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Original Research Article

Radiological Study of Appearance and Fusion of Ossification Centers of Elbow Joint

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Conflict of interest: Nil.

Abstract

Background: Appearance and fusion of ossification centers like any other biological phenomenon are subject to variation from place to place and race to race. No authentic study on ossification centers has been done in southern Kerala in the last 25 years.

In this study, we wanted to determine radiologically the age of appearance and fusion of ossification centers of elbow joint.

Materials and Methods: This was a hospital based descriptive study conducted among 139 patients(72 males and 67 females) aged between 5 and 19 years who presented with radiographs of elbow joint in anteroposterior and lateral views in each case to the Department of Orthopaedics, Government Medical College, Trivandrum, over a period of 12 months from May 2011 to April 2012 after obtaining clearance from Institutional Ethics Committee and written informed consent from the study participants and the legal guardians.

Results: Mean age of appearance of ossification center for trochlea was 11.021 years with standard deviation of 0.3219. Sex difference in the appearance of ossification center for trochlea was not statistically significant. Mean age of appearance of ossification center for lateral epicondyle was 12.717 years with standard deviation of 0.5191. Sex difference with respect to appearance of ossification center for lateral epicondyle was not statistically significant. Mean age of formation of conjoint epiphysis was 13.556 years with standard deviation of 0.2396. Sex difference with respect to appearance of ossification center for conjoint epiphysis was not statistically significant. Mean age of complete fusion of conjoint epiphysis was 13.948 years with standard deviation of 0.3534. Sex difference in the fusion of conjoint epiphysis was not statistically significant. Mean age of complete fusion of medial epicondyle was 14.961 years with standard deviation of 0.8291. Sex difference in the fusion of medial epicondyle was not statistically significant. Mean age of complete fusion of Head of radius was 13.948 years with standard deviation of 0.3534.

Conclusion: Age of appearance of ossification center for capitulum could not be scrutinized as it fell below the lower age limit of sample size. All subjects from 5 to 6 age group onwards showed presence of capitulum. As per the present study, appearance and fusion of ossifications centers are taking place slightly earlier than the existing standards except for appearance of ossification center for medial epicondyle. The enhancement of bone maturity may be due to better nutritional and health standards and changing life styles. Moreover, no subject selected for the study was ill nourished. Sex difference in the appearance and fusion of ossification centers was seen to be statistically insignificant. The age of appearance and

fusion of the ossification centers of the elbow joint had shown differences from the conventional values followed for medico legal purpose.

Keywords: Age Determination, Radiological Method, Ossification Centers.

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Introduction:

Appearance and fusion of ossification centers like any other biological phenomenon are subject to variation from place to place and race to race. No authentic study on ossification centers has been done in southern Kerala in the last 25 years. Ossification centers of elbow joint are a focal area of age identification. It encompasses various centers that appears and fuses in early adolescence and puberty and the corresponding ages are medicolegally important. Hence, this is a humble effort to arrive at an incalculably useful data regarding ossification centers around elbow.

Aims and Objectives

1) To determine radiologically the age of appearance and fusion of ossification centers of elbow joint.
2) To compare and analyse the results of the study with existing data.

Materials and Methods

This was a hospital based descriptive study conducted among 139 patients (72 males and 67 females) aged between 5 and 19 years who presented with radiographs of elbow joint in anteroposterior and lateral views in each case to the Department of Orthopaedics, Government Medical College, Trivandrum, over a period of 12 months from May 2011 to April 2012 after obtaining clearance from Institutional Ethics Committee and written informed consent from the study participants and legal guardians.

Inclusion Criteria

Patients of known age between 5 and 19 years under Orthopaedics Department of Medical College Trivandrum in whom x-ray of elbow joint are taken in anteroposterior and lateral views as part of their routine treatment process.

