

Study of Carpal Bone Ossification by Using Radiological Method for Age Estimation of Infant and Paediatric Group in North Indian Population

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ABSTRACT

Background: Ossification of carpal bones forms the most significant aspect of development in clinical sciences and in medical jurisprudence. Important factors influencing the process of ossification include age, sex, heredity, the state of nourishment and particular geographical region may not be exactly similar to that in another area. The main purpose of this study is to evaluate the average age of appearance of the ossification centre of Indian population in comparison with western data. **Materials & Methods:** Present work was performed in 200 healthy individual of both sexes of which date of birth proof was present. X-ray of carpal bones were taken for presence or absence of centre of ossification of the individual carpal bones.

Results: In the present study 102(51%)males and 98 (49%) females were taken who had accurate birth certificate indicating their age from < 6 month to 12 year. Variation in the appearance of centre of ossification in carpal bones shows influence of race, climate, nutritional, and geographical factors.

Conclusion: Ossification of carpal bones in the population of North India occur 1-2 year later than Europeans and appearance of the ossification centre is earlier in females than males.

Key words: Carpal bones, Ossification Centre, Age determination.

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INTRODUCTION

The study of ossification of carpal bones of a child is very important to indicate the level of structural maturity, age estimation, clinical anatomy, in orthopedic surgery and for forensic practitioner.

Skeleton and teeth are the principle sources of information for estimation of age in younger age group.^[1,2] With the invention of Roentgen rays it become possible to visualize the ossification centre for age determination. Radiological data of the hand and wrist is the commonest and most reliable method for the assessment of actual age of a person.^[2]

It became an established fact that appearance of ossification centre are influenced by various factors like age, sex, race, environment, diet, endocrin and also some others. There is evidence that skeletal maturation may vary between different


socioeconomic groups of children or among children living in various geographical locations.^[2]

Considering the vastness of our country it is likely that some variation is found in appearance and fusion of ossification centre. It may be due to varying geographical condition, climate, dietary habits and also some others factors which might have influenced the bony development of a person.

The present work is intended to find a standard data for the appearance of ossification centre in carpal bones in North Indian population.

The first person to work on this issue was Pryor (1907 and 1928), who studied the age and order of appearance of ossification centre of carpal bones to formulate a standard data for establishment of age.^[3,4]

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METHODS

Present work was performed in the Department of Anatomy and Department of Radiology of Jaipur National University for Institute of Medical Sciences and Research Centre, Jaipur. The 200 healthy individuals of both sexes (102 males and 98 females) between the age of < 6 months to 12 years were selected for the present study. Data was collected from K.M.C.H., Katihar, Bihar and SRMSIMS, Bareilly(U.P.) from 2011 to 2016. X-ray machine used are 500 mAGE and 800 mA Siemens poly doors. Postero-anterior view^[5] of wrist were taken. Permission from ethical committee was obtained and cross-sectional study was done.

Only those cases in which the actual age could be ascertained beyond any doubt, were considered for the study. The cases of congenital defect, bony deformity, severe malnutrition and history of trauma of carpal bones were excluded.

RESULTS

The study was performed on 200 subjects who had accurate birth certificate indicating their age from < 6 month to 12 years. Observation done on the individual carpal bones for presence or absence of ossification centre. In the present study 102(51%) males and 98 (49%) females were taken for equal proportion of male and female.

In present study (Table -1) our observation on ossification of carpal bone were following:-

-Ossification centre of Capitate and Hamate appear within one year of life i.e. they are first to appear in carpal bones.

-Triquetral appeared at 3-4.5 year in both males and females.

-Lunate appeared at 4 to <6 year in both sexes.

-Sex variation in the age of ossification of Trapezium, Trapezoid and Scaphoid was observed because ossification centre appears earlier in females i.e. in the age of 6 to 6.5 year in 100% of cases. In males at the age of 7 to 7.5 years in 100% of cases.

