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"OSSIFICATION AND AGE: A RELATION"

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ABSTRACT
The process of gradual bone formation is known as 'ossification'. Both cartilages and bones are mesodermal in origin. They develop from the embryonic mesenchyme. ossification in membrane is an urgent affair and the process is accomplished with extreme rapidity. Whereas ossification in cartilage is a gradual and leisurly procedure. But in the both situations final histological structures of membrane and cartilage bones is identical. The point from where ossification starts is known as the centre of ossification. It is of two types viz. primary and secondary. Primary centres appear in pre-natal life whereas secondary centres appear post-natal with certain exceptions. Epiphysis in bones other than long bones fuse with the main part of the bone between 20-25 years. Fusion of epiphysis with diaphysis occurs two years earlier in women than in men. Epiphysis also appears earlier in women. Biological and structural maturity of a child is assessed in a comprehensive way by the estimation of bone-age rather than arithmetic operations since date of birth. The most common method to assess bone-age is through radiograph of the manus and the wrist joint. Other method stated is ultrasonography but it serves no good as compared to radiograph technique. It remains as theoretical entity only. Dental age serves as an optional tool to assess bone age in relation with skeletal maturity. There is a need to develop more comprehensive tool for bone-age estimation and skeletal maturity.

KEYWORDS: Ossification, epiphysis, diaphysis, bone-age, skeletal maturity.

INTRODUCTION
Skeletal growth is a continuous process occurring during the whole of childhood and adolescence. It is steady until the pubertal growth, at puberty it accelerates abruptly and subsequently slows considerably.

The skeleton is mature once the epiphysis or growth plates at the end of long bones fuse to the shaft or diaphysis. This occurs by 18 years of age or so in girls and by 20-22 years of age in case of boys. The degree of skeletal maturation correlates with the degree of sexual maturation. An individual who has advanced sexual maturity will also have earlier skeletal maturation.

Skeletal maturation is assessed by noting the appearance and fusion of epiphysis at the ends of long bones. Apart from this the bone mineral density (BMD) can now be ascertained by duel energy X-ray absorptiometry (DXA). This method allows assessment of bone mineral content and density at different ages. Possibly in the near future it may provide an accurate tool to assess the skeletal mass, density and determine the need for remedial measures in an individual found deficient in mineral content.[1]

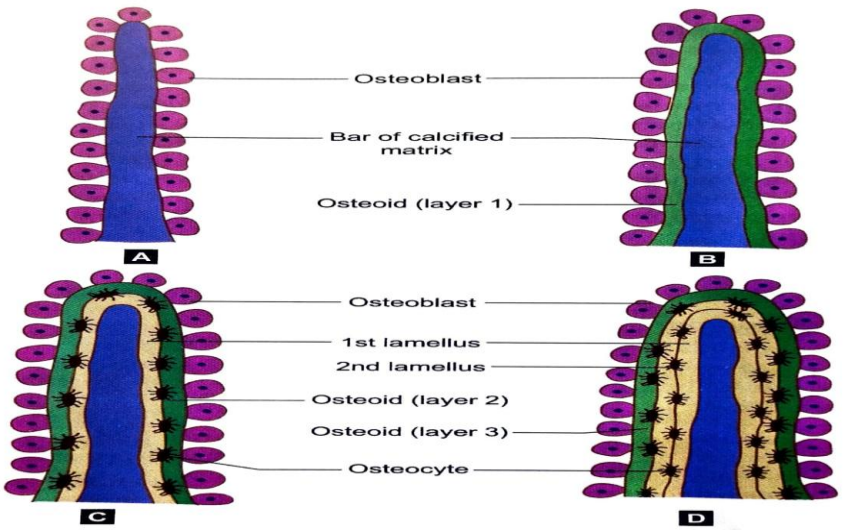
HISTOLOGICAL ASPECT OF OSSIFICATION[2]
The process of bone formation is called ossification. All bones are of mesodermal origin.
Types- 2 viz. (a) Endochondral ossification
(b) Intramembranous ossification

1. ENDOCHONDRAL OSSIFICATION
Bone formation is preceded by cartilaginous model. e.g. Most of the bones.

2. INTRAMEMBRANOUS OSSIFICATION
Here bone is laid down directly in a fibrous membrane. For example:
(a) Bones of the vault of the skull.
(b)The mandible
(c) Clavicle

