

# Bone Formation, Remodeling, Fractures and Healing

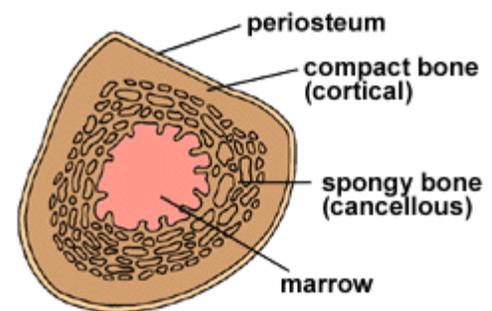
(Text Pg 29)

**Ossification:** Process by which new bone is produced

**Remodeling:** Further development of a bone whereby bone is created and destroyed.

## OSSIFICATION -The Process of Bone Formation

1. Bones begin as hyaline cartilaginous models (8 wks after conception)
2. The periosteum forms around the models.
3. Osteoblasts synthesize the compact bone of the diaphysis by releasing osteoid combined with inorganic salts.
4. Cartilage in diaphysis is transformed into cancellous bone as growth continues outward from the centre. Again the osteoclasts release osteoid into the membrane which forms a spongy membrane.
5. Osteoclasts breakdown cancellous bone to form the medullary cavity.



## Bone Growth

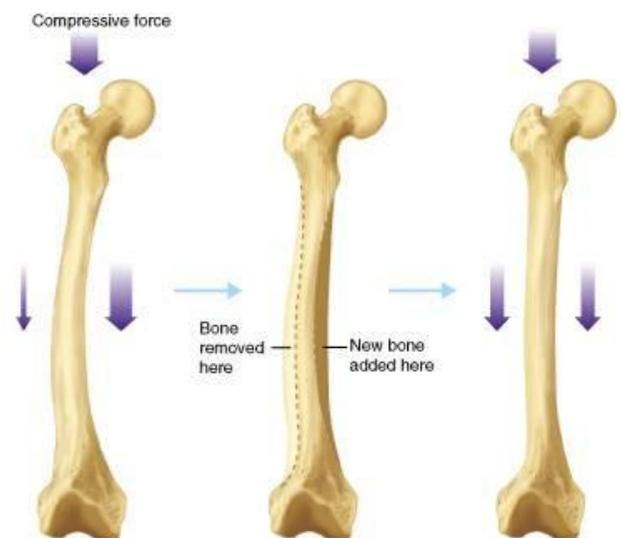
- Bone growth is governed by the combined effect of growth hormone, thyroid hormone, sex hormones, proper nutrition and physical activity.
  - *The Epiphyseal plate* (cartilaginous growth region) allows for bone growth to continue.
  - *The Epiphyseal line* appears when longitudinal bone growth stops.
- The Epiphyseal plate becomes an epiphyseal line as we reach the end of maturity.

## Bone Remodeling

- The process by which our body continually destroys and bone tissue throughout our lives.
- The process of bone remodeling is governed by:

**Wolf's law** "*Bones will grow or remodel in response to the forces or demands placed on them*"

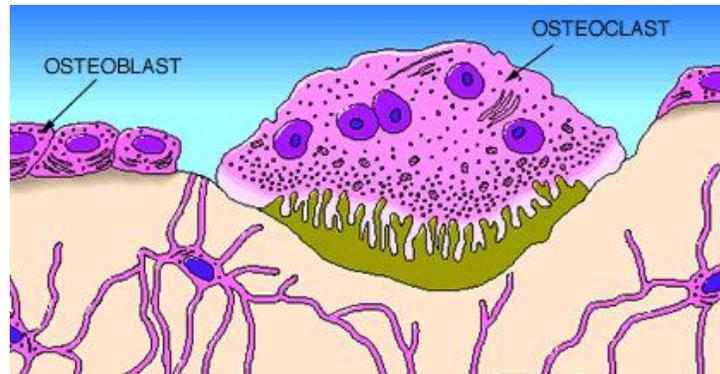
- Therefore:
  - When bones are subjected to regular loads they tend to become more dense and mineralized. e.g. a tennis player's arms.
  - Inactivity works in the opposite way leading to a decrease in bone weight and strength, e.g. bed rest



## PROCESS OF BONE REMODELING:

1. Osteoclasts release enzymes and acids that will break down old bone.
2. Osteoblast then release a gelatin-like protein called osteoids that then shapes new bone.

Remodeling peaks by the mid 30's, whereby a decline of reshaping begins to drop and resorption begins to exceed bone formation. In other words by the age of 40, adult begin to lose bone mass at significant rate.



# Fractures

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## Fractures Defined:

- When a bone **cracks** or **breaks** when subjected to extreme loads, impacts or stresses.

## Two Basic Types of Fractures

### 1. Simple/Incomplete Fractures:

- a. Bone is not exposed to the air through the skin
- b. No separation of the bone into parts.
- c. A crack or break is usually detectable.



### Two Types of Simple Fractures:

- i. **Hairline/Fissure Fracture:** The fracture only extends into the outer layer of the bone.
- ii. **Greenstick Fracture:** The fracture occurs only on one side of the bone (outside of bend). Mostly seen in children.

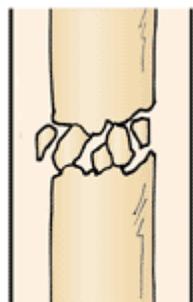


### 2. Compound/Complete Fractures:

- a. The bone has been completely fractured through its own width.
- b. Usually also results in damage to the surrounding soft tissue (**Complex Fracture**).
- c. They are either **OPEN** (Bone breaks through the skin) or **CLOSED** (Bone does not break through the skin)

### Four Types of Compound Fractures:

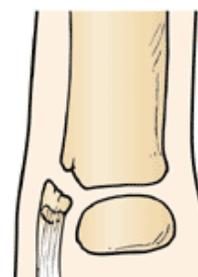
- i. **Comminuted Fracture:** The bone is broken into more than two fragments (highly unstable).
- ii. **Spiral Fracture:** The bone has been broken due to a twisting type motion and looks like a corkscrew.
- iii. **Avulsion Fracture:** A fragment of bone is detached from its point of insertion by a tendon or ligament.
- iv. **Impacted Fracture:** One bone fragment is driven into the medullary space or spongy bone of itself or another bone. The ends of the broken bones are wedged together.



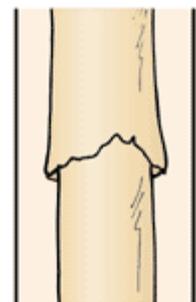
Comminuted



Spiral C



Avulsion



Impacted

# The Process of Bone Healing

## Step 1: Fracture Hematoma

- a. Bleeding occurs at the fracture site and a 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

## Step 2: Fibrocartilagenous Callus formation

- a. Collagen fibres, a cartilage matrix, and trabeculae span the break to splint the bone.

## Step 3: Bony Callus formation

- a. Bone trabeculae increase in number and convert the fibrocartilagenous callus into a **bony callus**.
- b. The bony callus seals the broken ends of the bone and forms a band of thickened material, like a cuff, around the break site. (~ 6-8 weeks).

## Step 4: Bone Remodeling

- a. During the next several months, the bony callus is continually remodeled.
- b. **Osteoclasts** work to remove the temporary supportive structures
- c. **Osteoblasts** rebuild the compact bone and reconstruct the bone so it returns to its original shape/structure.

**Immobilization:** In order to avoid disturbing the actions of bone healing, the bone must be immobilized.

