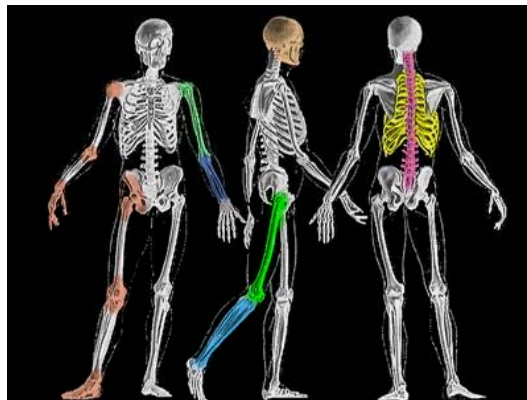


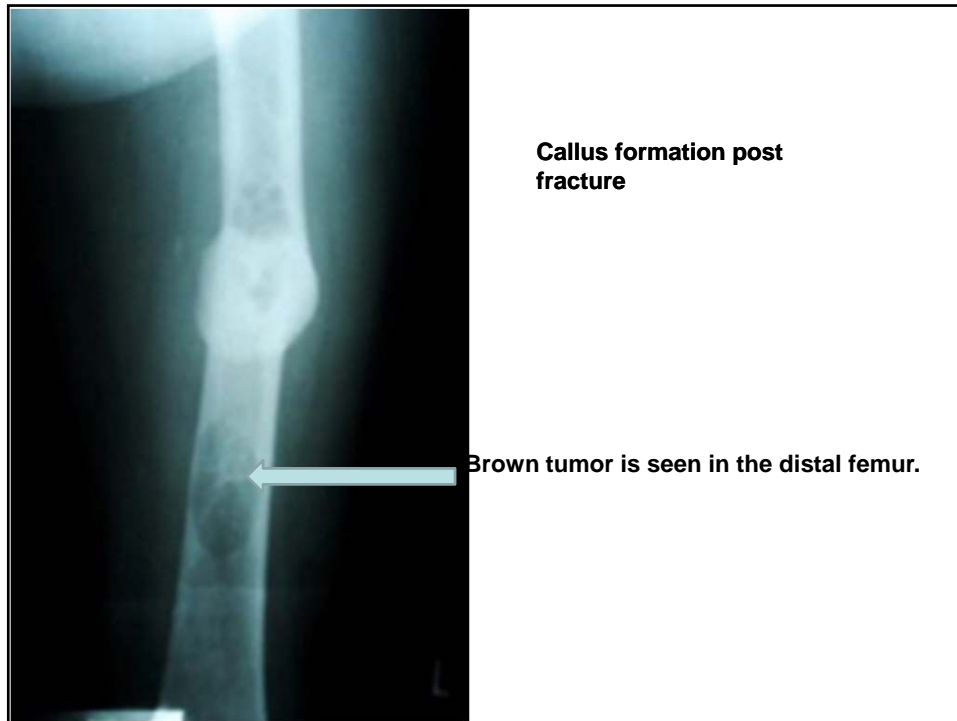
BONE CONDITION AND DISEASES

D.HAMMOUDI.MD

Fractures







Fractures

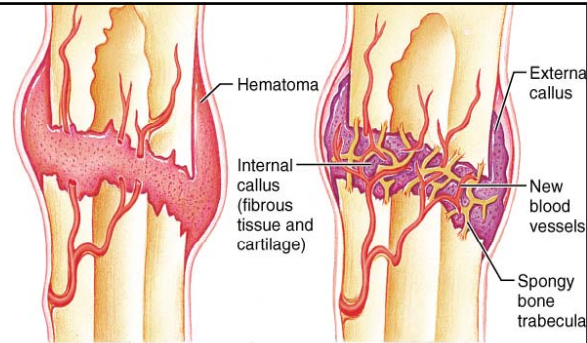
- Despite its mineral strength, bone may crack or even break if subjected to extreme loads, sudden impacts, or stresses from unusual directions.
 - The damage produced constitutes a **fracture**.
- The proper healing of a fracture depends on whether or not, the blood supply and cellular components of the periosteum and endosteum survive.