Exclusion Criteria

1) Those who do not have authenticated birth records
2) Cases showing marked bony deformity
3) Presence of malnutrition

Statistical Methods

Data was entered in MS Excel and analysed using Statistical Package for Social Sciences (SPSS) software. Results were presented as tables.

Sample Size Estimation

130 cases between 5 years and 19 years with radiographs of elbow joint in anteroposterior and lateral view in each case

The sample size is calculated using the formula

$$n = \frac{2(z\alpha + 2z\beta)^2 \sigma^2}{d^2}$$

σ =standard deviation

d = difference in mean age values of males and females

Study Procedure

Data was collected by personal interview and examination. Subjects were requested to bring the birth record for obtaining accurate age while coming for review.139 Subjects between5 and 19years were studied. While recording age, more than 15 days was taken as one month. They were divided into fourteen groups namely 1) 5 to 6 years 2) 6 to 7 years 3)7 to 8 years 4)8 to 9 years 5)9 to 10 years 6)10 to

11 years 7)11 to 12 years 8)12 to 13 years 9)13 to 14 years 10)14 to 15 years 11)15 to 16 years 12)16 to 17 years 13)17 to 18 years 14) 18 to 19 years.

Upper age limit was inclusive in each group. For example, subject aged 6 years was grouped under 5 to 6 years' age group. In all the cases, detailed examination was conducted to detect malnutrition and gross deformities of joint. All subjects who showed signs of malnutrition or retarded growth and those who gave history of retarded milestones of development, metabolic and hereditary disorders were discarded. Data analysis was done with the help of Excel 2007 and SPSS version 17.

Age of appearance of each ossification center of elbow except that of capitulum was studied. Age of fusion of ossification centers of elbow joint was also studied.

Results

51.8% (72 cases) were males and 48.2% (67 cases) were females. The different age groups studied ranged from 5 to 19 years and were grouped at one-year interval. Study was not an age or sex matched one. Hence, number of males and females were not equal in each group. Frequency of males were either more or equal to that of females except in age groups 8 – 9, 12 – 13 ,15 – 16, 16 – 17 and 18 – 19.

Table 1: Age of appearance of centers of Head of radius, Median Epicondyle and Olecranon

Age in Years (Upper Age Limit is Inclusive)	Appearance of Head of Radius				Total	
	Appearance		Non-Appearance			
	No.	%	No.	%	No.	%
5-6	5	50.0	5	50.0	10	100.0
6-7	11	100.0	0	0.0	11	100.0
7-8	14	100.0	0	0.0	14	100.0
8-9	9	100.0	0	0.0	9	100.0
9-10	9	100.0	0	0.0	9	100.0
10-11	10	100.0	0	0.0	10	100.0
11-12	10	100.0	0	0.0	10	100.0
12-13	9	100.0	0	0.0	9	100.0
13-14	12	100.0	0	0.0	12	100.0
14-15	9	100.0	0	0.0	9	100.0
15-16	10	100.0	0	0.0	10	100.0
16-17	12	100.0	0	0.0	12	100.0
17-18	7	100.0	0	0.0	7	100.0
18-19	7	100.0	0	0.0	7	100.0
Total	134	96.4	5	3.6	139	100.0
Age of Appearance of Ossification Center for Median Epicondyle						
5-6	0	**0.0**	10	100.0	10	
6-7	0	0.0	11	100.0	11	
7-8	2	14.3	12	85.7	14	
8-9	9	100.0	0	0.0	9	
9-10	8	88.9	1	11.1	9	
10-11	10	100.0	0	0.0	10	
11-12	10	100.0	0	0.0	10	
12-13	9	100.0	0	0.0	9	
13-14	12	100.0	0	0.0	12	
14-15	9	100.0	0	0.0	9	
15-16	10	100.0	0	0.0	10	