-The Pisiform was last to ossify in both the sexes. In female it appeared between 11 to 11.5 years of age. In males it appeared between 11.5 to 12 years of age .

DISCUSSION

In the present study to establish the age of an individual from carpal bones, it is necessary to identify the time of appearance of ossification centre and comparison with similar studies performed by several eastern and western authors.

According to Standring S, (2016) the age of ossification is Capitate -2nd month, Hamate-at the end of 3rd month, Triquetral-3rd year, Lunate, Scaphoid, Trapezium, Trapezoid in 4th year in female ,5th year in male. Pisiform-9-10 year in female and 12th year in male. The order varies according to sex, nutrition and race.^[6]

Hasan and Narayan (1963) studied the Indian children belonging to U.P. and presented the age of ossification of carpal bones were-Capitate and Hamate (<6month), Triquetral (3rd year in female and 5th year in male) Lunate (6th year), Scaphoid (7th year), Trapezium (6th year in female and 7th year in male)and Pisiform (11th year in female and 13th year in male).^[7]

Observation by other Authors on influence of sex in carpal bone ossification that they ossified earlier in female than in male. Francis et al (1939) observed on role of sex on ossification of carpal bones whereas Hasan and Narayan

(1963) observed earlier onset of ossification in female. Davies (1974) has reported Trapezium, Trapezoid, Scaphoid and Pisiform being influenced by sex.^[8,7]

Similar views have been observed by Pryor (1928) and Paterson(1929) A possible explanation for this fact might be that females may be skeletally more advanced and mature than males and this could be due to some hormonal factors, the exacts role of which still remains unexplained .^[3,9] In present study Capitate, Hamate, Triquetral and Lunate showed evidence of ossification simultaneously in both the sexes .Whereas remaining four carpal bone i.e. Trapezium ,Trapezoid ,Scaphoid and Pisiform showed slight variation (1-2 year)in their ossification in male and female. Shrivastava A, Saraswat P. K .et al (2004) Studied 244 healthy children of both sexes up to 12 years of age in Central Rajasthan for age of ossification centre at wrist joint i.e. carpals and lower end of radius and ulna. Their observation for ossification of carpal bone were: Capitate and Hamate ossified during infancy in both sexes, Triquetral at 3-4 years and Lunate at 4-5 years in both sexes. Trapezium, Trapezoid and Scaphoid ossified in female at 8-9 years and in male at 9-10 years. Pisiform was last to ossify in both the sexes, in male 11-12 years (25%) in female at 11-12 years (75%).So up to the age of 12 years Pisiform did not ossify in all female in this study.^[10]

Kumar A. Kumar S. et al (2016) studied 200 individuals from Indian population of North Bihar. They observed that Pisiform appeared by the age of 12 years in male and female both.^[11]

In the present study Capitate and Hamate ossified during infancy this is also observed by Indian and Non -Indian authors.^[3,9,10,11]

Chaurasia B.D.(2013)mentioned appearance of capitate at the age of 2nd month and Hamate at the age of 3rd month, Triquetral at the 3rd year , lunate at 4th year, Scaphoid, Trapezium, Trapezoid at 5th year, Pisiform at 12 years of age.^[12]

In Indian population^[10-12] and in present study ossification centre of Triquetral appeared in 3-4.5 years of age and Lunate ossified in 4-6 year of age but it ossified earlier in Non -Indian population.^[3,9] The difference in the age of ossification between Indian and Non -Indian people may be on the basis of race, nutritional state and geographical environment.

This variation in the age of ossification existing between areas within India i.e. U.P., Bihar, North India may be due to local conditions do have a significant role in determining the onset and process of ossification of carpal bone.

In this regard, the present work will provide some help for the North Indian population because known age of ossification of carpal bones of the particular area is mandatory for age estimation by examination of the ossification of carpal bones. In present study all the carpal bones ossify from single centre. Davies and Parsons (1927) and Paterson(1929)also had similar observation.^[3,9,13] Pryor (1928)observed more than one centre of ossification in lunate and Triquetral, Sawtell (1929) for theTriquetral.^[14]

CONCLUSION

-Ossification of carpal bone in the population of North India occur 1-2 year later then Europeans. -The appearance of the ossification centre is earlier in female than male by about 1.5 years.

