

# Radiological study of hand and wrist in the age groups 1-10 years in persons of North Karnataka

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## Abstract

**Introduction:** Ossification is a process of deposition of calcium and other minerals in osteoid tissue. This process of deposition starts as a small point, then it spreads in all the direction that point at which calcium starts depositing is known as ossification center. **Material and Methods:** The subjects of the present study consists of total number of 228 healthy students which 125 were boys and 103 girls, collected over a period of two years (1998 – 2000) from Revansiddheswar Primary School, Ambedkar high school and other neighbouring areas in and around Bijapur city. **Discussion:** The present study was undertaken to assess the age of appearance of primary and secondary ossification centres of various bones of the wrist and hand viz. lower end of radius lower end of ulna, carpal bones, metacarpal bones, phalangeal bones of the fingers in the age group 0-20 years in Bijapur (North Karnataka) region and to compare the findings with that of other workers. Investigations of the present study are of great importance to assess. **Conclusion:** The study is extended all other bones so that the age determination by X – ray can be taken accurately for population of this part of the country and also influence of nutrition and hormones can be assessed. Thus the growth pattern of the individuals can be determined.

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## INTRODUCTION

Ossification is a process of deposition of calcium and other minerals in osteoid tissue. This process of deposition starts as a small point, then it spreads in all the direction that point at which calcium starts depositing is known as ossification center. If it appears before birth, then it is known as primary ossification centre and if it

appears after the birth it is known as secondary ossification centre. That part of the bone ossified from the primary centre is known as diaphysis and that part by the secondary centre is known as epiphysis. Fusion of epiphysis and diaphysis determine the growth of the bone in length, thus growth of the child. No doubt the long bone grows at both the ends; the end which fuses last is called as growing end. Thus the long bones are formed out of preformed cartilage models. These processes of appearance of ossification centres and their fusion is genetically determined for each bone (Dreizensamuel)<sup>12</sup> and differ in each sex, varies with the race. The nutrition plays an important role in critical period of growth, thus the growth is affected by malnutrition, diseases which are affecting nutrition. India is a developing country, prevalence of poverty and ignorance plays a major role in the growth and development of our children. Thus the present study aims at understanding of the parameters of appearance and fusion of ossification centres accounting

for the growth of the children in this part of the country and to compare with that of the other workers.

## **MATERIAL AND METHODS**

The subjects of the present study consists of total number of 228 healthy students which 125 were boys and 103 girls, collected over a period of two years (1998 – 2000) from Revansiddheswar Primary School, Ambedkar high school and other neighboring areas in and around Bijapur city. The age of the students was ranging between 1-10 years and the same was confirmed from their school records and birth certificates. Both hands and wrists of all the students were radio graphed from radiology department BLDEA'S Sri B.M. Patil Medical college hospital and research center Bijapur and their radiological findings of carpal bones, meta carpal bones, phalangeal bones, lower end of radius and lower end of ulna of both hands and wrist were recorded to assess the time of appearance of ossification centers.

**Criteria:** Appearance of ossification centre the assessment of ossification centre was made on the basis of appearance of radio – opaque shadow the different parts of diaphysis and epiphysis of bone, carpal bones, metacarpal bones, phalangeal bones, lower end of radius and lower end of ulna.

### **Observations**

#### **Lower end of radius:**

In males the mean age of appearance was  $3.07 \pm 0.82$  years with an earliest and latest age of appearance 2.0 and 4.0 years respectively. In females the mean age of appearance was  $2.33 \pm 0.958$  years with an earliest and latest age of appearance 1.0 and 3.54 year respectively.

#### **Lower end of ulna:**

In males the mean age of appearance was  $6.78 \pm 0.63$  years with an earliest and latest age of appearance 5.64 and 7.5 years respectively. In females the mean age of appearance was  $6.21 \pm 1.16$  years with an earliest and latest age of appearance 3.0 and 7.64 years respectively.

#### **Scaphoid:**

In males the mean age of appearance was  $6.5 \pm 0.67$  years with an earliest and latest age of appearance 4.16 and 7.76 years respectively. In females the mean age of appearance was  $6.3 \pm 0.27$  years with an earliest and latest age of appearance 3.64 and 9.0 years respectively.

#### **Lunate:**

In males the mean age of appearance was  $6.38 \pm 1.18$  with an earliest and latest age of appearance 3.64 and 9.0 years respectively. In females the mean age of appearance was  $6.25 \pm 1.29$  years with an earliest and latest age of appearance 3.64 and 8.0 years respectively.

#### **Triquetral:**

In males the mean age of appearance was  $4.08 \pm 0.40$  with an earliest and latest age of appearance 3.56 and 4.68 years respectively. In females the mean age of appearance was  $4.45 \pm 0.39$  years with an earliest and latest age of appearance 3.64 and 5.0 years respectively.