16-17	12	100.0	0	0.0	12	
17-18	7	100.0	0	0.0	7	
18-19	7	100.0	0	0.0	7	
Total	105	75.5	34	24.5	139	
Age of Appearance of Ossification Center for Olecranon						
5-6	0	0.0	10	100.0	10	100.0
6-7	0	0.0	11	100.0	11	100.0
7-8	0	0.0	14	100.0	14	100.0
8-9	1	11.1	8	88.9	9	100.0
9-10	1	11.1	8	88.9	9	100.0
10-11	10	100.0	0	0.0	10	100.0
11-12	10	100.0	0	0.0	10	100.0
12-13	9	100.0	0	0.0	9	100.0
13-14	12	100.0	0	0.0	12	100.0
14-15	9	100.0	0	0.0	9	100.0
15-16	10	100.0	0	0.0	10	100.0
16-17	12	100.0	0	0.0	12	100.0
17-18	7	100.0	0	0.0	7	100.0
18-19	7	100.0	0	0.0	7	100.0
Total	88	63.3	51	36.7	139	100.0

Center for head of radius started appearing from 5 to 6 years. Fifty percent of subjects in age group of 5 to 6 years showed the presence of ossification center for head of radius.

Center was present in all the subjects in the 6 to 7 years' age group. Minimum age of appearance of ossification center for head of radius was 5 years 3 months and maximum age was 6 years. The mean age was 5.517 years with standard deviation 0.3140.

Statistically the appearance of head of radius in males and females did not show any significant difference.

Centre for medial epicondyle started appearing from 7 to 8 years onwards. All the subjects in the 8 to 9 age group showed the center.

However, one male subject in 9 to 10 age group showed non-appearance which was not taken into account for fixing upper age limit. Minimum age of appearance was 7 years 5 months and maximum age of appearance was 8 years. Mean age of appearance of ossification center for head of radius was 7.714 years with standard deviation of 0.28.

Sex difference with respect to appearance of medial epicondyle is not statistically significant.

Ossification center for olecranon started appearing from 8 to 9 years onwards. All subjects from 10 to 11 years age group onwards showed center for olecranon.

Table 2: Age of appearance of centers of Trochlea and lateral Epicondyle

Age in Years (Upper Age Limit is Inclusive)	**Appearance of Trochlea**				**Total**	
	Appearance		**Non Appearance**			
	No.	**%**	**No.**	**%**	**No.**	**%**
5-6	0	0.0	10	100.0	10	100.0
6-7	0	0.0	11	100.0	11	100.0
7-8	0	0.0	14	100.0	14	100.0

8-9	0	0.0	9	100.0	9	100.0
9-10	0	0.0	9	100.0	9	100.0
10-11	2	20.0	8	80.0	10	100.0
11-12	8	80.0	2	20.0	10	100.0
12-13	9	100.0	0	0.0	9	100.0
13-14	12	100.0	0	0.0	12	100.0
14-15	9	100.0	0	0.0	9	100.0
15-16	10	100.0	0	0.0	10	100.0
16-17	12	100.0	0	0.0	12	100.0
17-18	7	100.0	0	0.0	7	100.0
18-19	7	100.0	0	0.0	7	100.0
Total	76	54.7	63	45.3	139	100.0
Age of Appearance of Ossification Center for lateral Epicondyle						
	No.	**%**	**No.**	**%**	**No.**	**%**
5-6	0	0.0	10	100.0	10	100.0
6-7	0	0.0	11	100.0	11	100.0
7-8	0	0.0	14	100.0	14	100.0
8-9	0	0.0	9	100.0	9	100.0
9-10	0	0.0	9	100.0	9	100.0
10-11	0	0.0	10	100.0	10	100.0
11-12	1	10.0	9	90.0	10	100.0
12-13	3	33.3	6	66.7	9	100.0
13-14	12	100.0	0	0.0	12	100.0
14-15	9	100.0	0	0.0	9	100.0
15-16	10	100.0	0	0.0	10	100.0
16-17	12	100.0	0	0.0	12	100.0
17-18	7	100.0	0	0.0	7	100.0
18-19	7	100.0	0	0.0	7	100.0
Total	61	43.9	78	56.1	139	100.0

For olecranon Minimum age of appearance was nine years and maximum age of appearance was nine years ten months. Mean age of appearance of ossification center for olecranon was 9.7 years with standard deviation 0.5.

