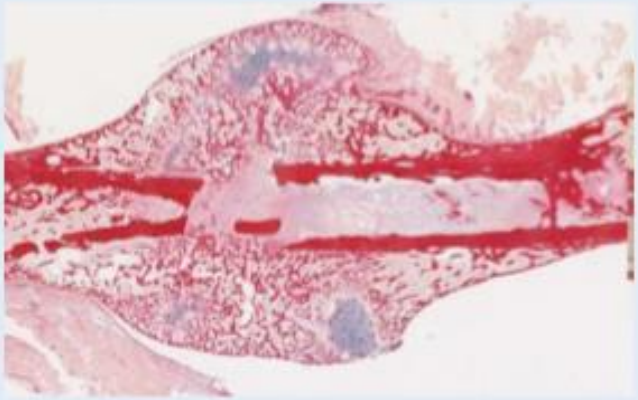
lecture

No SAQ

Fracture Healing



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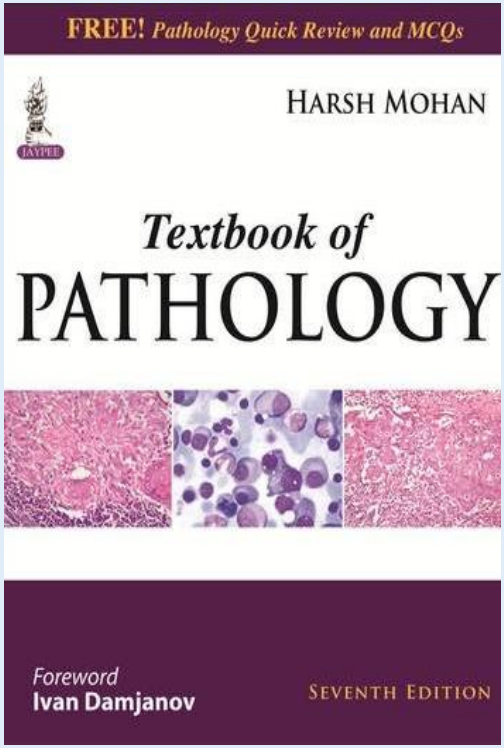
Intended Learning Outcomes:

By the end of this lesson, students will be able to:

1- Define fracture healing and classify the types of fracture
2. Explain the various stages of fracture healing
3- Discuss the factors influencing fracture healing
4- Discuss complications of fracture healing

References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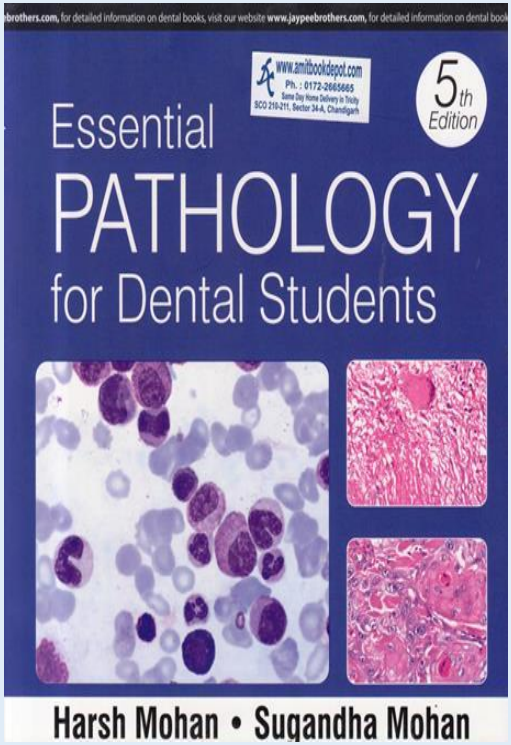
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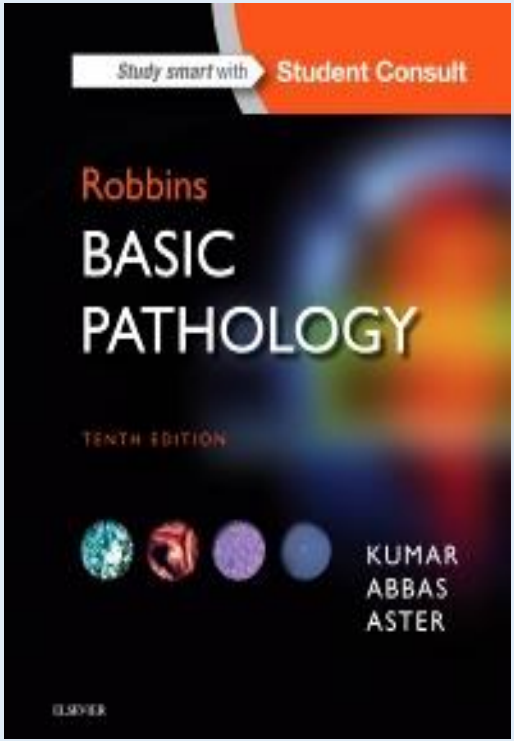
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Bone Fracture

Fracture is loss of bone integrity resulting from mechanical injury and/or reduced bone strength.