#### **Trapezium:**

In males the mean age of appearance was  $6.5 \pm$  years with an earliest and latest age of appearance 4.16 and 9 years respectively. In females the mean age of appearance was  $6.4 \pm 1.21$  years with an earliest and latest age of appearance 3.16 and 9 years respectively.

#### **Trapezoid:**

In males the mean age of appearance was  $6.4 \pm 1.06$  years with an earliest and latest age of appearance 4.64 and 9 years respectively. In females the mean age of appearance was  $6.4 \pm 1.21$  years with an earliest and latest age of appearance 3.64 and 9 years respectively.

#### **Capitate and Hamate:**

In males all the subjects showed the appearance from 0.833 to 18.936 years. In males all the subjects showed the appearance from 1 year to 20 years, in females.

**Metacarpal I -V:** In males the mean age of appearance was  $3.02 \pm 0.843$  years with an earliest and latest age of appearance 2.0 and 4.0 years respectively. In females the mean age of appearance was  $2.92 \pm 0.693$  years with an earliest and latest age of appearance 2.0 and 4.0 years respectively.

#### **Thumb finger:**

In males the mean age of appearance in both, the proximal and distal phalanges were  $3.08 \pm 0.7905$  years with an earliest and latest age of appearance 2.0 and 4.0 years respectively. In females the mean age of appearance in both, the proximal and distal phalanges were  $2.911 \pm 0.695$  years with an earliest and latest age of appearance 2.0 and 3.88 years respectively.

#### **Index finger:**

In males the mean age of appearance in all the proximal, middle and distal phalanges was  $3.08 \pm 0.7905$  years with an earliest and latest age of appearance 2.0 and 4.0 years respectively. In females the mean age of appearance in all the proximal, middle and distal phalanges was  $2.94 \pm 0.695$  years with an earliest and latest age of appearance 2.0 and 3.88 years respectively.

#### **Middle finger:**

In males the mean age of appearance in all the proximal, middle and distal phalanges were  $3.08 \pm 0.7905$  years with an earliest and latest age of appearance 2.0 and 4.0 years respectively. In females the mean age of appearance in all, the proximal, middle and distal phalanges were  $2.911 \pm 0.695$  years with an earliest and latest age of appearance 2.0 and 3.88 years respectively.

#### **Ring finger:**

In males the mean age of appearance in all the proximal, middle and distal phalanges were  $3.08 \pm 0.7905$  years with an earliest and latest age of appearance 2.0 and 4.0 years respectively. In females the mean age of appearance in all, the proximal, middle and distal phalanges were  $2.911 \pm 0.695$  years with an earliest and latest age of appearance 2.0 and 3.88 years respectively.

#### **Little finger:**

In males the mean age of appearance in all the proximal, middle and distal phalanges were  $3.08 \pm 0.7905$  years with an earliest and latest age of appearance 2.0 and 4.0 years respectively. In females the mean age of appearance in all the proximal, middle and distal phalanges were  $2.911 \pm 0.695$  years with an earliest and latest age of appearance 2.0 and 3.88 years respectively.

## **DISCUSSION**

The present study was undertaken to assess the age of appearance of primary and secondary ossification centres of various bones of the wrist and hand viz. lower end of radius lower end of ulna, carpal bones, metacarpal bones, phalangeal bones of the fingers in the age group 0-20 years in Bijapur (North Karnataka) region and to compare the findings with that of other workers. Investigations of the present study are of great importance to assess:

### **Appearance of secondary ossification centre of lower end of radius**

It was observed that the age of appearance of the secondary ossification centre of the lower end of radius was  $3.07 \pm 0.82$  years in males and  $2.33 \pm 0.958$  years in females. The centre appeared later in males by 0.74 years. Sawtell RO. (New York) 1929<sup>2</sup> observed roentgenograms of the hands of the 112 children (58 boys, 54 girls) of 3 – 6 years of age group and found that the age of appearance in both males and females 0.833 years. The present findings are higher by 2.237 years in males, 1.497 years in females than the findings given by Sawtell RO. Appearance of secondary centre of ossification of lower end of Ulna- It was observed that the appearance of the secondary ossification centre of the lower end of Ulna  $6.78 \pm 0.63$  years in males,  $6.21 \pm 1.16$  years in females (Table 1A) The appeared later in males by 0.57 years. Sawtell RO. (New York) 1929<sup>2</sup> studied the roentgenograms of the hand of the 112 children (58 boys, 54 girls) between 3 – 6 years age and found the age in year of the appearance of secondary ossification centre of the lower end of ulna was 3.833 years in males, 5.25 year in females. The centre appeared earlier in males by 1.417 years. The present findings are higher by 2.947 years in males, 0.96 years in females than the findings of Sawtell RO.

