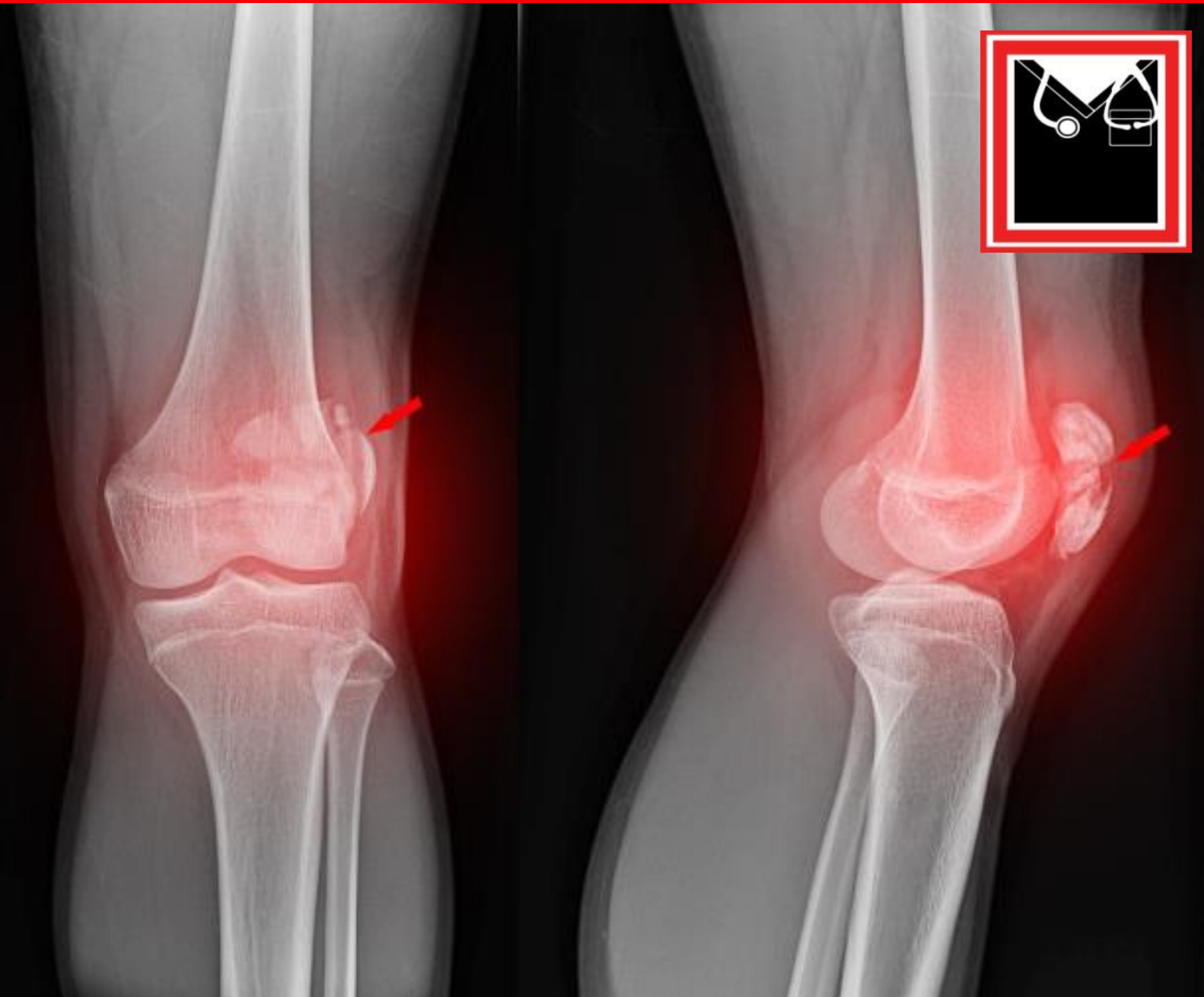


CLINICAL

ORTHOPAEDICS

High Yield Study Notes

FIRST EDITION



MEDICALTIMESMT.COM



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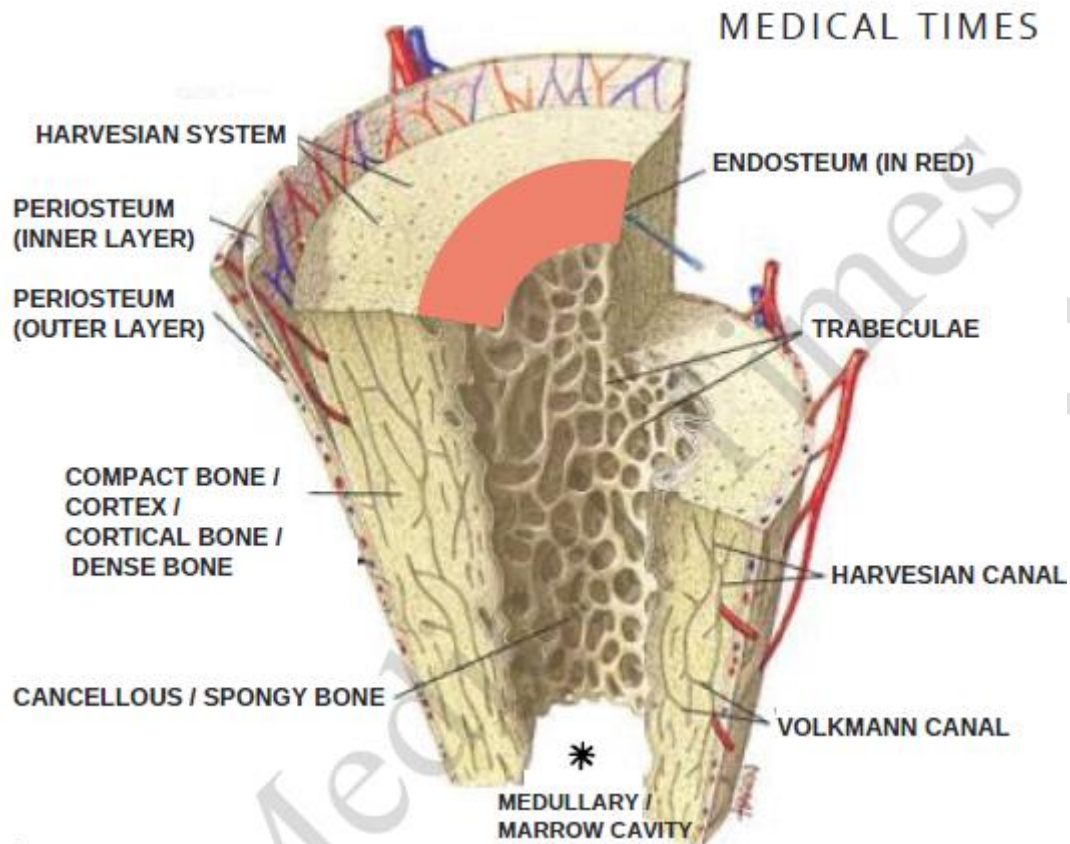