Fracture Repair

• Step 1:

- A. Immediately after the fracture, extensive bleeding occurs. Over a period of several hours, a large blood clot, or **fracture hematoma**, develops.
- B. Bone cells at the site become deprived of nutrients and die. The site becomes swollen, painful, and inflamed.



① Hematoma formation

② Fibrocartilaginous callus formation

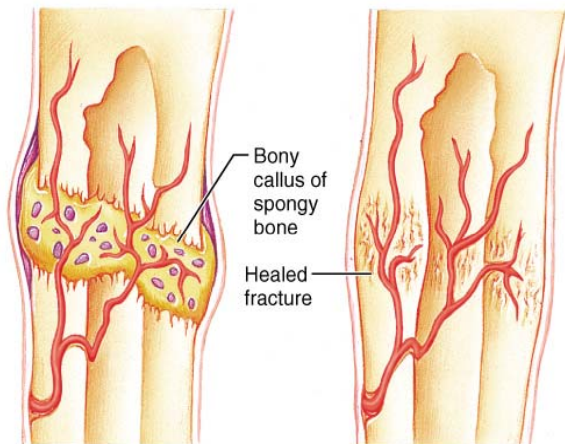
• Step 2:

- A. Granulation tissue is formed as the hematoma is infiltrated by capillaries and macrophages, which begin to clean up the debris.
- B. Some fibroblasts produce collagen fibers that span the break, while others differentiate into chondroblasts and begin secreting cartilage matrix.
- C. Osteoblasts begin forming spongy bone.
- D. This entire structure is known as a **fibrocartilaginous callus** and it splints the broken bone.

Fracture Repair

• Step 3:

- A. Bone trabeculae increase in number and convert the fibrocartilaginous callus into a **bony callus** of spongy bone. Typically takes about 6-8 weeks for this to occur.



③ Bony callus formation

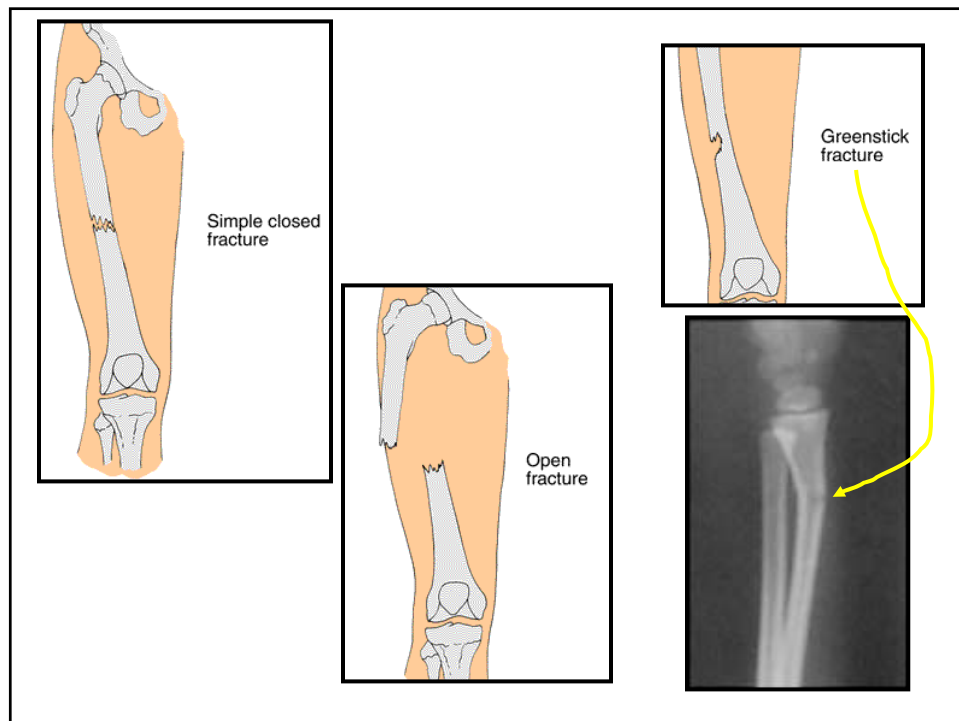
④ Bone remodeling

• Step 4:

- A. During the next several months, the bony callus is continually remodeled.
- B. Osteoclasts work to remove the temporary supportive structures while osteoblasts rebuild the compact bone and reconstruct the bone so it returns to its original shape/structure.