Fracture healing: is complex and sequential set of events to restore injured bone to the original condition.

Type of fractures

According to

1- The cause: traumatic , pathological.

2- The shape: linear, spiral , transverse

An elderly female brock her femoral bone while walking. She was a known case of osteoporosis (increased bone fragility). What type of fracture is this?

a-Traumatic fracture

b-Compound fracture

c-Pathological fracture

d-Greenstick fracture

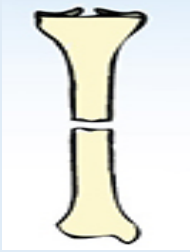
3- Clinical types : Simple, Compound , Comminuted, Greenstick

Intact skin

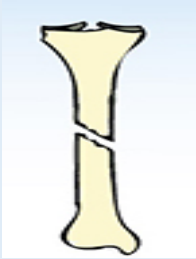
Skin torn open

Fragmented bone

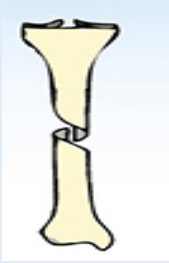
In soft bone



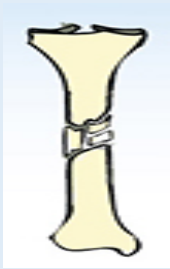
Transverse



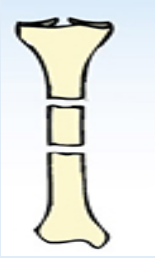
Oblique



Spiral

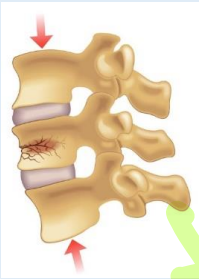


Comminuted



Segmental

Green stick



Compression fracture

cells and what is it function?

What cells needed for # healing?

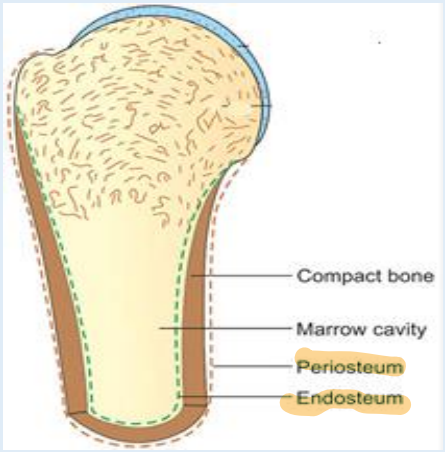
1- **Inflammatory cells** : (neutrophils , macrophages, platelets) produce cytokines and growth factors as **PDGF, TGF-β, FGF**

2- **Osteoclasts** : remove bone fragments and do remodeling

3- **Osteoblasts** : produce new bone

4- **Fibroblasts** :lay down fibers for union of fracture gap

5- **Periosteum and endosteum** : needed in callus formation



Osteoclast
(Macrophages of bone)

Osteoblast

fibroblast

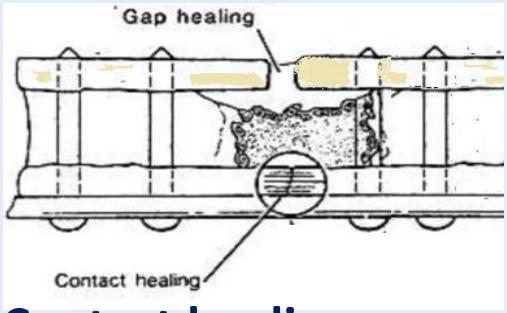
Types of Fracture Healing

By Primary union

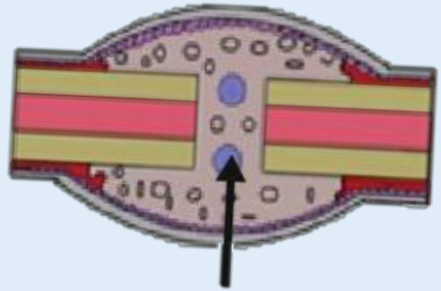
- When ends are surgically approximated
- No callus formation
- Fast – but weak healing
- Two types
  - Contact healing: Gap < 0.01 mm smaller
  - Gap healing :Gap < 0.1 mm small

By Secondary union

- Common
- Medullary and periosteal callus
- Strong healing



Contact healing

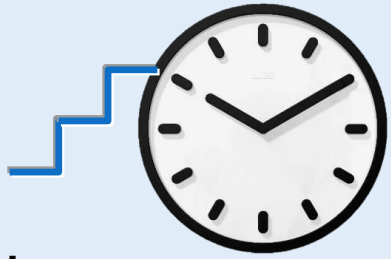


Callus in 2ry healing

callus : also

large clot

Steps of Fracture Healing



1- Hematoma / inflammation → 48 hours to 7days

2-Demolition : osteoclasts remove dead tissues → 2 weeks

3-Granulation tissue : Fibers (collagen type 2) and blood vessels

4- Soft callus formation: Scaffold. → months(only cartilage or fibers)