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Anatomy of Bone

A) Structure of a long bone:



➤ Periosteum:

- Has Outer Fibrous Layer & Inner Cambium Layer
- Inner Cambium Layer forms Callus [Absent in Neck of Femur]
- 1st Visible X-Ray Sign of Fracture Healing: Callus
- Absent in articular surface & sesamoid bone

➤ Endosteum:

- Most Metabolically Active Layer in Long Bone
- Junction between Compact & Spongy Bone

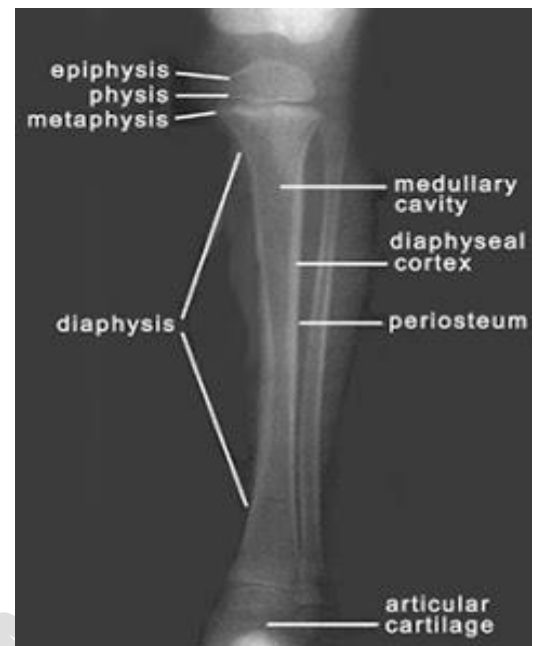
➤ Sharpey's Fibres: Connects Cortex to Periosteum

➤ Types of Bone:

Immature Bone	Mature Bone
<ul style="list-style-type: none"> • Woven bone • Weak • Callus 	<ul style="list-style-type: none"> • Lamellar Bone • Compact / cortical bone [Diaphysis] • Spongy / cancellous bone [Epiphysis & Metaphysis]

B) Bone & its parts:

- Articular Cartilage (Hyaline Cartilage) towards the joint
 - Cartilage: Type 2 Collagen
 - Bone: Type 1 Collagen
- Epiphysis
- Physis
- Metaphysis
 - Most Vascular area of bone
 - Most common location for infection & tumor
- Diaphysis (Middle)
 - Upper end of bone: Epiphysis + Physis + Metaphysis
 - Middle of bone: Diaphysis



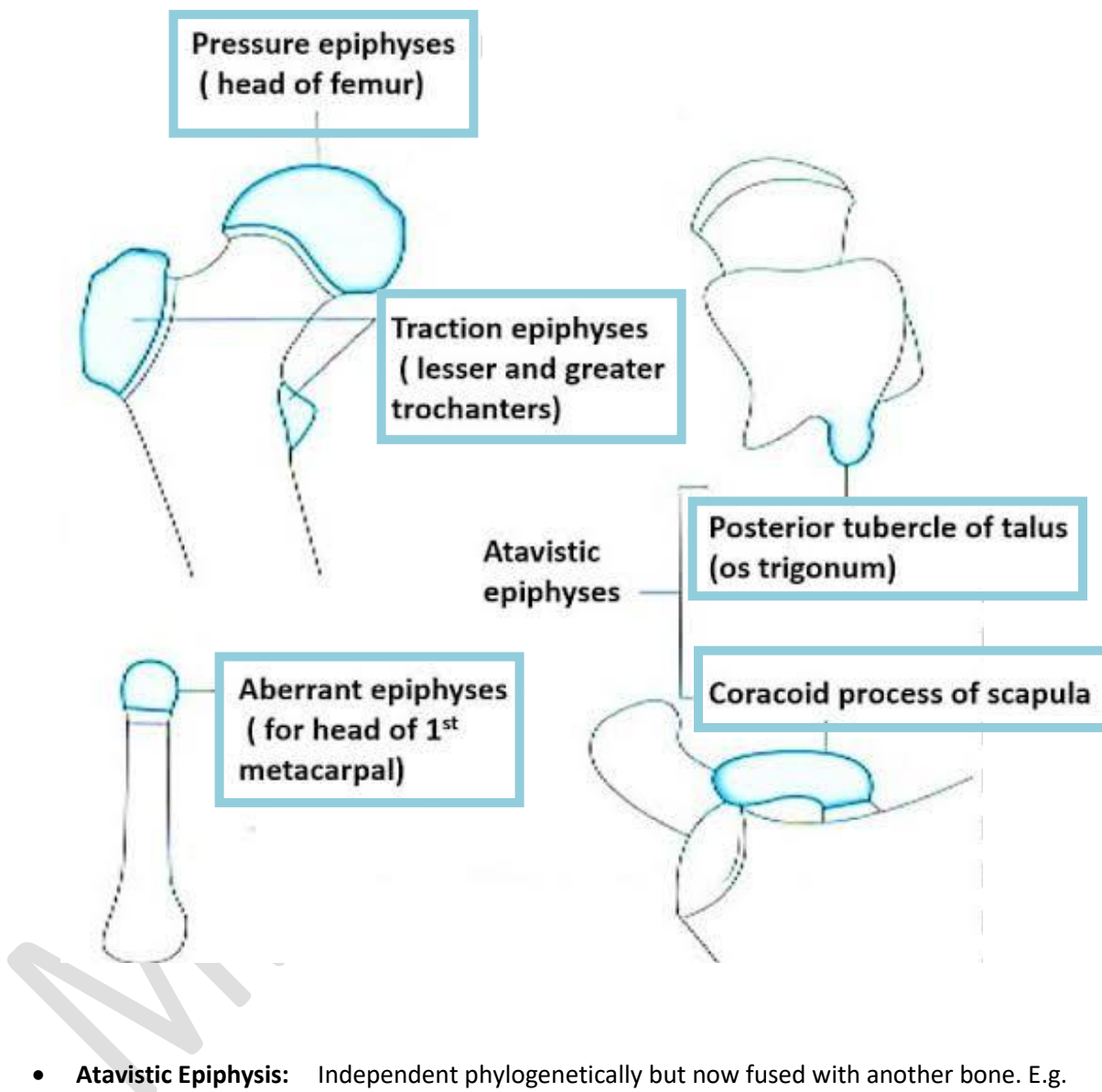
1) Articular cartilage:

- Above Articular cartilage, Joint Fluid is present
- Zones of Articular cartilage:
 - a) Zone 1
 - Superficial zone
 - Progenitor Cells for Articular Cartilage
 - High density chondrocytes
 - High water content (as it is close to joint fluid which is above it)
 - b) Zone 2
 - Transition Zone — Thickest
 - Chondrocytes are in low density
 - c) Zone 3
 - Middle Zone
 - Most Active Chondrocytes
 - Highest Density Proteoglycans
 - Low density water content
 - d) Zone 4
 - **Calcified Cartilage** — because it's close to bone (Epiphysis)
- On X-ray:
 - Cartilage not seen
 - Physis seen as Radiolucent because Physis is also made up of Cartilage

2) Epiphysis:

➤ Functional Classification:

- **Pressure Epiphysis:** Weight Bearing & Intra Articular [E.g. Head of Femur & Humerus]
- **Traction Epiphysis/ Apophysis:** Produced due to Pull/Attachment & Extra Articular. E.g.
 - Trochanters of Femur
 - Tuberosities of Humerus



- **Atavistic Epiphysis:** Independent phylogenetically but now fused with another bone. E.g.
 - Coracoid Process of Scapula
 - Posterior Tubercle of Talus
- **Aberrant Epiphysis:** Accessory Ectopic Epiphysis & Anatomical Anomaly. E.g.
 - Head of 1st Metatarsal
 - Base of 5th Metacarpal

3) Physis / Growth Plate:

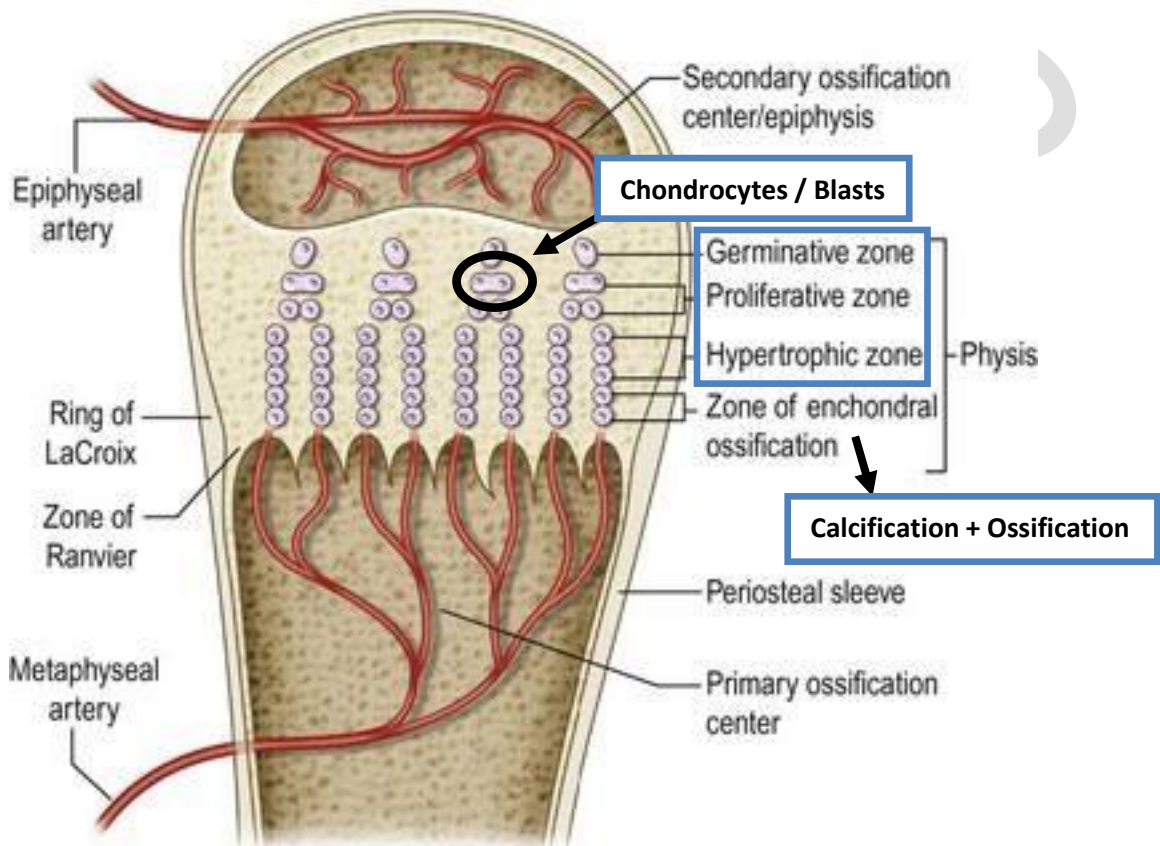
- Physis is **Temporary Primary Cartilaginous**
- Structure of Physis:

a) Resting / Germinative Zone

- Zone of Resting Cells

b) Proliferative Zone

- Cells Proliferate



c) Hypertrophic / Maturation Zone

- Cells mature & increase in size

d) Calcification Zone

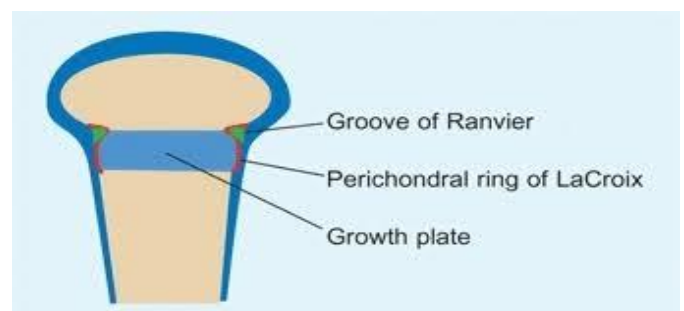
- Region of Calcification within cells

e) Ossification Zone (Bone formation)

- Creeping of Metaphyseal Vessels into Physis giving rise to Bone Formation

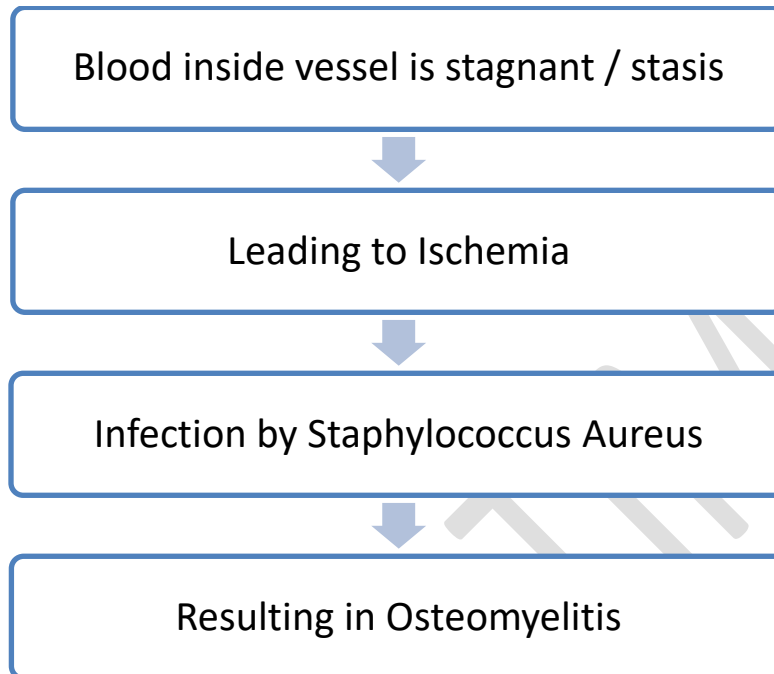
➤ Perichondrial Ring of La'croix:

- It acts as a **watch guard** to ensure **more vertical growth of long Bone rather than horizontal spread**

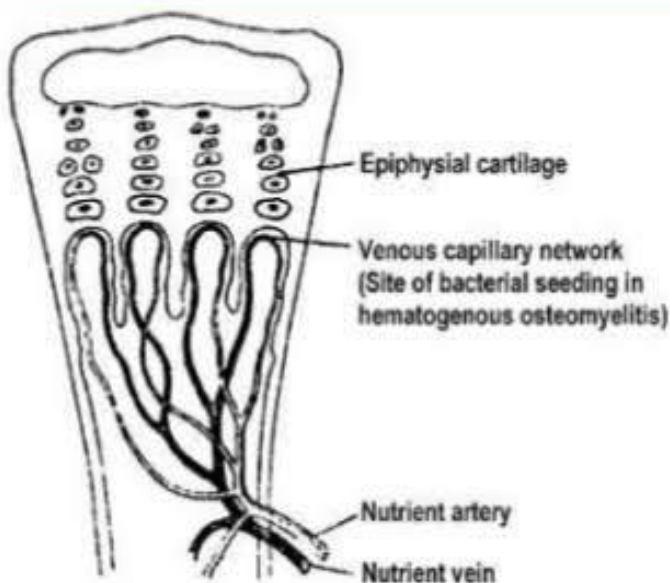


4) Metaphysis:

- Highly Vascular Area [Abundant Blood Supply]
- It consists of Loose / Spongy / Cancellous Bone
- Blood Vessels are dilated & tortuous [Hair- Pin Loop of Vessels]