Fracture Types

- Fractures are often classified according to the position of the bone ends after the break:
 - Open (compound)** → bone ends penetrate the skin.
 - Closed (simple)** → bone ends don't penetrate the skin.
 - Comminuted** → bone fragments into 3 or more pieces. Common in the elderly (brittle bones).
 - Greenstick** → bone breaks incompletely. One side bent, one side broken. Common in children whose bone contains more collagen less mineralized.
 - and are
 - Spiral** → ragged break caused by excessive twisting forces. Sports injury/Injury of abuse.
 - Impacted** → one bone fragment is driven into the medullary space or spongy bone of another.



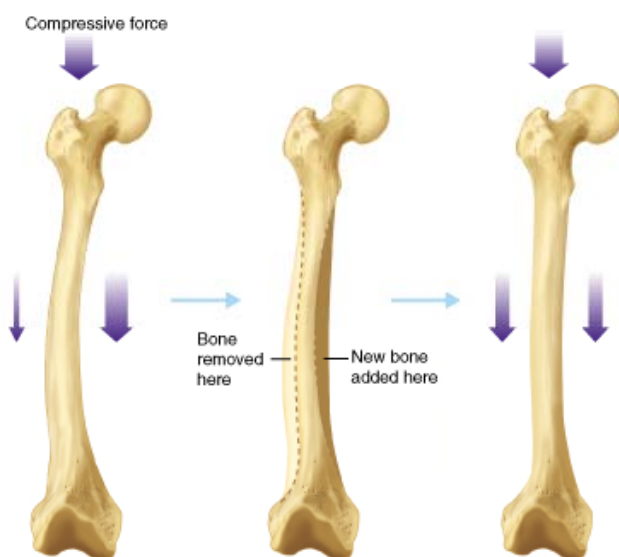
What kind of fracture is this?



It's kind of tough to tell, but this is a _____ fracture.



Bone Remodeling

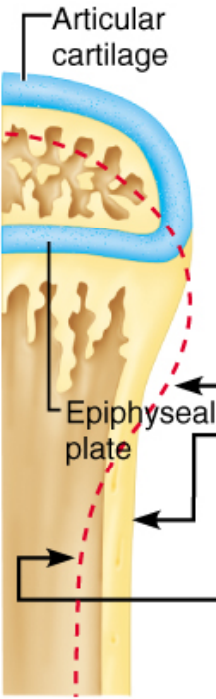


- Bone is a dynamic tissue.
 - What does that mean?
- Wolff's law holds that bone will grow or remodel in response to the forces or demands placed on it. *Examine this with the bone on the left.*

Check out the mechanism of remodeling on the right!

Why might you suspect someone who's been a powerlifter for 15 years to have heavy, massive bones, especially at the point of muscle insertion?

Astronauts tend to experience bone atrophy after they're in space for an extended period of time. Why?

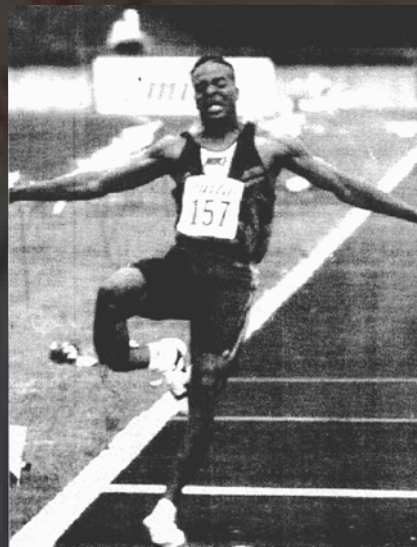


Remodeling
Growing shaft is remodeled by:

- ① Bone resorbed here
- ② Bone added by appositional growth here
- ③ Bone resorbed here

