

Assessment of age in female population by radiographic examination of Carpal bones

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Abstract

Introduction: Assessment of the age of an individual from the appearance and the fusion of the ossification centers is a well-accepted fact in Medical and Legal professions. In the age estimation of juvenile offenders, radiological examination of bones gives valid idea of age needed in courts.

Objectives: Aim was to assess the age of the ossification of carpal bones at wrist joint in females. The objectives were to estimate the age specific difference in all subjects, also to study difference age of ossification in central part of India with other part of country and abroad.

Method: After obtaining the ethical clearance the subjects below the age of 20 years residing in central India were included in this study. As per inclusion criteria carpal bones forming wrist joint were examined radiologically with standard accepted procedures and guidelines to assess the age.

Result: The outcome of this study was very fruitful and knowledgeable as it revealed age specific difference and remarkable difference in the age of ossification as compared to the foreign countries and other parts of India.

Conclusion: Radiological examination plays very vital role in age estimation in judicial cases. It can be concluded that such studies should be conducted with good sample size and at regular intervals for academic as well as in judicial point of view.

Keywords: Age, Asses, Ossification, Wrist joint, Radiological.

Introduction

Age is helpful in identification of an individual which in turn is helpful in both civil and criminal cases according to Sangma William Bilkey ch. et al¹. It has

been also stated that the study of epiphyseal union of bones is considered a reasonable scientific and accepted method for age determination by the law courts all over the world². **Forensic Osteology** is the branch of Forensic Medicine which deals with the study of the bones. Epiphysis of the bones unites during age periods which are remarkably constant for a particular epiphysis³. Epiphysis of the bones unites at the particular age and this is helpful in the age determination. In law the crime and punishment is entirely based on the criminal responsibility and this in turn depend on the age of a person⁴. Reddy KSN stated that (2009) the bones of human skeleton develop from a number of ossification

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centers. At eleventh to twelfth week of intrauterine life, there are 806 centers of ossification, at birth there are about 450. The adult human skeleton carries only 206 bones⁵. India is a vast country with diversity in social customs, multiple religions, dietary habits and variations in climatic conditions. In Modi's textbook it is quoted that owing to variation in climatic, dietetic, hereditary and other factors affecting the people of the different states of India, it cannot be reasonably expected to formulate a uniform standard for the determination of the age of the union of epiphyses for the whole of India⁶. Mehta Homi S (1963) observed that it has been approved by research in our country that the epiphysio-diaphysial union in Indian occurs about a year or two in advance of the age at which that occurs in Europeans⁷. According to Parikh CK Union of epiphysis in cartilaginous bones takes place earlier in the females by about 2 years than in males except in case of skull sutures where obliteration sets in little later and proceeds more slowly in females than in males and under tropical conditions ossification is observed earlier than in temperate areas⁸. According to Iscan M.Yasar and Loth Susan R(1984) estimation of age from the adult skeleton has been the most difficult part of Human identification studies. Human growth is continuous process which goes through first, a developmental stage and second, the maintenance of status quo. In the developmental stage, changes in skeletal and dental morphology occur in an age –age predictive sequence⁹. Jit and Balbir Singh revealed that the Precocity of epiphyseal union has been attributed to racial and climatic factors. Works in different regions of India-North (Punjab, Delhi and UP), East (Bengal) and South (Madras) have given different ages of fusion of the epiphysis. Further, workers in the same region have also given different ages of fusion of the epiphysis of the same bone and in the same sex. This difference could possibly be due to inadequate material or recording of incorrect ages of the subjects¹⁰.

Hence, it was, decided to reestimate age radiologically in the central part of India, by including authentically examined subject, with valid age proof belonging to indigenous population.

Aims and Objectives: Radiological evaluation of carpal bones forming the Wrist joints (Scaphoid, Lunate, Triquetral, Pisiform, Trapezium, Trapezoid, Capitate, and Hamate) in female subjects was undertaken with the following aims and objectives:

1. To estimate the age from ossification of carpal bones of Wrist joint in relevant Subjects belonging to indigenous population of the central India.
2. To assess the age specific difference in ossification of bones in all the subjects.
3. To assess and evaluate the difference in the ossification in Central part of the India with other part of India on the basis of literature available.
4. To compare the deduced data with previously available data of other countries.