METAPHYSIS OF LONG BONE



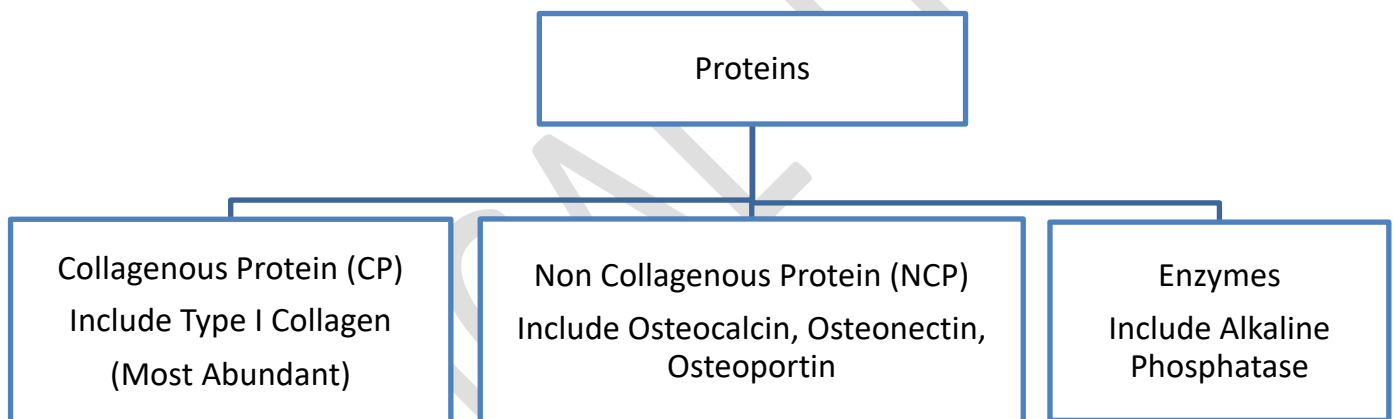
- Highly vascularized zone
- Venous system begins in this area and drains towards the diaphysis
- Vessel are arranged in the form of *hair-pin arrangement* → blood stasis → responsible for the metaphysis being the favourite site for bacteria → osteomyelitis

5) Diaphysis:

- Consists of Dense / Compact / Cortical Bone
- Structure includes Endosteum & Periosteum

Biochemistry of Bone

- Structural & Functional Unit of Bone: **Osteon**
- Osteon has 2 parts:
 1. Inorganic [Consists of Minerals]
 - A) Calcium (M/C) [In Bound Form: Calcium Hydroxyapatite]
 - B) Phosphate
 2. Organic [Further has 2 parts]:
 - A) Matrix [Consists of]:
 - Proteoglycan [Provides Compressible Strength to Bone]
 - Proteins



- B) Cells
- Osteoblasts
 - Osteocytes
 - Osteoclasts

Osteoblasts	Osteocytes	Osteoclasts
<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Osteoblast With the help of Type I Collagen, NCP & ALP</div> <div style="text-align: center;">↓</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Synthesise Osteoid. Osteoid With the help of Ca & PO4</div> <div style="text-align: center;">↓</div> <div style="border: 1px solid black; padding: 5px;">Synthesise Osteon</div>	<ul style="list-style-type: none"> • Resting / Spent / Mature / Quiescent Osteoblasts • Most abundant cell of bone • Most Long lived cell of bone 	<ul style="list-style-type: none"> • Belong to Giant Cell family • Belong to Monocyte: Macrophage Cell Lineage • Functions: 2R: Resorption & Remodelling of Bone

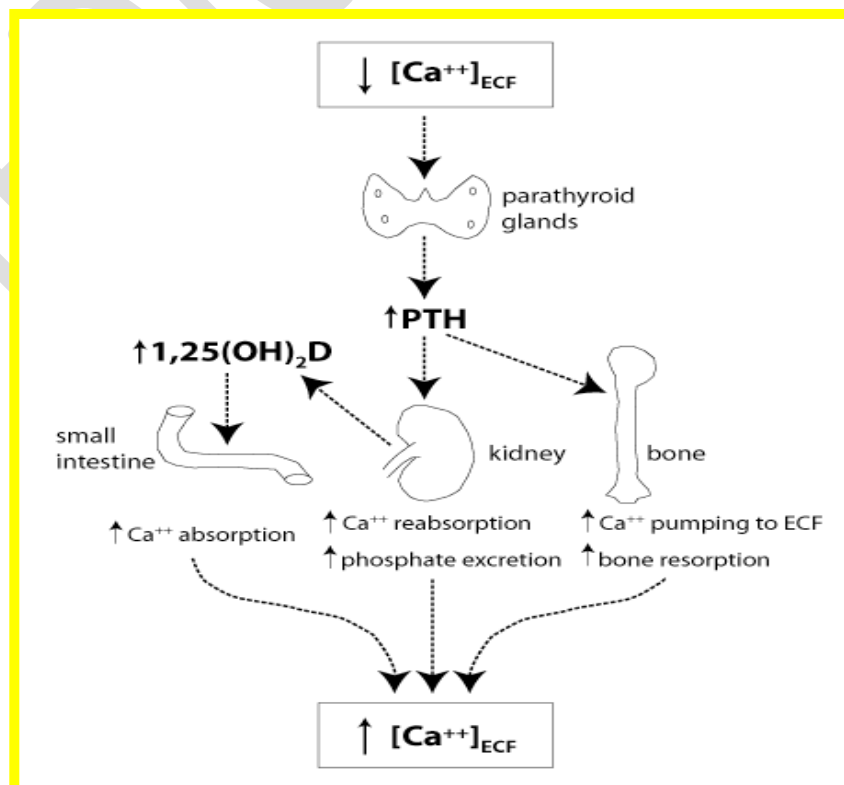
➤ **Howship's Lacunae [Microscopic Finding]:**

- Shallow excavation area / cavity / pit created in bone after Osteoclastic Resorption