Sex difference with respect to appearance of ossification center for olecranon is not statistically significant.

Centre for trochlea started appearing from 10 to 11 years onwards. All subjects in 12 to 13 years age group showed the presence of ossification center for trochlea.

Minimum age of appearance of ossification center for trochlea was 10 years 7 months and maximum age of appearance was 11 years 4 months. Mean age of appearance of ossification center for trochlea was 11.021 years with standard deviation of 0.3219.

Sex difference in the appearance of ossification center for trochlea is not statistically significant.

Centre for lateral epicondyle started appearing from 11 to 12 years. All subjects in the age group of 13 to 14 years showed the presence of ossification center for lateral epicondyle.

Minimum age of appearance was 12 years and maximum age of appearance was 12 years 11 months. Mean age of appearance of ossification center for lateral epicondyle is 12.717 years with standard deviation of 0.5191.

Table 3: Age of appearance and fusion of Conjoint Epiphysis

Age in Years (Upper Limit Inclusive)	Appearance of Conjoint Epiphysis				Total	
	Appearance		Non-Appearance			
	No.	%	No.	%	No.	%
5-6	0	0.0	10	100.0	10	100.0
6-7	0	0.0	11	100.0	11	100.0
7-8	0	0.0	14	100.0	14	100.0
8-9	0	0.0	9	100.0	9	100.0
9-10	0	0.0	9	100.0	9	100.0
10-11	0	0.0	10	100.0	10	100.0
11-12	0	0.0	10	100.0	10	100.0
12-13	0	0.0	9	100.0	9	100.0
13-14	7	58.3	5	41.7	12	100.0
14-15	9	100.0	0	0.0	9	100.0
15-16	10	100.0	0	0.0	10	100.0
16-17	12	100.0	0	0.0	12	100.0
17-18	7	100.0	0	0.0	7	100.0
18-19	7	100.0	0	0.0	7	100.0
Total	52	37.4	87	62.6	139	100.0

Age of Fusion of Ossification Center for Conjoint Epiphysis								
	No.	%	No.	%	No.	%	No.	%
5-6	10	100.0	0	0.0	0	0.0	10	100.0
6-7	11	100.0	0	0.0	0	0.0	11	100.0
7-8	14	100.0	0	0.0	0	0.0	14	100.0
8-9	9	100.0	0	0.0	0	0.0	9	100.0
9-10	9	100.0	0	0.0	0	0.0	9	100.0
10-11	10	100.0	0	0.0	0	0.0	10	100.0
11-12	10	100.0	0	0.0	0	0.0	10	100.0
12-13	9	100.0	0	0.0	0	0.0	9	100.0
13-14	5	41.7	2	16.7	5	41.7	12	100.0
14-15	0	0.0	3	33.3	6	66.7	9	100.0
15-16	0	0.0	0	0.0	10	100.0	10	100.0
16-17	0	0.0	0	0.0	12	100.0	12	100.0
17-18	0	0.0	0	0.0	7	100.0	7	100.0
18-19	0	0.0	0	0.0	7	100.0	7	100.0
Total	87	62.6	5	3.6	47	33.8	139	100.0

Sex difference with respect to appearance of ossification center for lateral epicondyle was not statistically significant.

Conjoint epiphysis started appearing from 13 to 14 years. All subjects from 14 to 15 years age group onwards showed the presence of conjoint epiphysis.

Minimum age of appearance was 13 years 4 months and maximum age of appearance was 13 years 11 months. Mean age of formation of conjoint epiphysis is 13.556 years with standard deviation of 0.2396.

Sex difference with respect to appearance of ossification center for conjoint epiphysis was not statistically significant.

