

Harsukh Educational Charitable Society
International Journal of Community Health and Medical Research

Journal home page: www.ijchmr.com

doi: 10.21276/ijchmr

ISSN E: 2457-0117 ISSN P: 2581-5040

Index Copernicus ICV 2018=62.61

Original ARTICLE

Assessment of age on the basis of appearance of pisiform bone: An observational study

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ABSTRACT

Background: The determination of skeletal maturity plays an important role in diagnostic and therapeutic investigations. 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. Hence; the present study was undertaken for assessing age on the basis of appearance of pisiform bone among males and females divided the basis of gender. **Materials & Methods:** A total of 50 males and 50 females were included in the present study. All the subjects were within the age group of 8 to 13 years. Verification of the actual age of all the subjects was done by assessment of birth certificates. Subjects with presence of congenital anomalies were excluded from the present study. Subjects with presence of fracture of carpal bones were also excluded. Assessment of radiographs of all the patients was done for identification and evaluation of appearance of ossification center of pisiform bone. All the results were recorded in Microsoft excel sheet and were assessed by SPSS software. **Results:** Significant results were obtained while assessing the status of pisiform on left and right wrists in males and females divided on the basis of age. **Conclusion:** Although actual accurate age estimation through radiographic examination of pisiform bone is not possible, a rough estimation could be achieved by assessing the time of appearance of ossification centers.

Key Words: Age, Bone, Pisiform

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This article may be cited as: Baranwal RK, Kumar S, Yadav P. Assessment of age on the basis of appearance of pisiform bone: An observational study. HECS Int J Comm Health Med Res 2019; 5(3):140-142.

INTRODUCTION

The determination of skeletal maturity ('bone age') plays an important role in diagnostic and therapeutic investigations of endocrinological problems and growth disorders of children. In clinical practice, the most commonly used bone age assessment method is atlas matching by a left hand and wrist radiograph against the Greulich & Pyle (G&P) atlas which contains a reference set of normal standard images.¹⁻³ However, besides the fact that the data in G&P atlas was collected in 1950s, this method strongly depends on experience of the observer, leading to considerable inter- and intra-observer discrepancy. Therefore, an updated data collection and an objective method are desirable.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.⁵ Hence; under the light of above mentioned data, the present study was undertaken for assessing age on the basis of appearance of pisiform bone among males and females divided the basis of gender.

MATERIALS & METHODS

The present study was conducted in the department of forensic medicine of BRD Medical College, Gorakhpur -273013, Uttar Pradesh, India. It included assessment of appearance of ossification center of pisiform bone. Ethical approval was obtained from institutional ethical committee and written consent from all the patients after explaining in detail the entire research protocol. A total of 50 males and 50 females were included in the present study. All the subjects were within the age group of 8 to 13 years. Verification of the actual age of all the subjects was done by assessment of birth certificates. Subjects with presence of congenital anomalies were excluded from the present study. Subjects with presence of fracture of carpal bones were also excluded. Assessment of radiographs of all the patients was done for identification and evaluation of appearance of ossification center of pisiform bone. All the results were recorded in Microsoft excel sheet and were assessed by SPSS software. Chi-square test was used for assessment of level of significance. P-value of less than 0.05 was taken as significant.

RESULTS

In the present study, among males, pisiform on right wrists appeared in 26 cases, while it did not appear in 24 cases. Among males with 10 to 11 years of age, pisiform appear in 6 cases, while it did not appear in 4 cases. Among males of 11 to 13 years of age, it appeared in 18 cases, while it did not appear in 2 cases. Significant results were obtained while assessing the status of pisiform on right wrists in males divided on the basis of age. Among males, pisiform on left wrists appeared in 24 cases, while it did not appear in 26 cases. Among males with 10 to 11 years of age, pisiform appeared in 5 cases, while it did not appear in 5 cases. Among males of 11 to 13 years of age, it appeared in 17 cases, while it did not appear in 3 cases. Significant results were obtained while assessing the status of pisiform on left wrists in males divided on the basis of age.

In the present study, among females, pisiform on right wrists appeared in 28 cases, while it did not appear in 22 cases. Among females with 10 to 11 years of age, pisiform appeared in 4 cases, while it did not appear in 5 cases. Among females of 11 to 13 years of age, it appeared in 5 cases, while it did not appear in 16 cases. Significant results were obtained while assessing the status of pisiform on right wrists in females divided on the basis of age. Among females, pisiform on left wrists appeared in 30 cases, while it did not appear in 20 cases. Among females with 10 to 11 years of age, pisiform appeared in 5 cases, while it did not appear in 4 cases. Among females of 11 to 13 years of age, it appeared in 6 cases, while it did not appear in 15 cases. Significant results were obtained while assessing the status of pisiform on left wrists in females divided on the basis of age.