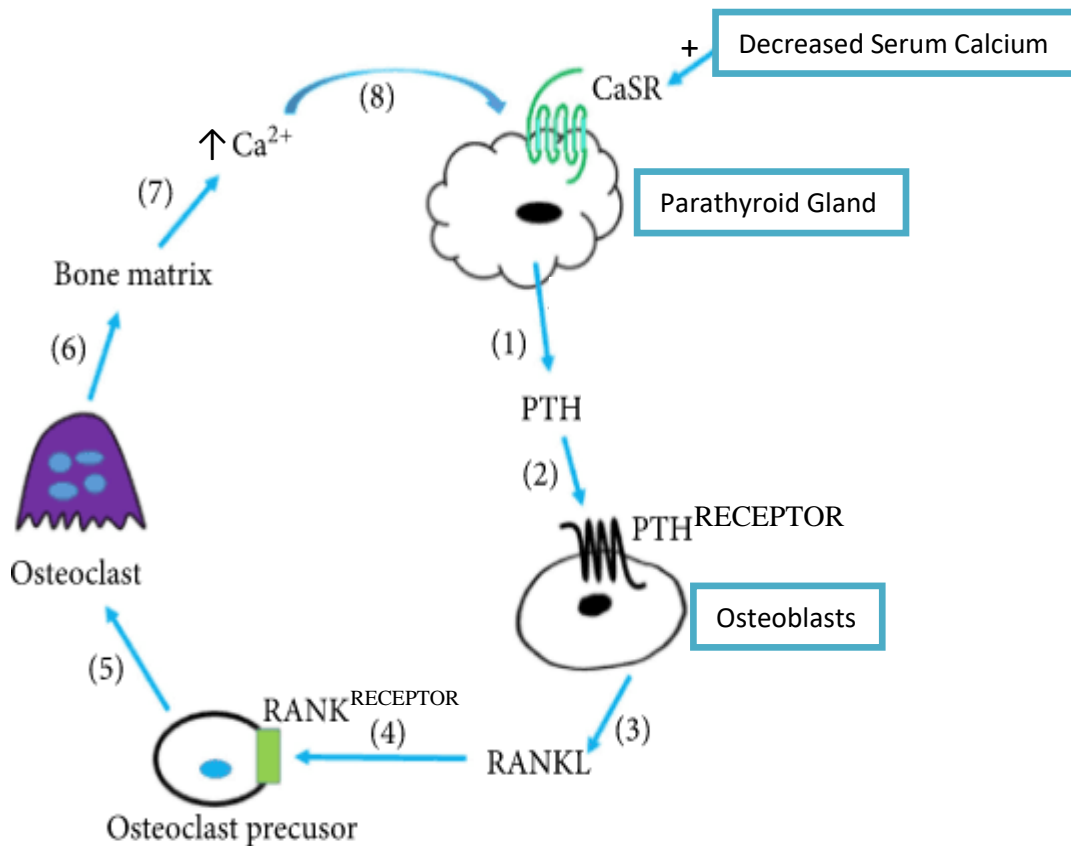


Physiology of Bone

- Calcitonin: Decreases Serum Calcium
- Parathormone: Increases Serum Calcium
- Normal Serum Calcium: 9 - 11 mg
- Decrease in Serum Calcium causes release of PTH from Parathyroid Gland
- PTH acts on GIT, Kidney & Bone



➤ Action of PTH on Bone



- CaSR: Calcium sensitive Receptor [Stimulated in response to decreased serum calcium]
- (1) Parathyroid gland releases PTH
- (2) PTH acts on PTH^{Receptor} present on osteoblasts
- (3) Osteoblasts releases RANK-L
- (4) RANK-L acts on RANK Receptor present on Osteoclast Precursor
- (5) Osteoclast precursor changes to osteoclast
- (6) Osteoclast causes bone resorption
- (7) Release of Calcium
- (8) Negative feedback to CaSR by Calcium

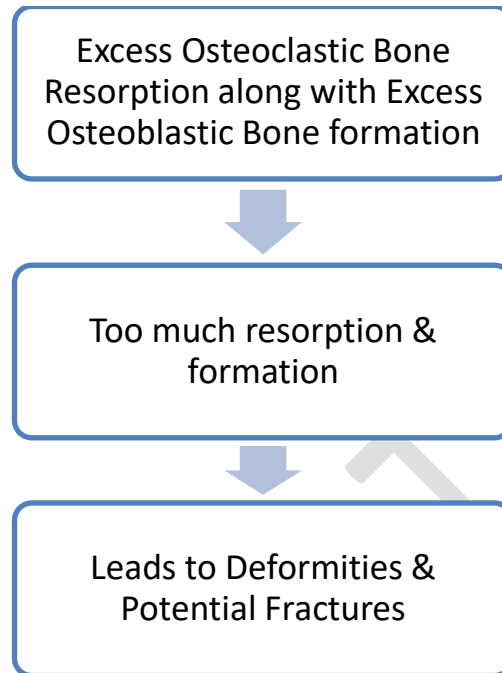
Important MCQs

- Most Abundant Cell of Bone: Osteocytes
- Most Long Lived Cell of Bone: Osteocytes
- Receptor for PTH: Osteoblasts
- Receptor for RANK-L: Osteoclasts
- Physis / Growth Plate: Temporary Primary Cartilaginous Joint
- Hueter Volkmann's Law:
 - Compression forces across Physis: Inhibit Growth
 - Tensile / Shearing Forces across Physis: Promote Growth
- Wolff's Law [Amount of Bone Formation \propto (Stress/Strain) applied on it]

Metabolic Bone Disorders

A) Paget's Disease of Bone / Osteitis Deformans:

- It is High Turnover Bone Disease
- Usually begins after 40 years of age
- Prevalence increases with increasing age
- More common in whites
- Pathology:



- Cause:
 - Exact Cause: Unclear
 - Hypothesis:

Linked to slow virus infection of Osteoclasts by paramyxovirus (E.g. Measles Virus)



Leading to resorption

- Genetic Mutations

SQSTM1 mutation



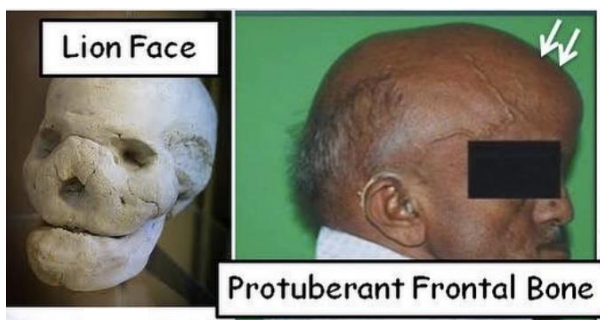
Leading to increased formation of Osteoclasts