5- Hard -Bony callus formation : Union of fracture gap :Two methods

a- Direct lay down of bone by osteoblasts

b- Indirect : first fibrosis or cartilage then ossification

6-Remodeling : final shaping of bone : by osteoclasts → up to many years

Summery of Healing steps

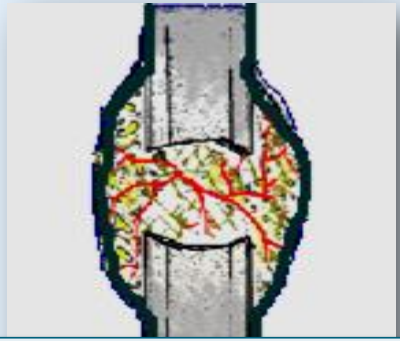
A- Pro-callus formation 1-2-3-4

B- Hard callus formation : 5

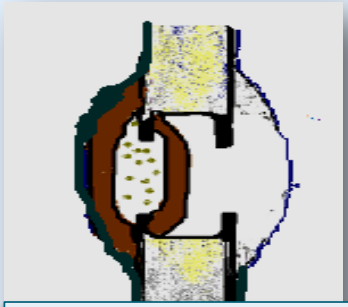
C- Remodeling : 6

1-Hematoma

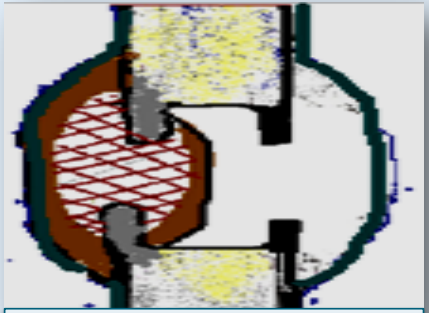
2- Demolition



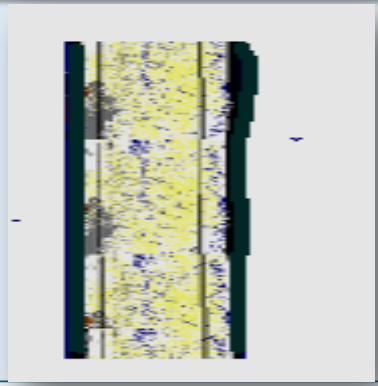
3-Granulation tissue



4- Procallus



5-Osseous callus



6-Remodeling

Demolition : Removal of dead bone fragments by osteoclasts
Pro Callus : Temporary tissue produced by periosteum. Acting as a scaffold . to support the fracture gap- also called **provisional callus**
Osseous callus : Union of fracture gap
Remodeling : final shaping of bone by removing excess tissues by osteoclasts

Bone Fracture Microscopy

A- Broken bone (lamellar bone)

B- Osteoid = Woven bone

C- Granulation tissue

Osteoid : is immature and soft bone , also called **woven** bone . With less mineral than lamellar hard bone , seen in case of rapid growth as in children and in fracture healing.

lamellar bone: Mature calcified bone with Haversian system

Granulation tissue : fibrosis + blood vessels

Factors influence fracture healing

Local factors

- Ischemia.
- Infections
- Tumors
- Foreign bodies
- Failure of reduction
- Instability

Systemic factors

- ✓Malnutrition
- ✓↓immunity
- ✓Chronic diseases
- ✓Old age

Vitamin D

1- A 19-year-old male suffers a mandibular fracture. After 2 weeks, the fracture site shows cartilage and woven bone. This stage is called:

A. Hematoma stage
B. Soft callus stage
C. Hard callus stage
D. Remodeling stage

Keyword
if bone its hard
if fibrous, cartillage
it's soft callus

2- A 52-year-old male presents with a mandibular fracture. After 6 weeks, radiograph shows minimal callus and poor healing. Which is the most likely cause?

A. Adequate immobilization
B. Diabetes mellitus
C. Good nutrition
D. Proper alignment of fragments

Complications of fracture healing

Early complications of fracture itself

- ✓Bleeding / shock
- ✓Fat embolism
- ✓Avascular necrosis
- ✓Infections

Late complications of healing

Delayed union

Mal union

Un union

Avascular necrosis = osteonecrosis

Death of part of bone due to block of blood supply → ischemia

Caused by

trauma, steroids therapy, radiation , …

1. The soft callus in fracture healing consists mainly of:

A. Woven bone

B. Cartilage and fibrous tissue

C. Mature lamellar bone

D. Osteoclast resorption cavities

2. Think about the teeth extraction socket as a wound. List the steps or events taking place to heal it

clot, inflammation


THANK
YOU
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