-All the carpal bones showed only one centre of ossification.

-Variation in the appearance of centre of ossification in carpal

Table I: Percentage (%) of cases Showing ossification.

Age Group in Year	Capitate		Hamate		Triquetral		Lunate		Trapezium		Trapezoid		Scaphoid		PisiformF		
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	
0 month - 6month	50	80	50	80	-	-	-	-	-	-	-	-	-	-	-	-	-
6 month-<1year	100	100	100	100													
1 - 1.5	100	100	100	100													
1.5 -<2	100	100	100	100													
2 -2.5	100	100	100	100													
2.5 -<3	100	100	100	100													
3 -3.5	100	100	100	100	-	50											
3.5 -<4	100	100	100	100	50	100											
4 - 4.5	100	100	100	100	100	100	15	70									
4.5 -<5	100	100	100	100	100	100	40	90									
5 - 5.5	100	100	100	100	100	100	80	100	16	30	18	40	25	50			
5.5 -<6	100	100	100	100	100	100	100	100	30	50	25	50	30	70			
6 - 6.5	100	100	100	100	100	100	100	100	40	100	40	100	50	100			
6.5 -<7	100	100	100	100	100	100	100	100	50	100	50	100	70	100			
7 - 7.5	100	100	100	100	100	100	100	100	100	100	100	100	100	100			
7.5 - <8	100	100	100	100	100	100	100	100	100	100	100	100	100	100			
8 - 8.5	100	100	100	100	100	100	100	100	100	100	100	100	100	100			
8.5 -<9	100	100	100	100	100	100	100	100	100	100	100	100	100	100			
9 - 9.5	100	100	100	100	100	100	100	100	100	100	100	100	100	100			
9.5 -<10	100	100	100	100	100	100	100	100	100	100	100	100	100	100			
10 - 10.5	100	100	100	100	100	100	100	100	100	100	100	100	100	100			
10.5 -<11	100	100	100	100	100	100	100	100	100	100	100	100	100	100	15	50	
11 -11.5	100	100	100	100	100	100	100	100	100	100	100	100	100	100	30	100	
11.5 - 12	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	

M – Male, F- Female

Table II: Showing comparison of appearance of ossification centre as observed by different authors.

Bones	Francis et al (1939)	Vij K. (2014)	Standring S. (2016)	Apurba N. (2010)	V V Pillay (2017)	K.S.Narayan O.P.Murty (2014)	Present work
Capitate	2m(M&F)	2 month	2 nd m	1 st Y	1 y	2 month	<1 year (M&F)
Hamate	2m(M&F)	3 month	3 rd m	1 st Y	2 y	2 month	<1 year (M&F)
Triquetral	10m(M&F)	2-3 Y	3 rd y	3 rd Y	3 y	3 Y	4-4.5 (M&F)
Lunate	2Y(M&F)	3-4Y	4 th y	4Y	4 y	4 Y	5-5.5 (F) 5.5-6(M)
Trapezium	4Y(M&F)	5-6Y	4 th (F) 5 th (M)	4-5Y	6 y	6 Y	7-7.5 (M&F)
Trapezoid	4Y(M&F)	5-6Y	4 th (F) 5 th (M)	4-5Y	7 y	5 Y	7-7.5 (M&F)
Scaphoid	4Y(M&F)	5-6Y	4 th (F) 5 th (M)	6Y	5 y	5 Y	7-7.5 (M&F)
Pisiform	12Y(M) 13Y(F)	10-12Y	10 th (F) 12 th (M)	9-12Y	12 y	11-12 Y	11.5-12(F) 12 (M)

bones shows influence of race, climate, nutritional and geographical factors prevailing in different parts of the world and also within the country.

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