

Age estimation based on appearance of pisiform bone: a radiographic study from North-Karnataka

Ramesh C. Patil¹, Ashfakhussain Magi², Anand Mugadlimath^{3*}, Rekha Hiremath⁴

¹Associate Professor, Al-Azhar Medical College, Kerala, ²Resident, Al-Azhar Medical College, Vijayapur, ³Associate Professor, Dept. of Forensic Medicine, ⁴Assistant Professor, Dept. of Anatomy, S. Nijalingappa Medical College, Bagalkot

***Corresponding Author:**

Email: rameshpatlalameen@gmail.com

Abstract

Introduction: Radiographic survey for appearance and fusion of ossification centers of various bones is undoubtedly one of the best methods for age estimation especially in children and adolescents till ossification is complete. The appearance of ossification centers for carpal bones especially for pisiform bone is one of the vital evidence for estimating age in young children between 9 and 13 years.

Material & Methods: The present study to estimate the age of children based on radiographic evaluation of the appearance of ossification center of pisiform bone was undertaken in the department of Forensic Medicine and Toxicology, Al-Ameen medical college Vijayapur. Duration of study period is from July 2014 to August 2016 (two year) and it is a cross sectional study.

Results: The mean age at which males show appearance of pisiform is 9.5 ± 1.71 years and in case of females it is 9.5 ± 1.7 years. The p value is <0.05 indicating that there is significant age difference in males and females with reference to appearance of ossification center of pisiform bone.

Conclusions: The accurate or precise age of the individual cannot be stated by radiological examination, but a reasonable range of age can be arrived by considering the timing of appearance of ossification centers. Hence application of radiological procedures for assessment of age in living individuals is a reliable method.

Keywords: Pisiform bone, Ossification centers, Medicolegal importance of age, Criminal responsibility

Introduction

Identification means the determination of the individuality of a person based on certain physical characteristics unique to that individual. There are several criteria used for identification and one such essential criterion is the estimation of age of an individual. Height, weight, eruption of teeth, appearance of secondary sexual characteristics, appearance and fusion of ossification centers are the principle means used in assessment of age with fair accuracy.⁽¹⁾ approximate age of an individual can be estimated by correlation of physical, dental and skeletal developmental parameters.⁽²⁾ The ability to age an individual with a degree of objectivity and certainty is important in many medico-legal circumstances involving both civil and criminal cases.⁽³⁾

The pediatric age group between 7 and 12 years has got significant medicolegal importance such as criminal responsibility, kidnapping a child, child labour, consent, rape and awarding judicial punishment especially in whom acceptable identification documents are not available.

Radiographic survey for appearance and fusion of ossification centers of various bones is undoubtedly one of the best methods for age estimation especially in children and adolescents till ossification is complete.⁽⁴⁾

The appearance of ossification centers for carpal bones especially for pisiform bone is one of the vital evidence for estimating age in young children between 9 and 13 years. Many authors have quoted different opinion on the range of age at which ossification center

for pisiform bone appears, this scenario encouraged to take up this radiographic study.

Many workers from India and abroad have undertaken such studies and they have observed that various factors like race, geography, climate, diet, heredity, metabolic disorders and endocrine factors do affect the physiological processes occurring in childhood like appearance and fusion of ossification centers, eruption of teeth. In light of these facts, it becomes an obvious necessity to have a local data for each population in the interest of proper dispensation of Justice.

Materials and Methods

The present study to estimate the age of children based on radiographic evaluation of the appearance of ossification center of pisiform bone was undertaken in the department of Forensic Medicine and Toxicology, Al-Ameen medical college in association with Department of Radio diagnosis, Al-Ameen medical college and hospital, Vijayapur. Duration of study period is from July 2014 to August 2016 (two year) and it is a cross sectional study.

The study group consists of 120 male and 120 female subjects with the age group ranging from 8 years to 13 years. They are further divided into 6 subgroups each containing 20 subjects. The subjects are selected among the children attending the radiology department either on outpatient basis or inpatients for various surgical and orthopedic problems of the hand.

Inclusion criteria: Children whose family origin is from Vijayapur and nearby districts, in the age group of above 8 years and below 13 years of both sexes with proper age proof certificates. The actual age of the subjects selected for the present study are verified by evaluation of date of birth certificates or school certificates.

Exclusion criteria: Congenital anomalies and other skeletal abnormalities of the hand. Metabolic abnormalities of the bone. Fracture of carpal bones.

Written informed consent is obtained from the concerned parents or guardians of each subject prior to the examination, if the age of the subject is below 12

years. Consent is obtained from the subject himself, if age is above 12 years.