Conjoint epiphysis fusion started from 13 to 14 years age group. Complete fusion of conjoint epiphysis was observed in 41.7% of subjects in age group of 13 to 14 years. Conjoint epiphysis was completely fused

in all subjects from 15 to 16 years group onwards.

Minimum age showing complete fusion is 13 years 5 months. Maximum age is 14 years 5 months. Mean age of complete fusion of conjoint epiphysis is 13.948 years with standard deviation 0.3534.

Table 4: Age of fusion of Medial Epicondyle and Head of Radius

Age in Years (Upper Age Limit is Inclusive)	Fusion of Medial Epicondyle								Total	
	NA		Not Fused		Started Fusion		Completely Fused			
	No.	%	No.	%	No.	%	No.	%	No.	%
5-6	10	100.0	0	0.0	0	0.0	0	0.0	10	100.0
6-7	11	100.0	0	0.0	0	0.0	0	0.0	11	100.0
7-8	12	85.7	2	14.3	0	0.0	0	0.0	14	100.0
8-9	0	0.0	9	100.0	0	0.0	0	0.0	9	100.0
9-10	1	11.1	8	88.9	0	0.0	0	0.0	9	100.0
10-11	0	0.0	10	100.0	0	0.0	0	0.0	10	100.0
11-12	0	0.0	10	100.0	0	0.0	0	0.0	10	100.0
12-13	0	0.0	8	88.9	1	11.1	0	0.0	9	100.0
13-14	0	0.0	5	41.7	4	33.3	3	25.0	12	100.0
14-15	0	0.0	0	0.0	5	55.6	4	44.4	9	100.0
15-16	0	0.0	0	0.0	2	20.0	8	80.0	10	100.0
16-17	0	0.0	0	0.0	0	.0	12	100.0	12	100.0
17-18	0	0.0	0	0.0	0	.0	7	100.0	7	100.0
18-19	0	0.0	0	0.0	0	.0	7	100.0	7	100.0
Total	34	24.5	52	37.4	12	8.6	41	29.5	139	100.0
Age of Fusion of Ossification Center for Head of radius										
5-6	5	50.0	5	50.0	0	0.0	0	0.0	10	100.0
6-7	0	0.0	11	100.0	0	0.0	0	0.0	11	100.0
7-8	0	0.0	14	100.0	0	0.0	0	0.0	14	100.0
8-9	0	0.0	9	100.0	0	0.0	0	0.0	9	100.0
9-10	0	0.0	9	100.0	0	0.0	0	0.0	9	100.0
10-11	0	0.0	10	100.0	0	0.0	0	0.0	10	100.0
11-12	0	0.0	9	90.0	1	10.0	0	0.0	10	100.0
12-13	0	0.0	8	88.9	1	11.1	0	0.0	9	100.0
13-14	0	0.0	3	25.0	4	33.3	5	41.7	12	100.0
14-15	0	0.0	0	0.0	3	33.3	6	66.7	9	100.0
15-16	0	0.0	0	0.0	0	0.0	10	100.0	10	100.0
16-17	0	0.0	0	0.0	0	0.0	12	100.0	12	100.0
17-18	0	0.0	0	0.0	0	0.0	7	100.0	7	100.0
18-19	0	0.0	0	0.0	0	0.0	7	100.0	7	100.0
Total	5	3.6	78	56.1	9	6.5	47	33.8	139	100.0

Sex difference in the fusion of conjoint epiphysis was not statistically significant.

Medial epicondyle started fusion by 12 to 13 years. Presence of complete fusion was evident from 13 to 14 years age group onwards. Medial epicondyle was completely fused in all subjects from 16 to 17 years age group onwards.

Minimum age showing complete fusion was 13 years 5 months. Maximum age was

15 years 11 months. Mean age of complete fusion of medial epicondyle was 14.961 years with standard deviation of 0.8291.

Sex difference in the fusion of medial epicondyle was not statistically significant.

