Healing Of Bones

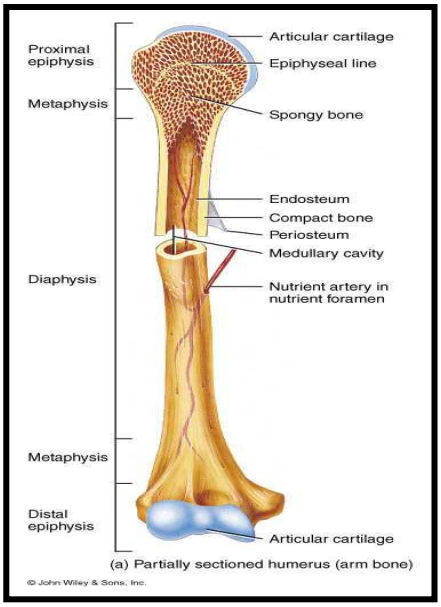
Supervised By Dr. Kawkab

Mahmoud Mohamed Mohamed Morsy
07288
Section: D

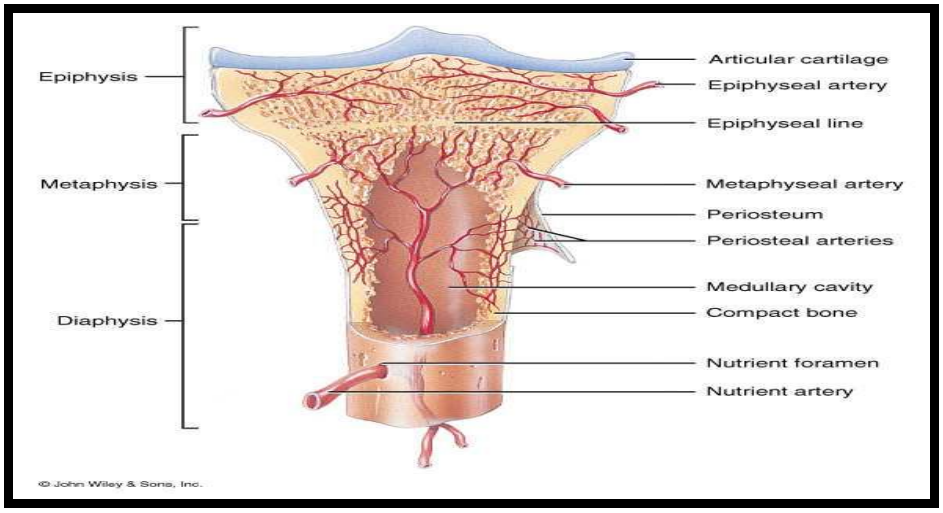
HEALING OF BONE

Bone Anatomy:

- Diaphysis
- Metaphysis
- Epiphysis – Prox/Dist
- Epiphyseal line
- Periosteum
- Compact cortical bone
- Spongy bone
- Articular Cartilage
- Medullary cavity
- Marrow
- Nutrient artery



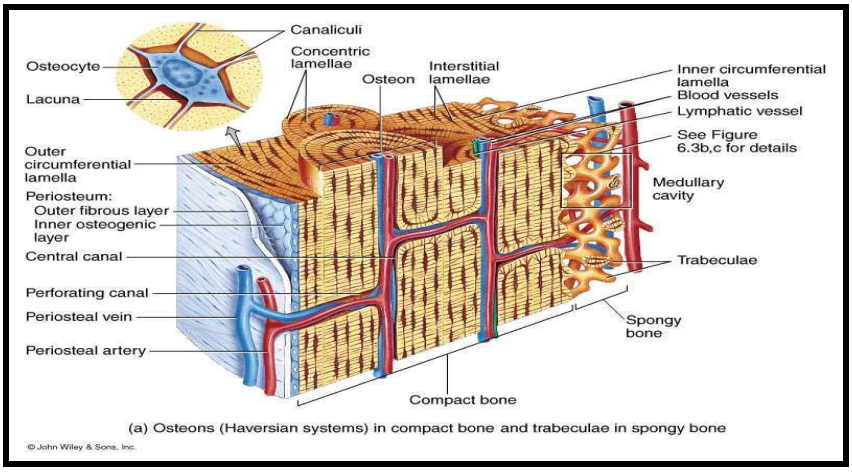
Blood Supply to Bone:



Types of Bone:

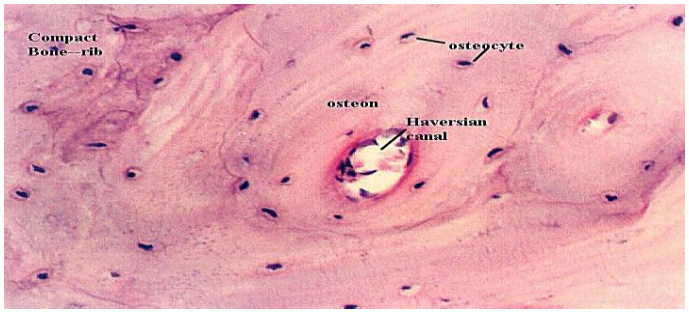
- Lamellar Bone
  - Collagen fibers arranged in parallel layers
  - Normal adult bone
- Woven Bone (non-lamellar)
  - Randomly oriented collagen fibers

  - In adults, seen at sites of fracture healing, tendon or ligament attachment and in pathological conditions
- Compact Bone



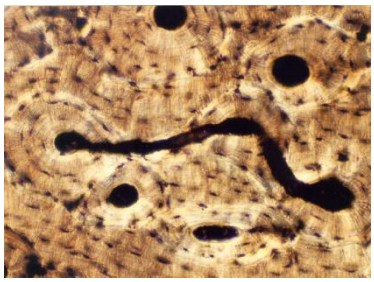
Lamellar Bone:

- Cortical bone
  - Comprised of osteons (Haversian systems)
  - Osteons communicate with medullary cavity by Volkmann's canals

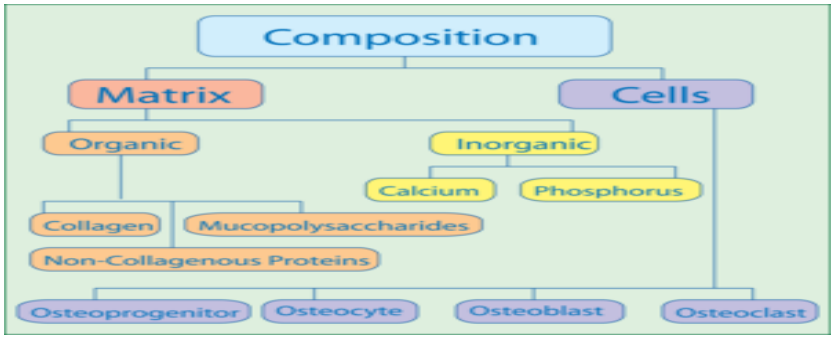


Haversian System:

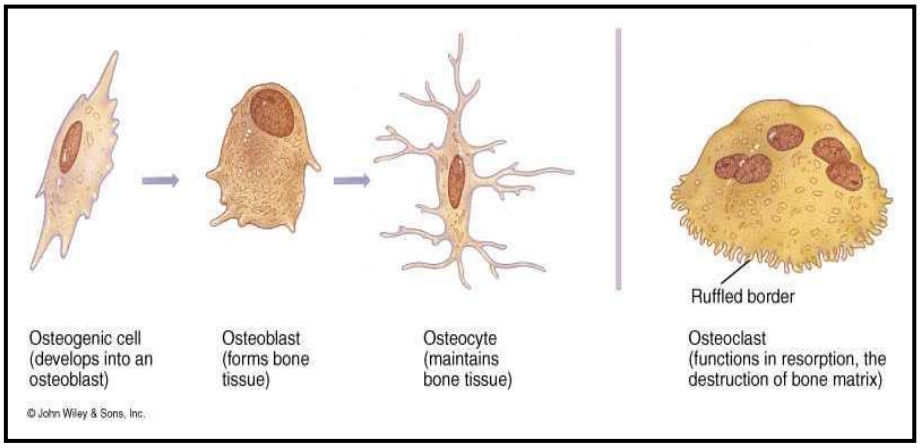
- Osteon with central haversian canal containing
  - Cells
  - Vessels
  - Nerves
- Volkmann's canal
  - Connects osteons

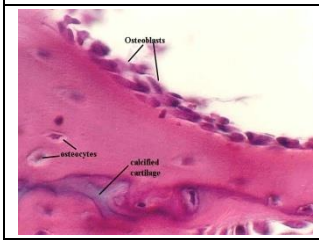
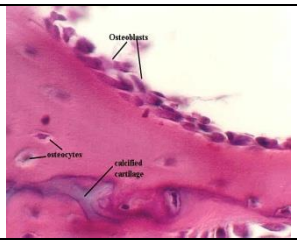
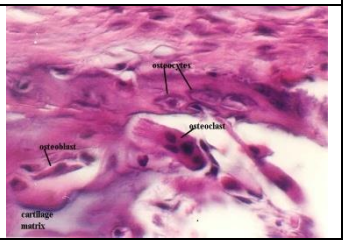