Fracture

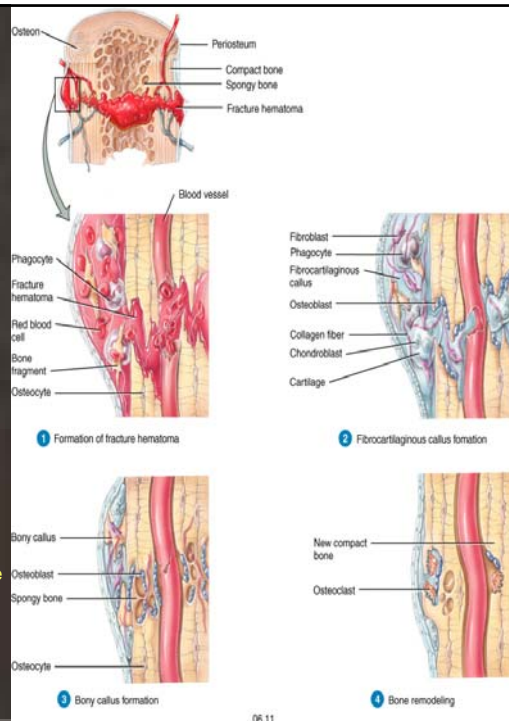
- A fracture is any break in bone



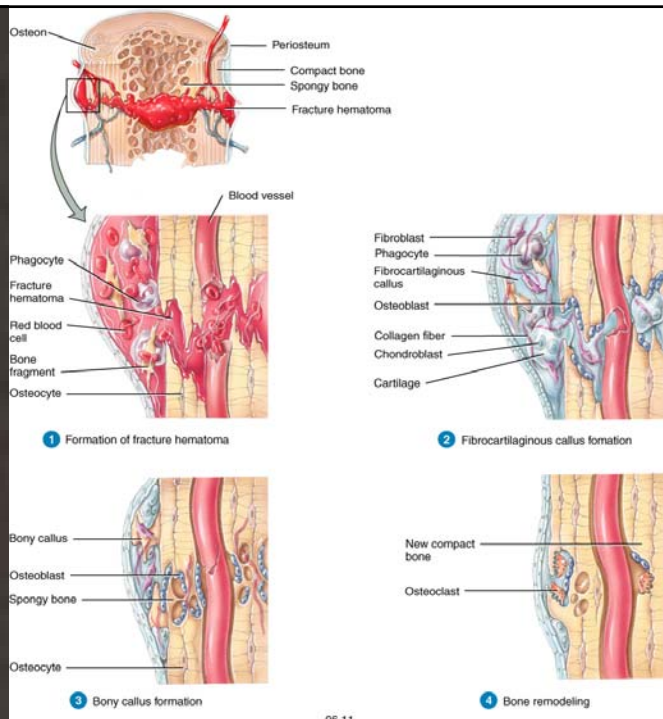
From: The Advertiser, Wednesday May 27 1992, p43

Fracture

- Following steps occur in fracture repair:
 - 1) Formation of fracture hematoma
 - Blood vessels damaged and forms clot
 - Inflammation
 - Phagocytes and osteoclasts remove dead tissue
 - 2) Fibrocartilaginous callus formation
 - Capillarisation of fracture haematoma forms procallus
 - Fibroblasts and osteogenic cells invade procallus
 - Fibroblasts produce collagen fibres – connect broken ends of bone
 - Osteogenic cells in avascular areas differentiate into chondroblasts and produce fibrocartilage
 - Procallus turns into fibrocartilaginous callus