The following statistical methods are applied in the present study to evaluate the age at which ossification center of pisiform appears.

Descriptive statistics: The Descriptive procedure displays univariate summary statistics for several variables in a single table and calculates standardized values (z scores). Variables can be ordered by the size of their means (in ascending or descending order), alphabetically, or by the order in which select the variables (the default).

Results

Table 1: Showing non-appearance and appearance of pisiform on right wrists in males

Cross Tab					
			Right		Total
			Not Appeared	Appeared	
Age (in Years)	7-8	Count (%)	20 (100%)	0 (0%)	20 (100%)
	8-9	Count (%)	19 (95%)	1 (5%)	20 (100%)
	9-10	Count (%)	15 (75%)	5 (25%)	20 (100%)
	10-11	Count (%)	7 (35%)	13 (65%)	20 (100%)
	11-12	Count (%)	2 (10%)	18 (90%)	20 (100%)
	12-13	Count (%)	0 (0%)	20 (100%)	20 (100%)
Total		Count (%)	63 (52.5%)	57 (47.5%)	120 (100%)

Symmetric measures				
			Value	Approx. Sig.
Nominal by Nominal	Contingency Coefficient		.622	.000
N of Valid Cases			120	

The following observations were made on radiographs of left wrist of male studied.

Table 2: Showing non-appearance and appearance of pisiform on left wrists in males

Cross Tab					
			Left		Total
			NA	A	
Age (in years)	7-8	Count (%)	20 (100%)	0 (0%)	20 (100%)
	8-9	Count (%)	20 (100%)	0 (0%)	20 (100%)
	9-10	Count (0%)	16 (80%)	4 (20%)	20 (100%)
	10-11	Count (%)	8 (40%)	12 (60%)	20 (100%)
	11-12	Count (%)	3 (15%)	17 (85%)	20 (100%)
	12-13	Count (%)	0 (0%)	20 (100%)	20 (100%)
Total		Count (0%)	67 (55.8%)	53 (44.2%)	120 (100%)

Symmetric Measures				
			Value	Approx. Sig.
Nominal by Nominal	Contingency Coefficient		.626	.000
N of Valid Cases			120	

In 120 female subjects studied, the following observations were found on right wrist, no case showed appearance of pisiform by the age 8 years. Subjects showing appearance of ossification center of pisiform gradually increase in the number as the age advances. 35% of subjects showed appearance by 9 years and 70% by 10 years. About 90% of subjects showed its appearance by 11 years and between 11 and 12 years of age 100% of the subjects showed appearance of pisiform bone.

The youngest subject showing the appearance of pisiform is 8 years and 01 months.

The eldest subject showing non-appearance of pisiform is 10 years and 02 months.

The average range of age for appearance of pisiform ossification center is between 9 and 11 years as more than 90% of the subjects showed its appearance.

The observations found on the left wrist of females were depicted in Table 4.

Table 3: Showing non-appearance and appearance of pisiform on right wrists in females

Cross Tab					
			Right		Total
			NA	A	
Age (in Years)	7-8	Count (%)	20 (100%)	0 (0%)	20 (100%)
	8-9	Count (%)	13 (65%)	7 (35%)	20 (100%)
	9-10	Count (%)	6 (30%)	14 (70%)	20 (100%)
	10-11	Count (%)	2 (10%)	18 (90%)	20 (100%)
	11-12	Count (%)	0 (0%)	20 (100%)	20 (100%)
12-13		Count (%)	0 (0%)	20 (100%)	20 (100%)
Total		Count (%)	41 (34.2%)	79 (65.8%)	120 (100%)

Symmetric Measures			
		Value	Approx. Sig.
Nominal by Nominal	Contingency Coefficient	.615	.000
N of Valid Cases		120	

The following observations were made on the left wrists of females studied.

Table 4: Showing appearance and non-appearance of pisiform on left wrists in females

Crosstab					
			Left		Total
			NA	A	
Age (in years)	7-8	Count (%)	20 (100%)	0 (%)	20 (100%)
	8-9	Count (%)	14 (70%)	6 (30%)	20 (100%)
	9-10	Count (%)	5 (25%)	15 (75%)	20 (100%)
	10-11	Count (%)	2 (10%)	18 (90%)	20 (100%)
	11-12	Count (%)	0 (0%)	20 (100%)	20 (100%)
12-13		Count (%)	0 (0%)	20 (100%)	20 (100%)
Total		Count (100%)	41 (34.2%)	79 (65.8%)	120 (100%)

Symmetric Measures			
		Value	Approx. Sig.
Nominal by Nominal	Contingency Coefficient	.624	.000
N of Valid Cases		120	

Table 5: Showing statistical analysis of mean age of appearance of pisiform between male and female children

Descriptive Age					
Sex	N	Mean (in years)	Std. Deviation (in years)	Minimum (in years)	Maximum (in years)
M	120	9.5607	1.7173	7.01	12.11
F	120	9.5623	1.7039	7.01	12.11
Total	240	9.5615	1.7071	7.01	12.11

The mean age at which males show appearance of pisiform is 9.5 ± 1.71 years and in case of females it is 9.5 ± 1.7 years.