Bone Composition:



A. Osteogenic cells:



1. Osteocytes	2. Osteoblasts	3. Osteoclasts
		

B. Extracellular Matrix

– Organic (35%)

1. Collagen (type I) 90%
2. Osteocalcin , osteonectin , proteoglycans , glycosaminoglycans , lipids (ground substance)

– Inorganic (65%)

1. Primarily hydroxyapatite Ca5(PO4)3(OH)2

Prerequisites for Bone Healing:

- Adequate blood supply
- Adequate mechanical stability

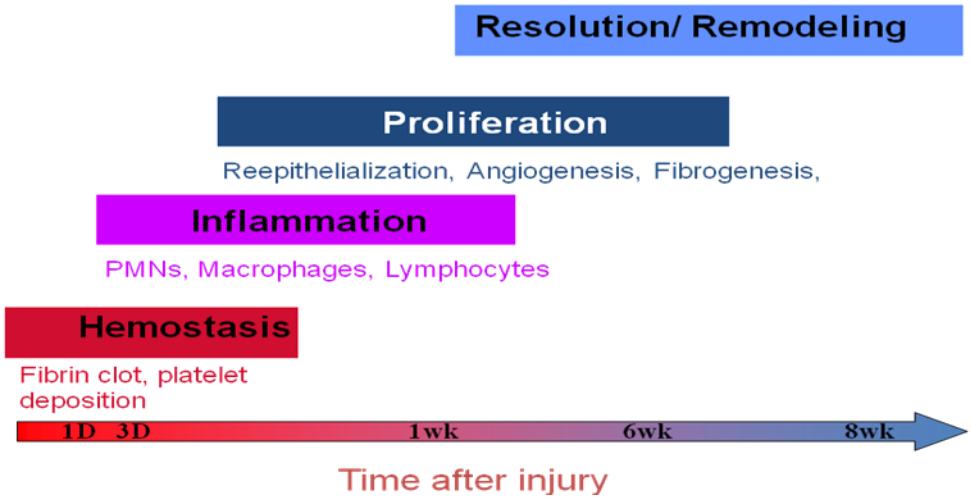
Fractures:

- Break in the bone.

- Simple / Compound – infection.
- Single - Horizontal, oblique, spiral,
- Comminuted – multiple.
- Greenstick – partial children.
- Torus – compression of cortex – children.

Types of Fracture:

Stages of wound healing:



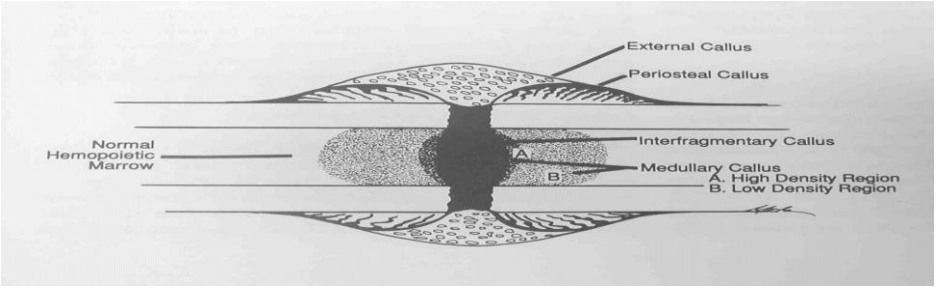
Inflammation:

- Tissue disruption results in hematoma at the fracture site
- Local vessels thrombose causing bony necrosis at the edges od the fracture
- Increased capillary permeability results in a lncal inflammatory milieu
  - Osteoinductive growth factors st)mulate the pr/liferation and differentiation of mesenchymal stem cells .