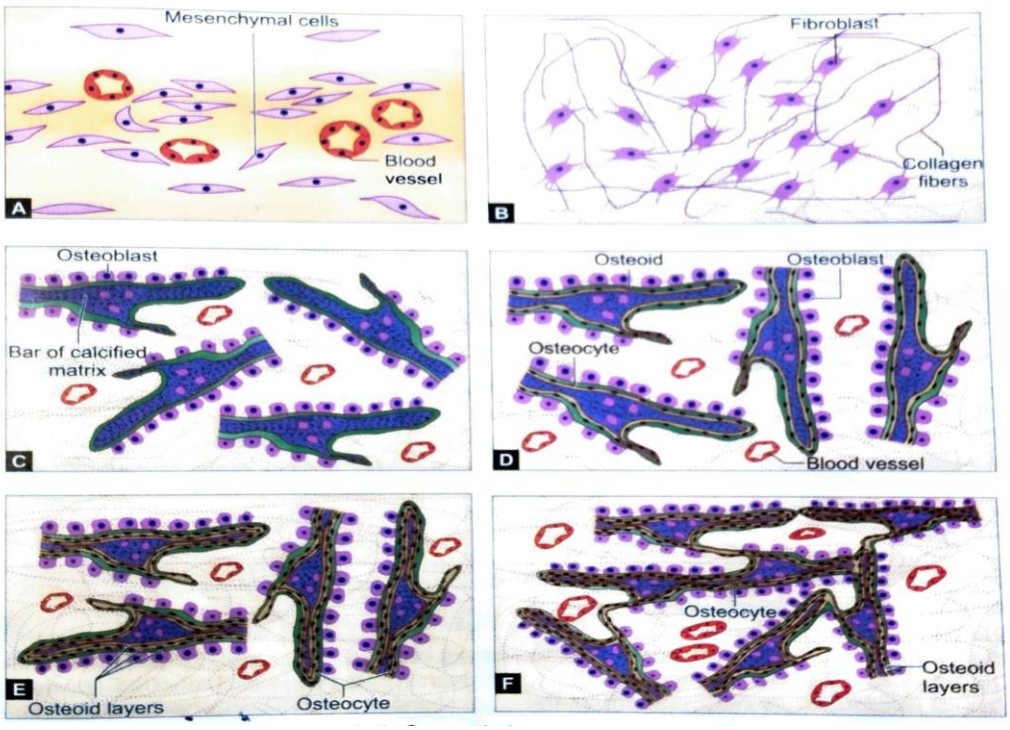
FLOWCHART SHOWING SCHEME OF BONE FORMATION(OSSIFICATION)
ENDOCHONDRAL OSSIFICATION[3]

Mesenchymal model
↓ Mesenchymal cell
Cartilaginous model
↓ Chondroblast
Hypertrophy of cartilage
↓ Cartilage Cell
Calcification of matrix (primary areolae)
↓ Cartilage cell
Vascularization of matrix(secondary areolae)
↓ Cartilage cell
Osteoid and Lamella
↓ Osteoblast
Lamellar bone
↓ Osteocyte
Bone trabeculae



INTRAMEMBRANOUS OSSIFICATION[3]

Mesenchymal model
↓ Mesenchymal cell
Fibrous model
↓ Fibroblast
Osteoid
↓ Osteoblast
Mineralization of osteoid (bony spicules)
↓ osteocyte
Lacunae & canaliculi
↓ Woven bone
Bone model



BONE AGE ESTIMATION

Assessment of bone- age postnatally is based on:

(1) Number, shape and size of epiphyseal centres and

(2) Size, Shape and density of the ends of bones.

"Tanner and Whitehouse" described 8 to 9 stages of development of ossification centres and gave them "maturity scoring". This is given as under:

50% of the score was given for carpal bones.

30% for phalanges

20% for radius and ulna

Twenty(20) ossification centres are generally used for determining the bone age. These include

(1) Carpal bones

(2) Metacarpal and patella in both sexes.

(3) Distal and middle phalanges in boys while Distal and proximal phalanges in girls.

(4) Distal and proximal toes.

To determine the skeletal age, following points should be taken into consideration:

(1) In infants between 3 and 9 months- Radiograph of shoulder is most helpful.

(2) A single film of hands and wrist is adequate in children between the ages of 1 and 13yrs.

(3) For children between 12 and 14 years, radiographs of elbow and hip give helpful clues.

OSSIFICATION CENTRE & AGE OF APPEARANCE[4]

A. BEFORE VIABILITY (Before 20th week)

1. Femur 7th week IUL(intra-uterine life)
2. Humerus, Radius, Ulna, Tibia Shaft 8th week IUL(intra-uterine life)
3. Ilium 2nd month
4. Ischium 3rd month
5. Pubis 4th months

B. At Viability

6. Calcaneus 3-5 month (20th week)

C. Post Viability (> 7 months)

7. Talus 6-7 month (end)
8. Cuboid 9th month
9. Femur lower end 9th month (at birth)
10. Upper end tibia Just after birth

AGE APPEARANCE OF CENTRE OF OSSIFICATION

5th year Head of radius, trapezoid, scaphoid
6th year Lower end of ulna, trapezium
6th to 7th year Medial epicondyle of the humerus
9th year Olecranon
9th to 11th year Trochlea of humerus
10th to 11th year pisiform
12th to 14th year Lesser trochanter of femur
14th year Crest of ilium, head and tubercles of ribs
15th year Acromion
16th year Ischial tuberosity
18th to 19th year Inner end of clavicle

आयुर्वेद शास्त्रीय विवेचन

आयुर्वेदानुसार **अस्थि** की उत्पत्ति गर्भोत्पादक भावों मे से **पितृज भाव** से होती है| यथा-

"तत्र गर्भस्य पितृजमातृजरसजात्मजसत्त्वजसात्म्यजानि शरीरलक्षणानि व्याख्यास्यामः |

गर्भस्य
केशश्मश्रुलोमा**स्थि**नखदन्तसिरास्नायुधमनीरेतःप्रभृतीनि स्थिराणि **पितृजानि** |"
सु० शा० 3/31.[5]

पितृजश्चायं गर्भः|
नहि पितुरृते गर्भोत्पत्तिः स्यात्, न च जन्म जरायुजानाम्|
यानि खल्वस्य गर्भस्य पितृजानि, यानि चास्य पितृतः सम्भवतः सम्भवन्ति, तान्यनुव्याख्यास्यामः; तद्यथा- केशश्मश्रुनखलोमदन्ता**स्थि**सिरास्नायुधमन्यः शुक्रं चेति **(पितृजानि)**||
च० शा० 3/7.[6]

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