### **Carpal Bones**

#### **Appearance of primary ossification centres:**

It was observed from the present finding that the age of appearance of primary ossification centres in years of capitate and hamate 0.833 years in males, 1.0 year in females triquetral  $4.08 \pm 0.40$  years in males,  $6.25 \pm 1.29$  years in females ; scaphoid  $6.5 \pm 0.67$  years in males  $6.3 \pm 1.18$  years in males  $6.3 \pm 0.27$  years in females ; trapezium  $6.5 \pm 1.29$  years in female ; scaphoid  $6.5 \pm 0.67$  years in males  $6.3 \pm 1.06$  years in females ; trapezium  $6.5 \pm 1.01$  years in male, 6.4 1.21 years in females ; trapezoid  $6.7 \pm 1.06$  years in male,  $6.4 \pm 1.21$  years in females ; The centres appeared earlier in males by 0.67 year in capitate and hamate ; 0.37 year in triquetral later by 0.13 year in lunate ; 0.2 year in scaphoid ; 0.1year in trapezium ; 0.3 year in trapezoid ; 1.47 years in pisiform. Sawtell R.O. (New York) 1929<sup>38</sup> observed roentgenograms of the hands of the 112 children (58 boys, 54 girls) of 3 – 6 years age and found out the age of appearance of primary ossification centers of carpal bones in year triquetral 3.0833 years in males and females ; lunate 4.416 years in males, 3.416 years in females ; scaphoid 5.33 years in males, 4.75 years in females ; trapezium 5.75 years in males, 4.583 years in females ; trapezoid 6.0 years in males, 4.646 years in females. The primary centres of ossification of carpal bones appeared at the same age in both males and females in triquetral later in males by 1.0 year in lunate, 0.58 years in scaphoid; 1.167 years in trapezium ; 1.354 years trapezoid. The present findings are higher by 0.996 years in males, 1.366 years in females in triquetral 1.964 years in males, 1.55 years in females; in scaphoid ; 0.75 years in males, 1.917 years in females in Trapezium ; 0.7 years in males, 1.754 in females in trapezoid. The present findings are higher by 0.996 year in males, 1.366 years in females in triquetral, 1.964 years in males, 2.834 years in females in lunate ; 1.17 years in males, 1.55 years in scaphoid ; 0.75 year in males, 1.917 years in females in trapezium ; 0.7 year in males, 1.754 years in females in trapezoid.

### **The Order of appearance of carpal bones in present findings:**

#### *In Males*

1. Capitate
2. Hamate
3. Triquetral
4. Lunate
5. Scaphoid
6. Trapezium
7. Trapezoid

#### *In females*

1. Capitate
2. Hamate
3. Triquetral
4. Lunate
5. Scaphoid
6. Trapezium
7. Trapezoid

The order of appearance of carpal bones as given by Hasan N. and Narayan D-

#### *In Males*

1. Capitate
2. Hamate
3. Triquetral
4. Lunate
5. Scaphoid
6. Trapezium
7. Trapezoid
8. Pisiform

#### *In females*

1. Capitate
2. Hamate
3. Triquetral
4. Lunate
5. Scaphoid
6. Trapezium
7. Trapezoid
8. Pisiform

In present findings the order of appearance of carpal bones is same in both sexes. scaphoid appeared earlier than trapezium and trapezoid. In the findings of Hasan N. and Narayan D. the scaphoid appeared later in females than trapezoid and trapezium where as scaphoid appeared early in males than trapezoid and trapezium. The primary centres of ossification of carpal bones in present findings appeared earlier in females by 0.167 time in capitate and hamate ; by 0.37 years in females in triquetral ; later by 0.13 years in lunate ; 0.2 years in scaphoid ; 0.1 year in trapezium ; 0.3 year in trapezoid ; 1.47 years in pisiform.

### **Metacarpal bones**

#### **Appearance of primary ossification centres:**

From the present findings it was observed that the presence of primary centres for metacarpals I to V at the age of 0.833 years in males, 1.0 years in females. The centre appeared earlier in males by 0.167 year. Flecker HMB. (Australia) 1942<sup>4</sup> studied roentgenologically and found out the primary centre of ossification appeared in metacarpal bones I to V at the age of 62mm crown rump length (11 ½ weeks).

#### **Appearance of secondary centres of ossification:**

From the present findings it was found out that the age of appearance of secondary ossification centres of metacarpal bones I to V 3.02 ± 0.843 years in males, 2.92 ± 0.693 years in females of Metacarpals I to V. the centres appeared later in males by 0.1 year. Sawtell. RO. (New York) 1929<sup>2</sup> observed the roentgenograms of the hands of the 112 children (58 boys, 54 girls ) of 3 – 6 years age and found out the age in years of appearance of secondary ossification centres for metacarpal I to V after 2.5 years.