Leading to resorption

- Can affect:
 - Single Bone/ Monostotic: Tibia, femur, lumbar vertebra, humerus
 - Multiple Bone / Polyostotic: Pelvis, spine, skull
 - **Note: M/C Bone involved: Pelvis**
- It is an Incidental Diagnosis

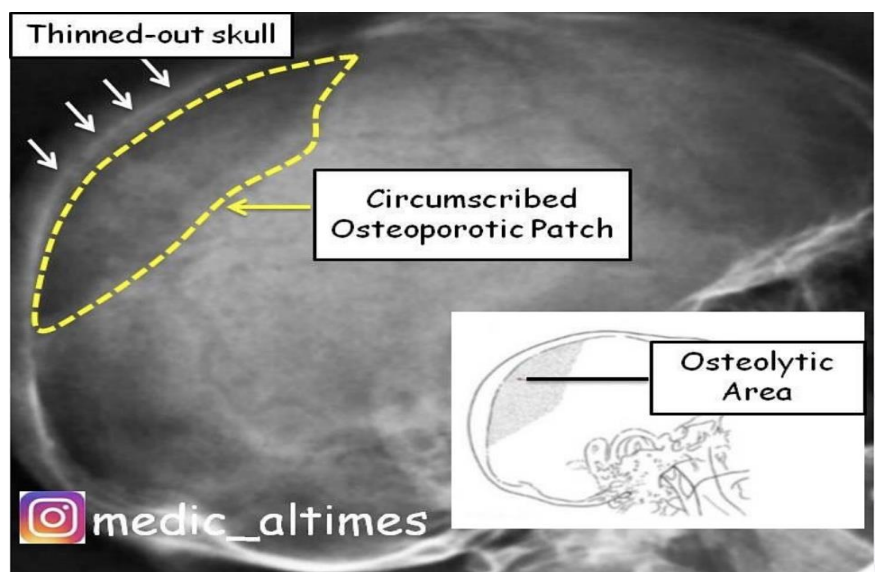
- It has the following four stages:
 - Initial osteolytic stage
 - Mixed osteoclastic-osteoblastic stage
 - Burnt-out quiescent osteosclerotic stage
 - Malignant Degeneration
- Clinical Picture:
 - Usually patients are asymptomatic
 - 1st symptom: Back pain
 - Progressive Sensori-neural Hearing Loss & Cranial nerve Palsies [Due to narrowing of foramen in phase of Excessive Bone Formation]
 - Enlarged Skull Size
 - Leontiasis Ossea (Lion Face) [Due to Bone overgrowth in the craniofacial skeleton]
 - Platybasia [Weakened Pagetic bone may lead to invagination of base of skull]
 - Bowed Tibia



- Complications:
 - High output cardiac failure
 - Paget's Disease [Most Common Premalignant lesion for development of **Secondary Osteosarcoma**]
 - Secondary osteoarthritis
 - Chalk-stick type fractures
- On X-ray:

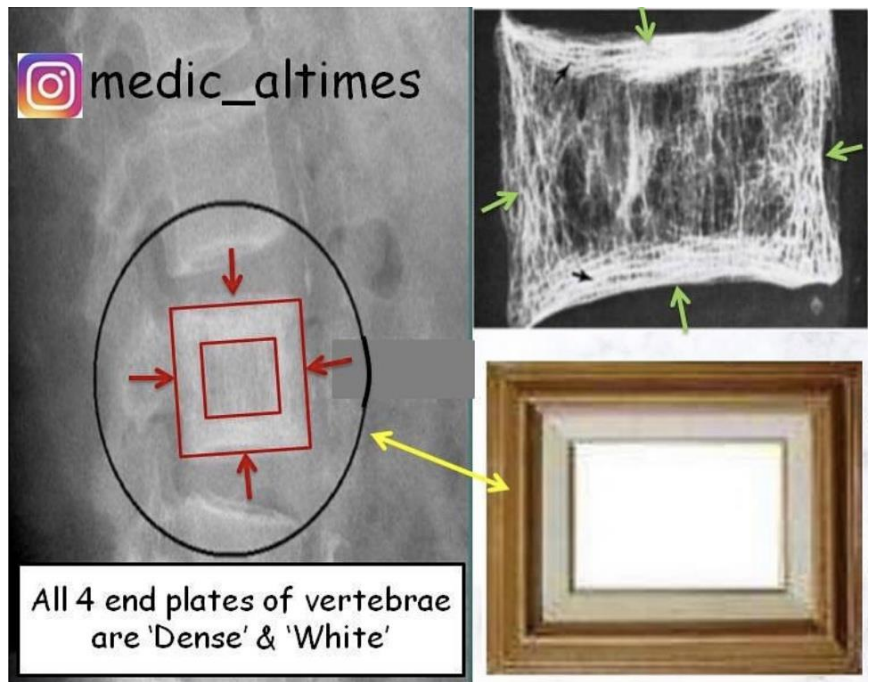
1) Osteoporosis Circumscripta:

- Circumscribed Osteoporotic Patch due to Excessive Resorption
- Thinned-out Outer Table of Skull
- **Not seen in Osteoporosis**