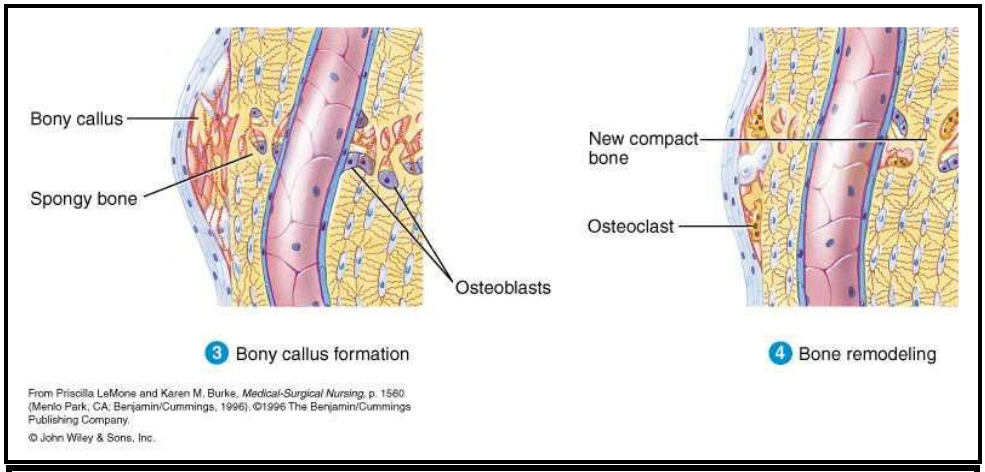
Repair:

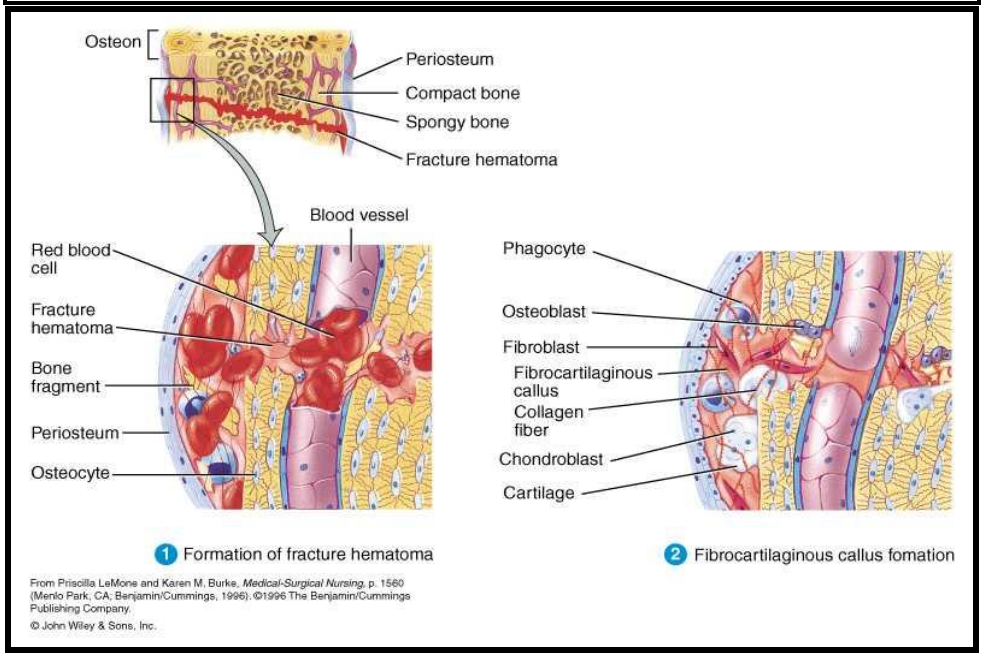
- Periosteal callus forms along The periphery of the f2acture site
  - Intramembranous ossification Initiated by preosteoblasts
- Intramedullary callus forms in the center of dhe fract5re site

  - Endochond2al ossificatIon at the site of the fracture hematoma
- Chemical and mechanical factors stimulate callus &ormation and mineralization



Healing in Bone:





Mechanisms for Bone Healing

Direct (primary) bone healing:

- Mechanism of bone healing seen when there is no motion at the fracture site (i.e. rigid internal fixation)
- Does not involve formation of fracture callus

- Osteoblasts originate from endothelial and perivascular cells
- A cutting cone is formed that crosses the fracture site
- Osteoblasts lay down lamellar bone behind the osteoclasts forming a secondary osteon
- Gradually the fracture is healed by the formation of numerous secondary osteons
- A slow process – months to years

Indirect (secondary) bone healing:

- Mechanism for healing in fractures that are not rigidly fixed.
- Bridging periosteal (soft) callus and medullary (hard) callus re-establish structural continuity
- Callus subsequently undergoes endochondral ossification
- Process fairly rapid – weeks

Factors affecting Healing:

- Systemic & Local factors
- Immobilization *
- Improper reduction – abnormal position
- Infection. Debris, dead tissue in wound
- Joint involvement

Complications:

- Delayed healing.
- Non healing.
- Joint involvement - ankylosis
- Abnormal position – arthritis.
- Bone necrosis – nutrient artery
- Involucrum formation.
- Pseudoarthrosis

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