Material and Method

50 female subjects from age 0 to 20 years, were included in this study. The individual chosen for the study were evaluated and confirmed for the authentic proof of date of birth, physical fitness and their native place of central India. Individual involved in study were predominately right handed. A written informed consent and permission from Ethical Committee of the Institute was obtained.

Procedure of Radiography: After taking the written consent, the thorough physical examination and radiological evaluation was done. Training of Researcher was undertaken to get well acquainted with all the radiological procedures essential for X-Ray examination and developing X-Ray films. X-Rays were taken with the help of X-Ray machine in the Department. Minimum shots were taken to expose the joints involved in study and minimum and appropriate voltage settings of X-Ray machine were applied so as to avoid unnecessary radiation exposure of the subjects to get the desired qualities of X-Rays. The developed X-Ray films were studied and reporting was done with the help of by experienced Radiologist and Anatomist. All the radiological procedure was undertaken according to the present accepted standards. Skeletal maturity was evaluated according to the **Jits and Kulkarnis classification as Appeared or non appeared**¹¹.

The master chart was prepared and tabulated & was classified, analysed and compared with known standards. 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.

Table 1: Appearance of carpal bones in Female on right side.

Agein years	Scaphoid	Lunet	Triquetral	Pisiform	Trapezium	Trapezoid	Capitate	Hamet
<1-5	1(2%)	5(10%)	8(16%)	0(0%)	1(2%)	0(0%)	9(18%)	9(18%)
6-10	13(26%)	13(26%)	13(26%)	6(12%)	13(26%)	13(26%)	13(26%)	13(26%)
11-15	12(24%)	12(24%)	12(24%)	11(22%)	12(24%)	12(24%)	12(24%)	12(24%)
16-20	15(30%)	15(30%)	15(30%)	15(30%)	15(30%)	15(30%)	1(2%)	15(30%)
Total	41(82%)	45(90%)	48(96%)	32(64%)	41(82%)	40(80%)	49(98%)	49(98%)
χ ² -value	26.96							
p-value	0.17, NS, p>0.05							

Scaphoid, Lunet, Triquetral, Trapezium, capitate, Hamate appeared in 1 (2%), 5 (10%), 8(16%), 1(2%), 9(18%), 9(18%) respectively in <1-5 age group. Pisiform and Trapezoid appeared in 6(12%), 13(26%) respectively in 6-10 age group.

Table 2: Comparison of the findings of the present study with the previous studies (in Yrs and months)

	Galstaun (Bengalis)	Nandy Apurba	Flecker (Australians)	Davies & Parsons (Englanders)	Present study
	Year	Year	Year	Year	Year
Triquetral					
Appearance	2-3	3	11/2	2-4	3
Lunate					
Appearance	2-3	4	4	3-4	4
Trapezium					
Appearance	4-7	4-5	5	6-7	5-6
Trapezoid					
Appearance	5-6	4-5	5	6-8	6-7
Scaphoid					
Appearance	6	6	5	6-8	5-6
Pisiform					
Appearance	9	9-12	9	12	9-10
Capitate					
Appearance	½	1	½	3-5	1
Hamate					
Appearance	1-14 mon.	1	6-10 months	4-5 months	1

Discussion

Scaphoid: In the female age groups of <1-5, 6-10, 11-15,16-20 years Scaphoid had appeared in 1(2%), 13(26%), 12(24%), 15(30%) subjects respectively. Scaphoid appeared earliest at 5-6 year in female subjects on right side. Galstaun G. (1937) in Bengali population found appearance of Scaphoid at 6 years in female¹². According to present study Scaphoid appeared

1 years earlier in females than in Galstaun G study. Flecker (1942) in Australians population found that the appearance of Scaphoid at 5 years in female, but in present study Scaphoid has appeared 0-1 year later¹³. Davies & Parsons (1927) in his study on Englanders found that the Scaphoid appears at 6 - 8 years, which appeared 0 - 3 year earlier in current study¹⁴. According to Nandy A (2000) Scaphoid appears at 6 years, which is observed 0 - 1 year earlier present study¹⁵.

Lunate: In the female age groups of <1-5, 6-10, 11-15, 16-20 years the Lunate had appeared in 5(10%), 13(26%), 12(24%), 15(30%) subjects respectively. In this study Lunate was appeared earliest at 4 years in females subjects. Galstaun G. (1937) in Bengali population found appearance of Lunate at 2-3 years, but in present study Lunate appeared 1-2 years later¹².