Complete fusion of center for head of radius was observed from 13 to 14 years age group onwards. All subjects in 15 to 16 years age group showed complete fusion.

Minimum age showing complete fusion was 13 years 5 months for head of radius. Maximum age was 14 years 5 months. Mean age of complete fusion of head of radius was 13.948 years with standard deviation of 0.3534.

Table 5: Age of Fusion of Ossification Center for Upper End of Ulna

Age in Years (Upper Age Limit Inclusive)	Fusion of Upper End of Ulna								Total	
	NA		Not Fused		Started Fusion		Completely Fused			
	No	%	No.	%	No.	%	No.	%	No.	%
5-6	10	100.0	0	0.0	0	0.0	0	0.0	10	100.0
6-7	11	100.0	0	0.0	0	0.0	0	0.0	11	100.0
7-8	14	100.0	0	0.0	0	0.0	0	0.0	14	100.0
8-9	8	88.9	1	11.1	0	0.0	0	0.0	9	100.0
9-10	8	88.9	1	11.1	0	0.0	0	0.0	9	100.0
10-11	0	0.0	10	100.0	0	0.0	0	0.0	10	100.0
11-12	0	0.0	10	100.0	0	0.0	0	0.0	10	100.0
12-13	0	0.0	9	100.0	0	0.0	0	0.0	9	100.0
13-14	0	0.0	4	33.3	5	41.7	3	25.0	12	100.0
14-15	0	0.0	0	0.0	5	55.6	4	44.4	9	100.0
15-16	0	0.0	0	0.0	2	20.0	8	80.0	10	100.0
16-17	0	0.0	0	0.0	0	0.0	12	100.0	12	100.0
17-18	0	0.0	0	0.0	0	0.0	7	100.0	7	100.0
18-19	0	0.0	0	0.0	0	0.0	7	100.0	7	100.0
Total	51	36.7	35	25.2	12	8.6	41	29.5	139	100.0

Sex difference in the complete fusion of head of radius was not statistically significant.

Centre for upper end of ulna started complete fusion by 13 to 14 age years. All subjects showed complete fusion of upper end of ulna in the age group of 16 to 17 years.

Minimum age showing complete fusion of upper end of ulna was 13 years 5 months. Maximum age was 15 years 11 months. Mean age of complete fusion of upper end of ulna was 15 years with standard deviation of 0.8.

Sex difference in the complete fusion of upper end of ulna was not statistically significant.

Discussion

I Appearance of Ossification Centers

I (a) Appearance of Ossification Center for Head of Radius

Age of appearance of ossification center for head of radius in the present study is 5 to 6 years in both sexes. Mean age of appearance is 5.5 years with standard deviation of 0.31. This study is in agreement with studies by Davis and Parson [1] and Kothari, [2] but not in agreement with study by Bhise and Nanandkar. [3]

I (b)Appearance of Ossification Center for Medial Epicondyle

Age of appearance of ossification center for medial epicondyle in the present study is 7 to 8 years in both sexes. Mean age of appearance is 7.71 years with standard

deviation 0.28. This study is in agreement with study by Kothari, but not in agreement with study by Davis and Parson and Flecker. Present study is in partial agreement with studies conducted by Galstaun, [4] Bajaj and Bharadwaj [5] and Bhise and Nanandkar.

I (c)Appearance of Ossification Center for Olecranon

Age of appearance of ossification center for olecranon in the present study is 8 to 10 years in both sexes. Mean age of appearance is 9.7 years with standard deviation of 0.5. This study is in agreement with study by Flecker [6] and Kothari, but not in agreement with study by Bhise and Nanandkar. Present study is in partial agreement with studies conducted by Galstaun and Bajaj and Bharadwaj.

I (d) Appearance of Ossification Center for Trochlea

Age of appearance of ossification center for trochlea in the present study is 10 to 12 years in both sexes. Mean age of appearance is 11.02 years with standard deviation of 0.32. This study is in agreement with study by Davis and Parson and Kothari and in partial agreement with studies conducted by Galstaun, Flecker [6], Balachandran [7] and Bhise and Nanandkar.