Table 1: Status of pisiform on right wrists in males

Age group (years)	Pisiform		Total	p- value
	Appeared (n)	Not appeared (n)		
8- 9	0	11	11	0.002 (Significant)
9- 10	2	7	9	
10-11	6	4	10	
11- 12	8	2	10	
12- 13	10	0	10	
Total	26	24	50	

Table 2: Status of pisiform on left wrists in males

Age group (years)	Pisiform		Total	p- value
	Appeared (n)	Not appeared (n)		
8- 9	0	11	11	0.000 (Significant)
9- 10	2	7	9	
10-11	5	5	10	
11- 12	7	3	10	
12- 13	10	0	10	
Total	24	26	50	

Table 3: Status of pisiform on right wrists in females

Age group (years)	Pisiform		Total	p- value
	Appeared (n)	Not appeared (n)		
8- 9	10	0	10	0.000 (Significant)
9- 10	9	1	10	
10-11	4	5	9	
11- 12	4	7	11	
12- 13	1	9	10	
Total	28	22	50	

Table 4: Status of pisiform on left wrists in females

Age group (years)	Pisiform		Total	p- value
	Appeared (n)	Not appeared (n)		
8- 9	10	0	10	0.001 (Significant)
9- 10	9	1	10	
10-11	5	4	9	
11- 12	5	6	11	
12- 13	1	9	10	
Total	30	20	50	

DISCUSSION

The pisiform, whose centre of ossification appears between 7.5 and 10 years, is the last carpal bone to ossify. The bone is fully developed by the age of 12. Before this age, there may be multiple centres of ossification, giving it a fragmented appearance. This appearance should be distinguished from a fracture, and if uncertain, it may be helpful to perform radiographs of the opposite wrist or magnetic resonance imaging (MRI) scan.⁶⁻⁸ In the present study, significant results were obtained while assessing the status of pisiform on right wrists in males divided on the basis of age. Among males, pisiform on left wrists appeared in 24 cases, while it did not appear in 26 cases. Among males with 10 to 11 years of age, pisiform appeared in 5 cases, while it did not appear in 5 cases. Among males of 11 to 13 years of age, it appeared in 17 cases, while it did not appear in 3 cases. Significant results were obtained while assessing the status of pisiform on left wrists in males divided on the basis of age. Bjork and Helm used four stages of bone maturation; all found at five anatomical sites located on the thumb, second finger, third finger, and radius. However, eight discrete adolescent skeletal maturity indicators covering the entire period of adolescent development are found on these five sites. On the other hand, Fishman used eleven indicators covering the entire period of development. The sequence of ossification progresses through four stages; A-Width of the epiphysis equal to the width of the Diaphysis. B-Sesamoid ossification (small calcified bone at the Thumb) C-Capping Stage. D-Fusion stage.^{9, 10} In the present study, significant results were obtained while assessing the status of pisiform on right wrists in females divided on the basis of age. Among females, pisiform on left wrists appeared in 30 cases, while it did not appear in 20 cases. Among females with 10 to 11 years of age, pisiform appeared in 5 cases, while it did not appear in 4 cases. Among females of 11 to 13 years of age, it appeared in 6 cases, while it

did not appear in 15 cases. Significant results were obtained while assessing the status of pisiform on left wrists in females divided on the basis of age. Daneff M et al assessed the chronological ultrasonographic emergence of the ossification centers of the hand and wrist. Cross-sectional study of healthy patients ages 1 to 24 months (n=498) from Buenos Aires, Argentina. All patients underwent ultrasonographic evaluation of the left hand and wrist to identify the different bone nuclei; a subgroup of infants had their nuclei measured (n=228). Girls showed an earlier emergence of the evaluated nuclei and a trend to a greater size than age-matched boys. Size-for-age relation showed linear increase. Carpal bones (capitate and hamate) were the first to appear, as early as from the first 3 months of life, an age gap not thoroughly present on the radiographic atlas developed by Greulich and Pyle. The distal epiphysis of the radius and the second metacarpophalangeal joint (index finger) followed in order of emergence. The proximal epiphysis of the first metacarpal bone (thumb) was the last to emerge and was infrequently found on boys at age 24 months. Overall, these findings are in accordance with the radiographic atlas. An ultrasonography atlas of the left hand and wrist was outlined for girls and boys. Conventional ultrasonography allows proper identification of the ossification centers of the hand and wrist and may become an innocuous follow-up tool for patients with growth disorders.¹¹

CONCLUSION

Under the light of above obtained results, the authors conclude that although actual accurate age estimation through radiographic examination of pisiform bone is not possible, a rough estimation could be achieved by assessing the time of appearance of ossification centers. However; further studies are recommended.

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