Flecker (1942) in Australians population found that the appearance of Lunate at 4 years in males, matching to this study¹³.

Triquetral: In the Female age group of <1-5, 6-10, 11-15, 16-20 years Triquetral had appeared in 8(16%), 13(26%), 12(24%), 15(30%) subjects respectively. It can be concluded that, centre for Triquetral appeared at 3 year. Galstaun G. (1937) in Bengali population found appearance of Triquetral at 2-3 years. In comparison with this study in present study Lunate appeared nearly at similar age. Flecker (1942) in Australians population found that the appearance of Triquetral at 1 ½ year. On contrary to his findings in present study it is found that Triquetral has appeared 1 ½ year later.

Pisiform: In the female age groups of 6-10, 11-15, 16-20 years, Pisiform had appeared in 6(12%), 11(22%), 15(30%) subjects respectively. In this study Pisiform was appeared earliest at 9-10 years. Galstaun G. (1937) in Bengali population found appearance of Pisiform at 9 years in female, it is matching with present study. Flecker (1942) in Australians population found that the appearance of Pisiform at 9 year in females, in present study Pisiform has appeared 0 - 1 year later.

Trapezium: In the female age group of <1-5, 6-10, 11-15, 16-20 years, Trapezium had appeared in 1(2%), 13(26%), 12(24%), 15(30%) subjects respectively. In this study Trapezium was appeared earliest at 5-6 years. Galstaun G. (1937) in Bengali population found appearance of Trapezium at 5-6 years, in present study Trapezium appeared nearly at similar age. Flecker (1942) in Australians population found that the appearance of Trapezium at 5 year in females, but here it has appeared 0 - 1 year later.

Trapezoid: In the female age group of 6-10, 11-15, 16-20 years, Trapezoid had appeared in 13(26%), 12(24%), 15(30%) subjects respectively. In this study Trapezoid was appeared earliest at 6-7 years. Galstaun G. (1937) in Bengali population found appearance of Trapezoid at 5-6 years which appeared 1-2 years later in present study. Flecker (1942) in Australians population

found that the appearance of Trapezoid at 5 year, on contrary in present study it appeared at 1-2 years late.

Capitate: In the female age groups of 6-10, 11-15, 16-20 years, Capitate had appeared in 9(18%), 13(26%), 12(24%), 15(30%) subjects respectively. In this study Capitate was appeared earliest at 1 years. Galstaun G. (1937) in Bengali population & Flecker (1942) in Australians population found appearance of Capitate at 6 months, which appeared nearly 6 months later in present study.

Hamate: In the female age group of 6-10, 11-15, 16-20 years, Hamate had appeared in 9(18%), 13(26%), 12(24%), 15(30%) subjects respectively. In this study Hamate was appeared earliest at 1 years. Galstaun G. (1937) in Bengali population found appearance of Hamate at 1-14 months in present study Hamate appeared 2 months later¹². Flecker(1942) in Australians population found that the appearance of Hamate at 6 – 10 months, on contrary to his findings in present study it is found that Hamate has appeared 2 – 6 months later¹³.

Summary and Conclusions

1. This study was conducted exclusively on the young indigenous male population of Central India keeping in mind that very less literature about the age estimation from ossification of Wrist joint on both the right and left side is available involving this particular region of India.
2. The ossification of carpals at the Wrist joint in females on right is completed in all instances at the age 9-10 year respectively.
3. By comparing the available literature, the age of skeletal maturity in females in this region is nearly similar to those in state of West Bengal.
4. By comparing the available literature ossification center appeared one to two years earlier in this study with population of Central India than those in Australia and England.
5. As this study is done in Central India region the application of standards of this study can be considered ideal for application in the region of Central India.
6. As the sample size is limited further studies are necessary. Region wise studies should be conducted for better correlation and comparison.
7. Due to changing life style pattern, dietary, climatic,

behavioral factors age of ossification is changing as mentioned in the available literature. So as to evaluate these changes, studies are recommended in every region of India at regular time period for academic and judicial interest.

8. Along with the clinical and dental examination, radiological study plays an important role to arrive at the opinion about the age in medicolegal cases.
9. The opinion about age should be given always in the range. From this study range of 1-2 years of margin of error can be concluded.

Conflict of Interest: No conflict of interest was reported during conduction of study and preparation of this research article

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Ethical Clearance: Due ethical clearance from institutional ethics committee was taken to undertake this study.

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