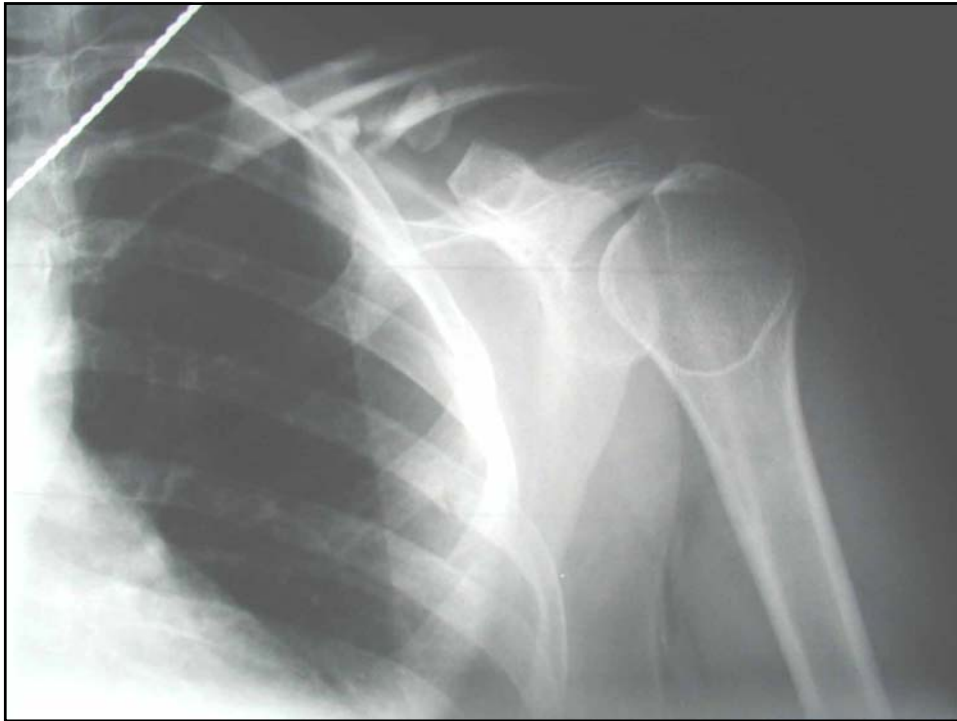


- Following steps occur in repair (continued):
 - 3) Bony callus formation
 - Osteogenic cells near capillaries differentiate into osteoblasts
 - Produce trabeculae
 - Fibrocartilaginous callus gradually converted to bony callus
 - 4) Bone remodelling
 - Compact bone replaces spongy bone around periphery of fracture



Fracture



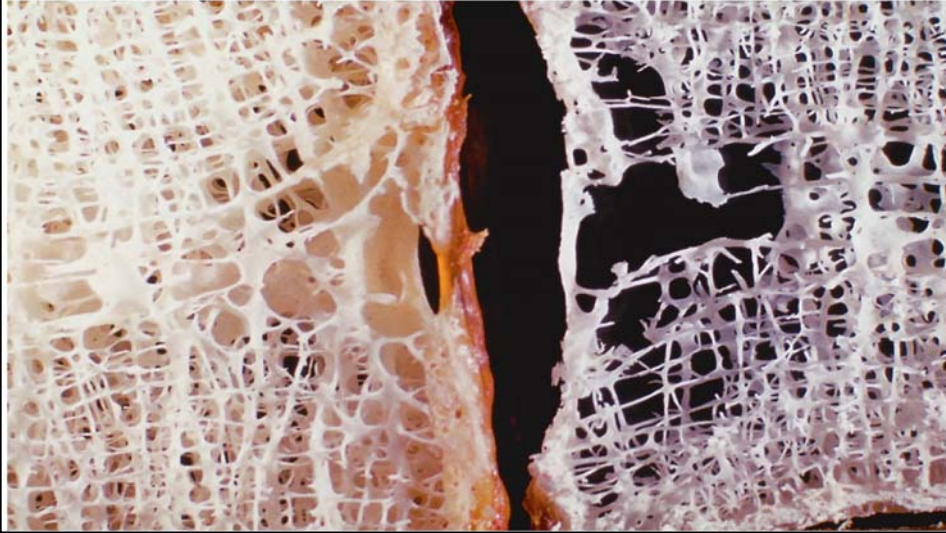


Aging and bone tissue

- Two principal effects of aging on bone:
 - loss of bone mass
 - Loss of calcium and other mineral from bone matrix
 - Decreased rate of collagen synthesis
 - Can lead to osteoporosis

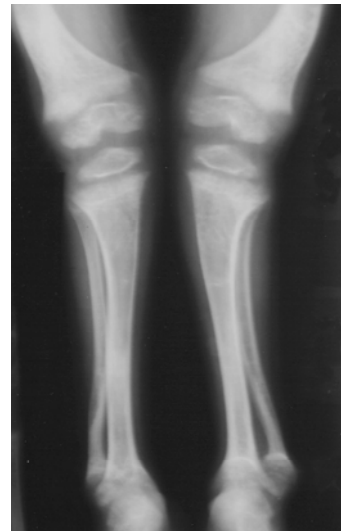
Osteoporosis

Normal bone (left) and bone loss in osteoporosis (right)