The p value is <0.05 indicating that there is significant age difference in males and females with reference to appearance of ossification center of pisiform bone.

Discussion

Many studies have been conducted by various workers in India and abroad on appearance and fusion of various ossification centers of bones. They found that the appearance and fusion of ossification centers are influenced by various factors such as geographic, racial, environmental, climatic, hereditary, nutritional, endocrinal abnormalities and metabolic disorders. In the present radiographic study the appearance of ossification center of pisiform bone of both sides of wrist are evaluated for age estimation and to study any possibility of symmetrical nature.

Galstaun et al⁽⁵⁾ study on Bengalis observed that the ossification center of pisiform appears by 9-12 years in females and 12-17 years in males. Hence appearance of ossification center is earlier in south Indians compared to the Bengalis and this study correlates with the literature. It is also observed in the present study that pisiform appears earlier (i.e. about one to two years) in females compared to males, which is consistent with the opinion given by earlier studies. Lal and Nat et al⁽³⁾ studied the appearance of pisiform in Uttar Pradesh population on both male and female subjects and observed that it appears by 11 years in females and by 13 years in males. So the average range of age for appearance of pisiform ossification center in this province is between 9 & 11 years in females and between 10 & 12 years in males.

Flecker et al⁽³⁾ studied the appearance of wrist ossification centers in Australians and concluded that pisiform appears by the age of 9 years in females and by 11 years in males. Results of the present study are not consistent with previous studies, which state that ossification center appears earlier in Indians compared to western countries.

Bajaj and Bharadwaj et al⁽⁶⁾ carried out radiological study up to 21 years of age of both hands. They did not find any significant difference in appearance of ossification centers between right and left sides, and they concluded that ossification center appearance is

symmetrical bilaterally. The present study revealed that there is no significant difference in the time of appearance of pisiform bone bilaterally. This is consistent with their observations. Srivastav A, Saraswat P K, Agarwal S K and Gupta P et al⁽⁷⁾ in 2004 carried out radiographic study on pediatric subjects of Ajmer (Rajasthan) from birth to 12 years of age of both sexes. They observed that Pisiform was the last carpal bone to appear. It concurs with our study. Halsagi et al⁽⁸⁾ a study on North Karnataka observed that the ossification center of Pisiform appears by 6.-15 years in females and 12-15 years in males.

S.S. Bhise et al⁽⁹⁾ studied the appearance of pisiform bone in Mumbai population on both males and females observed that it appeared by 10-11 years in females and 12-13 years in males. This observation is inconsistent with present study. P A Wankhade et al⁽¹⁰⁾ in their study of Wardha region observed that pisiform bone in males appeared in between age of 11-15 years. This is inconsistent with their observations. Niamuddin et al⁽¹¹⁾ in their study of Hyderabad region observed that pisiform appeared by 12 years in both males and females. In the present study 100% of subjects showed appearance of pisiform by the age of 12 years in females and 13 years in males. The observations are consistent with the above study. Ashwani K Sharman et al⁽¹²⁾ studied appearance of pisiform bone in Jammu region. He observed that pisiform appeared 9-10 years in females, and 12 years in males which is consistent with our study. G. Webster et al⁽¹³⁾ studied in Ceylon and found pisiform bone appeared in 9 years in females and 9-12 in Males, which is inconsistent from the present study.

Most of the workers observed that ossification centers appear earlier in females compared to that of the males. The similar finding has been noticed in the present study with the appearance of pisiform ossification center by 9 to 11 years in female (i.e. one year earlier) compared to males, which appears by 10 to 12 years.

Conclusion

The following conclusions were drawn from the observations made during the present study.

The accurate or precise age of the individual cannot be stated by radiological examination, but a reasonable range of age can be arrived by considering the timing of appearance of ossification centers. Hence

application of radiological procedures for assessment of age in living individuals is a reliable method. Variability in appearance of ossification center of pisiform is observed in this province after comparing this study with previous ones conducted in different regions of the country and abroad.

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