I (e) Appearance of Ossification Center for Lateral Epicondyle

Age of appearance of ossification center for lateral epicondyle in the present study is 11 to 13 years in both sexes. Mean age of appearance is 12.72 years with standard deviation 0. 52. This study is in agreement with study by Davis and Parson, Flecker, Balachandran and Kothari, but not in agreement with study byBajaj and Bharadwaj. Present study is in partial agreement with studies conducted by Galstaun and Bhise and Nanandkar.

I (f)Appearance of Conjoint Epiphysis

Age of appearance of conjoint epiphysis (formed by fusion of lateral epicondyle, trochlea and capitulum) in the present study is 13 to 14 years in both sexes. Mean age of appearance is 13.56 years with standard deviation of 0. 24 This study is in agreement with study by Kothari and in partial agreement with study by Balachandran.

I (g) Appearance of Ossification Centre for Capitulum

As per study by Bajaj and Bharadwaj, mean age of appearance of center for capitulum for both males and females is given as 0.5 years. As per the value compiled by Kothari, age for appearance of capitulum for Kerala population is 2 years. Due to paucity of elbow x-rays less than 5 years lower age limit of present study was fixed at 5 years. All subjects from 5 to 6 years' age group and above showed capitulum.

II Fusion of Ossification Centers

II (a) Fusion of Ossification Center for Head of Radius

Age of fusion of ossification center for head of radius in the present study is 13 to 15 years in both sexes. Mean age of fusion is 13.95 years with standard deviation of 0.35. This study is in partial agreement with studies by Davis and Parson, Pillai,[8] Galstaun, Flecker, Bajaj and Bharadwaj and Kothari but not in agreement with studies by Lall and Nat, Lall and Townsend [9] and Balachandran.

II (b) Fusion of Conjoint Epiphysis

Age of fusion of conjoint epiphysis in the present study is 13 to 15 years in both sexes. Mean age of fusion is 13.95 years with standard deviation 0.35. This study is in agreement with study by Bajaj and Bharadwaj and in partial agreement with studies by Flecker, Balachandran, Kothari and Bhise and Nanandkar.

II(c) Fusion of Ossification Center for Median Epicondyle

Age of fusion of ossification center for medial epicondyle in the present study is 13 to 16 years in both sexes. Mean age of fusion is 14.96 years with standard deviation of 0.83. This study is in agreement with studies by Galstaun, Flecker, Lall and Townsend and not in agreement with study by Davis and Parson. The study is in partial agreement with studies by Lall and Nat, Pillai, Bajaj and Bharadwaj, Kothari and Bhise and Nanandkar.

II (d) Fusion of Ossification Centre for Olecranon (Upper End of Ulna)

Age of fusion of ossification centre for olecranon in the present study is 13 to 16 years in both sexes. Mean age of fusion is 15 years with standard deviation of 0.8. This study is agreement with Lall and Nat, Pillai, Lall and Townsend, Bajaj and Bharadwaj and Flecker and not in agreement with study by Davis and Parson.

As per the present study, appearance and fusion of ossification centers are taking place slightly earlier than the existing data. The enhancement of bone maturity may be due to better nutritional and health standards and changing life styles. Moreover, no subject selected for the study was ill nourished.

Conclusion

As per the present study, appearance and fusion of ossifications centersis taking place slightly earlier than the existing standards except for appearance of ossification center for medial epicondyle. The enhancement of bone maturity may be due to better nutritional and health standards and changing life styles. Moreover, no subject selected for the study was ill nourished. Sex difference in the appearance and fusion of ossification centers was seen to be statistically insignificant. The age of appearance and fusion of the ossification centers of the elbow joint had shown differences from the conventional values followed for medico legal purpose. Hence, this study is of immense importance in the medico legal certification of age of an individual.

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