritional, developmental, and endocrinal abnormality which affects the skeletal growth. Data analysis was done in P4 computer using HPSS software. At the end conclusions were drawn which are compared with available results of various previous studies.

Key Words: Epiphyseal Fusion, Ossification Centres, X-Rays

Introduction:

Determination of the age of an individual from the appearance and the fusion of the ossification centres is a well accepted fact in the field of medical and legal professions. Epiphysis of bones unites during age periods which are remarkably constant for a particular epiphysis.

The determination of age presents a task of considerable importance from the viewpoint of the administration of justice. It is not possible to enunciate a hard and fast rule for age determination from this union for the whole India because the various geographical areas of our country differ in climatic, dietetic and disease factors. The present study was carried out to study roentgenographically the epiphyseal appearance and fusion of medial end of clavicle in subjects between age group of 3 to 25 years attending outpatient department of this hospital.

Aims and Objectives:

- To assess the skeletal maturity at medial end of clavicle for a known chronological age in subjects of Mumbai region.

- Do Comparative study of appearance & fusion of medial end of clavicle with known standards.
- To evaluate sex related variation & its correlation with age.
- To know variation if any & exception of appearance & fusion of medial end of clavicle.
- To evaluate the medico legal aspects of different ages.
- To suggest any additional radiological investigation to aid and to reduce range in determining age.

Material and Methods:

The study was carried out in Grant Medical College and Sir J. J. Group of Hospitals Mumbai which is a tertiary referral centre. The objective was to assess the general skeletal maturity of medial end of clavicle in subjects in Mumbai region. 131 males between age group of 9-25 years and 68 females between age group of 3-23 years attending the outpatient are selected. Age confirmed from history and noting the birth dates from driving license, passports ration card or voter's card. The cases were selected after ruling out the nutritional, developmental, and endocrinal abnormality which affects the skeletal growth. X-rays of medial end of clavicle, AP view were taken at department of radiology. The epiphysis of medial end of clavicle was observed for appearance (A) and non appearance (NA) and different phases

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of fusion were graded according to Dr. William Sangma et al and Mckern and Stewart's methods. The 5 stages were 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 neighbourhood but an epiphyseal line called epiphyseal scar could still be distinguished. (3/4 united)
- **Stage 5(F5): Complete union** – with absence of epiphyseal scar.

The appearance and fusion of medial end of clavicle was evaluated radiologically and the results were compared with the previous known standard studies

Results and observations:

Table No. 1 shows in males in 34 cases (89.6%) at 9 – 15 years and in 4 cases (10.4%) at 15 – 16 years centre was not appeared. In 6 (60%) cases at 15 – 16 years and 4 cases (40%) at 16 – 17 years centre was appeared

F1 stage of fusion was seen in 2 cases (40%) at 16 – 17 years age group and in 3 cases (60%) at 17 – 18 years age group.

F2 stage of fusion was seen in 1 case (10%) at 16 – 17 years age group, in 5 cases (50%) at 17 – 18 years age group, in 1 case (10%) at 18 – 19 years age group and in 3 cases (30%) at 19 – 20 years age group.

F3 stage of fusion was seen in 5 cases (17.2%) at 17 - 18 years age group, in 18 cases (62.1%) at 18 – 19 years age group, in 3 case (10.3%) at 19 – 20 years age group and in 3 cases (10.3%) at 20 – 21 years age group .

F4 stage of fusion was seen in 1 case (4.8%) at 18 - 19 years age group, in 1 case (4.8%) at 19 – 20 years age group, in 10 cases (47.6%) at 20 – 21 years age group and in 5 cases (23.8%) at 21 – 22 years age group and in 4 cases (19%) at 22 – 23 years age group.

Complete fusion (F5) was seen in 5 cases (27.8%) at 21 - 22 years age group, in 3 cases (16.7%) at 22 – 23 years age group, in 6 cases (33.3%) at 23 – 24 years age group and in 4 cases (22.2%) at 24 – 25 years age group.

Table No. 2 shows in females in 26 cases (83.9%) at 3 – 13 years, in 3 cases (9.6%) at 13 – 14 years and in 2 cases (6.5%) centre was not appeared.

In 2 (25%) cases at 14 – 15 years, 3 cases (37.5%) at 15 – 16 years and in 3 cases (37.5%) 16 - 17 centre was appeared

F1 stage of fusion was seen in 1 case (33.3%) at 15 – 16 years age group and in 2 cases (66.7%) at 16 – 17 years age group.

F2 stage of fusion was seen in 2 cases (50%) at 17 – 18 years age group and in 2 cases (50%) at 18 – 19 years age group.

F3 stage of fusion was seen in 2 cases (33.3%) at 17 - 18 years age group, in 4 cases (67.7%) at 18 – 19 years age group.