Clinical Conditions

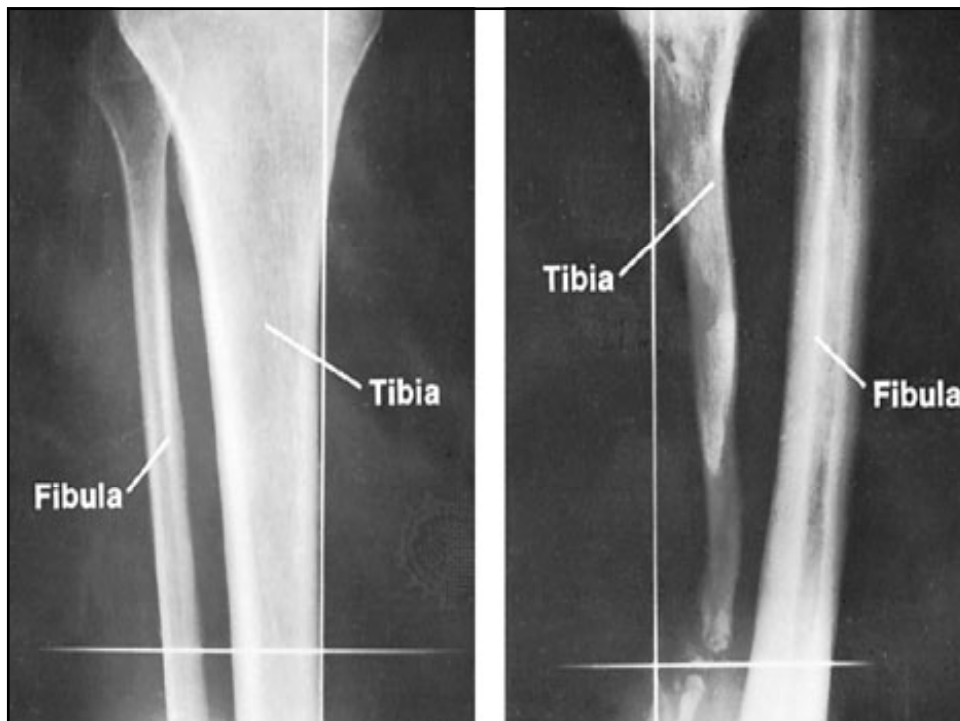
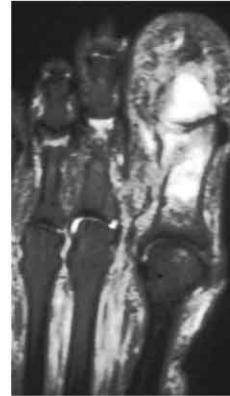
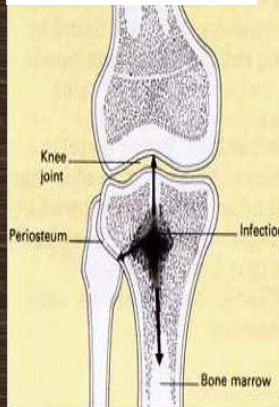
- **Osteomalacia**
 - Literally “soft bones.”
 - Includes many disorders in which osteoid is produced but inadequately mineralized.
 - Causes can include insufficient dietary calcium
 - Insufficient vitamin D fortification or insufficient exposure to sun light.
- **Rickets**
 - Children's form of osteomalacia
 - More detrimental due to the fact that their bones are still growing.
 - Signs include bowed legs, and deformities of the pelvis, ribs, and skull.



What about the above x-ray is indicative of rickets?

■ Osteomyelitis

- Osteo=bone + myelo=marrow + itis=inflammation.
- Inflammation of bone and bone marrow caused by pus-forming bacteria that enter the body via a wound (e.g., compound fracture) or migrate from a nearby infection.
- Fatal before the advent of antibiotics.





Radiographic manifestations of PHPT, seen in less than 2% of patients, include :

- sub periosteal erosions,
- diffuse osteoporosis,
- cystic lesions ('brown tumors'),
- pathological fractures,
- 'salt and pepper' mottling of skull,
- resorption of the distal end of clavicles
- and loss of lamina dura in the mandible.