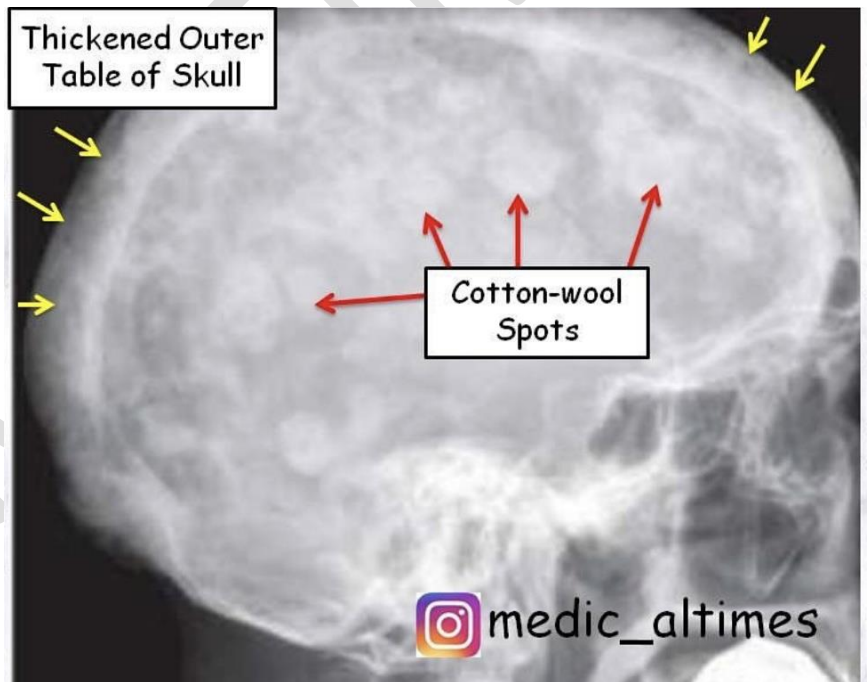
2) Picture Frame Spine:

- All 4 end plates (Anterior, Posterior, Superior, Inferior) are 'Dense' & 'White' resembling a "Picture Frame"
- In Rugged-Jersey Spine, only 2 end plates were dense (Superior & Inferior)
- But in Picture Frame Spine, all 4 end plates are dense



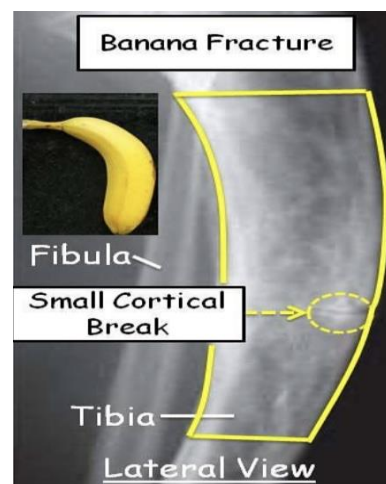
3) Cotton Wool Skull:

- Thickened Outer Table of Skull
- Excessive White Skull
- 'Cotton Wool Spots' due to too much of formation



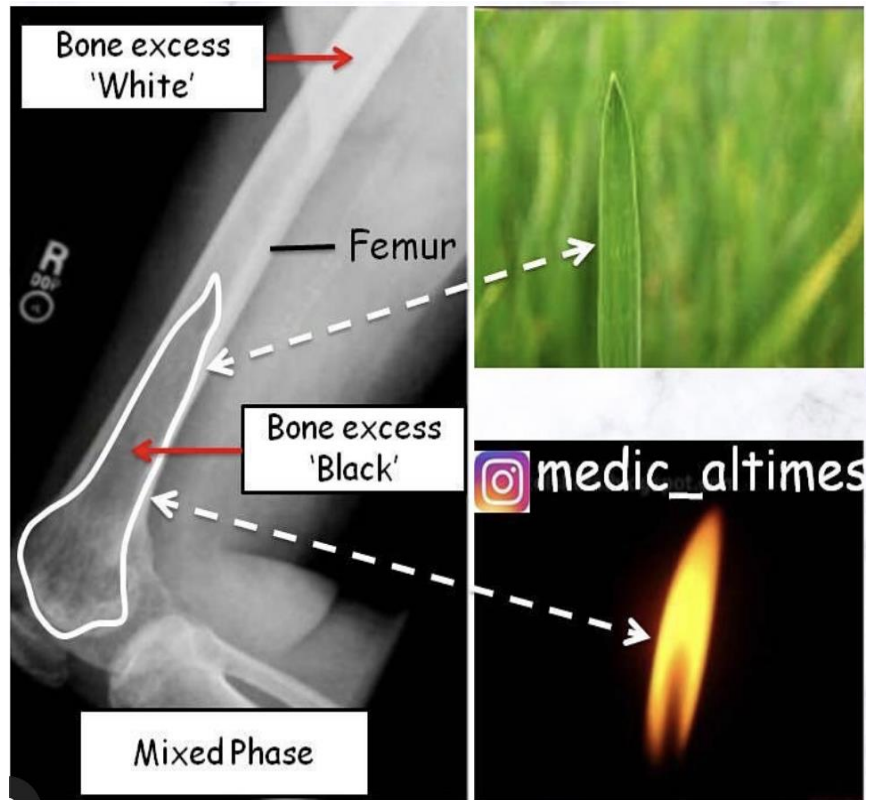
4) Banana Fracture:

- On lateral View, Bowed Tibia (Resembling Banana) with a small Cortical Break called as "Banana Fracture"



5) 'Blade of Grass Sign' / 'Flame Sign' / 'Advancing Wedge Sign' [Femur showing 'Mixed Phase']

- Excess White (due to too much Resorption)
- Excess Black (due to too much Formation)
- Excess Blackish Region is resembling a 'Flame' or 'Blade of Grass' or 'Wedge'



6) Mosaic/Jigsaw Pattern of Bone:

- Due to Prominent irregular cement lines
- Areas of Bone deposition & Resorption giving a mosaic/jigsaw puzzle appearance
- The involved bones are weak and fracture easily

HISTOLOGIC HALLMARK

Thickened, disorganized trabeculae lead to areas of sclerosis interspersed with lucent and more normal bone