F4 stage of fusion was seen in 3 cases (60%) at 19 - 20 years age group and in 2 cases (40%) at 20 – 21 years age group.

Complete fusion (F5) was seen in 4 cases (36.4%) at 20 - 21 years age group, in 4 cases (36.4%) at 21 – 22 years age group and in 3 cases (27.3%) at 22 – 23 years age group.

Discussion:

In present study both males and females in majority of cases show epiphyseal appearance at 15 – 16 years age group.

In present study males show epiphyseal union at 23 - 24 years age group and earliest union occurred at 21 years. Females show epiphyseal union at 21 - 22 years age group and earliest union occurred at 20 years.

The present study findings are close to Flecker, Galstaun, B. D. Chaurassia, Parikh, and Krishan Vij. [(5, 7, 9, 13]

According to Stevenson (1924) in both males and females earliest union occurred at 18 years but in present study for males, earliest union occurred at 21 years of age and for females it is 20 years of age. Present study and Stevenson show different results because they are performed in different races (Table - 3).

In present study majority of cases show complete union at 23 – 24 years for males and at 21 – 22 years for females. These findings are in tandem with study carried out by B. D. Chaurassia and Parikh because both studies are done in India.

Conclusions:

From the present study it can be concluded, that-

- Epiphysis of Medial end of Clavicle appears at 15 – 16 years in both males and females
- Epiphysis of medial end of clavicle fused in most of the cases at 23 – 24 years for males and at 21 – 22 years for females. Earliest

union occurs at 21 years in males and at 20 years in females.

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Table 1

Extent of Appearance and Fusion of Medial End of Clavicle in Males Different Age Groups

Extent of appearance & fusion	9-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	Total
	Cases (%)	Cases (%)	Cases (%)	Cases (%)	Cases (%)	Cases (%)	Cases (%)	Cases (%)	Cases (%)	Cases (%)	Cases (%)	Cases (%)
NA	34(89.6)	4(10.4)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	38(100)
A	0(0)	6(60)	4(40)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	10(100)
F1	0(0)	0(0)	2(40)	3(60)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	5(100)
F2	0(0)	0(0)	1(10)	5(50)	1(10)	3(30)	0(0)	0(0)	0(0)	0(0)	0(0)	10(100)
F3	0(0)	0(0)	0(0)	5(17.2)	18(62.1)	3(10.3)	3(10.3)	0(0)	0(0)	0(0)	0(0)	29(100)
F4	0(0)	0(0)	0(0)	0(0)	1(4.8)	1(4.8)	10(47.6)	5(23.8)	4(19)	0(0)	0(0)	21(100)
F5	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	5(27.8)	3(16.7)	6(33.3)	4(22.2)	18(100)

Table 2

Extent of Appearance and Fusion of Medial End of Clavicle in Females Different Age Gps

Extent of appearance & fusion	3-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	Total
	cases (%)	cases (%)	cases (%)	cases (%)	cases (%)	cases (%)	cases (%)	cases (%)	cases (%)	cases (%)	cases (%)	Cases (%)
NA	26(83.9)	3(9.6)	2(6.5)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	31(100)
A	0(0)	0(0)	2(25)	3(37.5)	3(37.5)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	8(100)
F1	0(0)	0(0)	0(0)	1(33.3)	2(66.7)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	3(100)
F2	0(0)	0(0)	0(0)	0(0)	0(0)	2(50)	2(50)	0(0)	0(0)	0(0)	0(0)	4(100)
F3	0(0)	0(0)	0(0)	0(0)	0(0)	2(33.3)	4(67.7)	0(0)	0(0)	0(0)	0(0)	6(100)
F4	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	3(60)	2(40)	0(0)	0(0)	5(100)
F5	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	4(36.4)	4(36.4)	3(27.3)	11(100)

Table 3

Comparison of Time of Fusion (n Years)

Author	Year	Race	Sex					Earliest Union (Yrs) Male/female
			Males		Females		Mixed	
			Appear	Fusion	Appear	Fusion		
Stevenson's	1924	White and Negroes		22-24		22-25	--	18
Davies& Parson	1927	English		--		--	25	
Flecker	1932	Australians		21		21	---	
Galstaun	1937	Bengalies (Indians)	15-19	22	14-16	20	--	
Krogman	1962	U.S.A.		--		--	25-28	
Stewart	1973	U.S.A.		26 or more		--	--	
Chaurassia	1980	Indian		--		--	21-22	
Parikh	1990	Indian		--		--	22	
Inderbir	1993	Indian		--		--	25	
Krishnan Vij	2001	Indian		--		--	20-22	
Present study	2010	Mumbai (Indian)		23-24		21-22	--	Male-21 Female-20