### **Phalangeal bones:**

#### **Appearance of primary ossification centers:**

From the present findings it was observed that the primary centres of ossification were present at the age of 0.833 years in males and 1.0 years in females. The centre appeared earlier in males by 0.167 years. Sawtell RO (New York) 1929<sup>2</sup> observed roentgenograms of the hands of the 112 children (58 boys and 54 girls) of 3 – 6 years age and found the age of appearance of primary ossification centres of phalangeal bones 2.41 years in all the proximal, middle and distal phalangeal bones of all the fingers. The present findings are lower by 1.577 years in males, 1.41 years in females than the Sawtell RO.

#### **Appearance of secondary ossification centres:**

From the present findings it was observed that the age of appearance of secondary centres of ossification was 3.08 ± 0.790 years in males 2.911 ± 0.695 years in females of proximal, middle and distal row of phalanges of all the fingers (thumb, index, middle, ring and little) The secondary centres of all the phalanges appeared later in males by 0.169 years.

Sawtell RO. (New York) 1929<sup>2</sup> observed the roentgenograms of the hands of the 112 children (58 boys, 54 girls) of 3 – 6 years age and found the age of appearance of secondary osseification centres of proximal, middle and distal row phalanges of all the fingers (thumb, index, middle, ring and little ) 2.41 years. The present findings higher by 0.67 year in males 0.5 years in females than that of Sawtell RO. The secondary centres of ossification of phalanges appeared later in males proximal row - thumb by 1.74 years, index by 1.6 ; middle finger by 0.8 years ; ring finger by 0.9 years little finger by 0.8 years ; middle row - index finger by 1.5 years middle finger by 0.7 years ; ring finger by 0.9 years little finger by 0.8 years ; distal row thumb by 1.3 years, index finger by 0.9 years ; middle finger by 0.8 year ; ring finger 0.5 year little finger by 0.8 year. The present findings are higher in male proximal row thumb by 0.28 years in males, 1.851 year in females, index finger lower in males by 0.98 year, higher in females by 1.411 years. Middle finger higher in males by 0.68 year, by 1.311 years in females ; ring finger higher in males by 0.68 year, in females by 1.411 year little finger higher by 0.68 year in males, by 1.38 years in females middle row index finger lower in males by 0.12 year higher by 1.211 years on females ; middle finger higher by 0.68 year in males, by 2.11 year in females ; ring finger higher in males by 0.68 years in female by 1.411 year ; little finger higher in male by 0.68 year in males by 1.411 year in females ; distal row higher in males by 0.08 in thumb and index fingers by 0.68 year in middle, ring and little fingers; higher in females by 1.211 year in thumb; by 0.811 year in index by 1.311 years in middle by 1.011 year in ring by 1.311 year in little finger than that of Bajaj I.D. *et al.* Surya Prakash (Punjabees from Rohtale) 1975<sup>5</sup> studied 500 Hindus children from birth to 6 years of age roentgenologically and found the appearance age in years of secondary ossification centres of phalangeal bone. Proximal row thumb 3.166 years, Index 1.999 years ; middle finger 1.465 years, ring finger 1.566 years little finger 2.047 years, middle row Index finger 2.533 years, middle finger 3.378 years, ring finger 2.379 years, little finger 3.744 years. distal row thumb – 1.436 years, index finger 3.283 years, middle finger 2.533 years, ring finger 2.696 years, little finger 3.521 years. Middle row index finger higher by 0.547 years middle finger higher by 0.742 years, ring finger higher by 0.701 years, little finger lowers 0.694 years. distal row thumb higher by 1.644 years, index finger lower by 0.203 years, middle finger higher by 0.547 years, ring finger higher by 0.384 years, little finger lower by 0.441 years than the findings of Surya Prakash. The present findings are proximal row - thumb lower by 0.886 years, index finger higher by 0.081 year, middle finger – higher by 1.615 years, ring finger –

higher by 1.514 year, little finger – higher by 1.033 years. Middle row Index finger higher by 0.547 years middle finger higher by 0.742 years, ring finger higher by 0.701 years, little finger lowers 0.694 years. Distal row - thumb higher by 1.644 years, index finger lower by 0.203 years, middle finger higher by 0.547 years, ring finger higher by 0.384 years, little finger lower by 0.441 years than the findings of Surya Prakash.

## CONCLUSION

The study is extended all other bones so that the age determination by X – ray can be taken accurately for population of this part of the country and also influence of nutrition and hormones can be assessed. Thus the growth pattern of the individuals can be determined.

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