

## pathology | ملخص شامل لمعلومات المحاضرة الرابعة

**Fractures:** loss of bone integrity &/or diminished bone strength due to a disease such as osteoporosis, osteopetrosis, osteomalacia, etc.

**Simple # Closed,** Skin is intact, Swelling.

**Compound # Opened,** Skin is ruptured, Fractured bone communicates with overlying skin.

**Displaced #** two ends of the fractured bone are **not at the same axial line**

**Non-displaced #** two ends are **at the same axial line.**

**Stress #** it is a repetitive **slowly progressive** bone fracture that happens in cases of osteoporosis, chronic abnormal bone and weak bone

**Stress fracture.** *It usually happens in the axial skeleton, predominantly in the vertebral bodies leading to compression fractures.*

*Book: a slowly developing fracture that follows a period of increased physical activity in which the bone is subjected to repetitive loads*

**Greenstick #** soft bone fracture in children or young when

the bone is not completely ossified (mineralized)

it doesn't appear under the X-ray scan, neither the hematoma has appeared yet.

**Pathologic #** any fracture that happens in an abnormal bone

**weakened by an underlying disease process,**

pathologic fractures might be the first presentation which leads to the discovery of a bone tumor

### Examples:

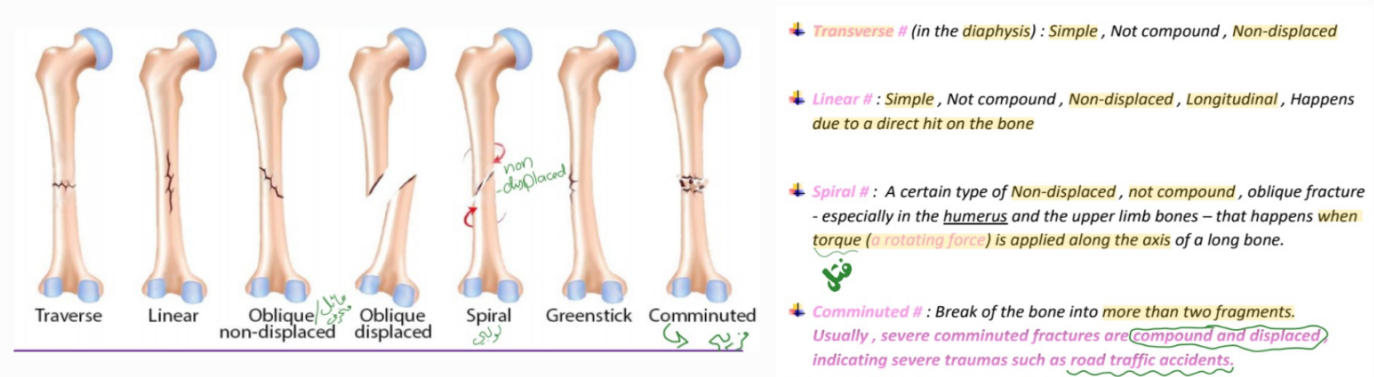
- *Compression fracture in the fifth lumbar vertebra in a woman suffering from severe osteoporosis.*
- *Fracture in the neck of femur in a man suffering from paget disease of bone after an accidental slip.*
- *Osteosarcoma of the proximal femur, chondrosarcoma of the neck of the femur might lead to fractures after minimal traumas.*

Example: A 55-year-old male presented with a fracture in the neck of femur, & after X-ray has been done, **multiple osteolytic lesions** have been found indicating multiple myeloma or metastatic carcinoma

### Healing stages:

1. **organizing hematoma** which fills the fracture gap and surrounds the area of bone injury.

2. Stimulation of platelet Derived Growth Factor (PDGF), TGF- $\beta$ , Fibroblast Growth Factor (FGF), Platelets, Inflammatory cells, osteoclastic and osteoblastic activity.
  3. Chondrocytes will be stimulated for cartilage healing
- During the healing process, woven bone appears**
4. lamellar bone appears (in late phases)
  5. Complete repair of the bone after 3-4 weeks



## FACTORS IMPACTING PROPER HEALING:

- Displaced and comminuted fractures: hard to treat, require more time.
- Inadequate immobilization: leads to delayed union or nonunion.
- Pseudoarthrosis: happens in severe cases when nonunion persists, where the luminal surface may become lined by synovial-like cells, creating a false joint.
- Infection in open fractures: might lead to osteomyelitis post fracture
- Malnutrition: proper nutrition including protein, calcium and vitamin D is required to speed up the healing process.
- Steroids & anti-inflammatory drugs (AIDrugs).

## OSTEONECROSIS (AVASCULAR NECROSIS):

Osteonecrosis : Death of the bony tissue, mainly due to ischemia, also called Avascular necrosis, and it is ( ischemic necrosis ) of bone and marrow cells

\*occur in any bone, more commonly in certain bones and fracture sites; like the femoral head.

**Associated conditions:**

### 1) Vascular injury

\*Trauma: it is considered one of the major causes of osteonecrosis includes fractures; for example: **Fracture of the neck of femur → blood supply gets compromised → Avascular necrosis**  
 one of the complications of pelvic fractures following a trauma is

Avascular Necrosis of the head of the femur.

**Vasculitis: inflammation of the blood vessels → vascular thrombosis → ischemia .**

**2) Drugs:**

**Steroids : increases osteoclasts activity → osteoporosis → fractures → blood supply becomes compromised → ischemia**

Example : A 65-year-old patient known to have rheumatoid arthritis for the last 15 years has been on steroids for the last 7 years , suddenly the patient wasn't able walk on his feet in addition to pelvic pain , the X-ray scan shows shadowing in the head of femur. → Avascular Necrosis

**3) systemic diseases (Sickle cell disease) :** patients with this disease are at higher risk to develop vascular thrombosis due to sickle cell crisis

**4) Radiation:** Repeated radiation therapy damages vascular components of the bone leading to ischemia.

**Mechanism :** Avascular Necrosis due to vascular occlusion.

Example: A patient diagnosed with sarcoma or malignancy in the pelvic bone with a previous history of radiation (radiotherapy) is at a higher risk of osteonecrosis

**Osteonecrosis mechanisms :-**

1) Mechanical disruption (Trauma leading to cut of blood supply by force )

2) Thrombotic occlusion (Sickle cell , Drugs-steroids- , Radiation )

3) Extravascular compression ( Trauma / Hematoma / Tumors / Fracture )

\*Necrotic bone is pyramidal in shape

\*avascular necrosis is wedge shaped necrosis in the head of the femur

**Osteomyelitis:** inflammation of bone / bone marrow due to an infection.

**Causes:**

- systemic infection

Example : A patient with osteomyelitis of a vertebral body due to systemic septicemia such as gram-negative sepsis.

- Primary solitary focus: only one bone is infected

\*\*bacterial osteomyelitis is the most common one.

**Pyogenic Osteomyelitis:** pus forming inflammation of the bone caused by an infecting organism.

**Bacteria causing pyogenic osteomyelitis:**

\* Staph. aureus, the most common

\*Escherichia-coli, Pseudomonas & Klebsiella are more frequent in patients with (UTIs) or patients who are drug abusers.

## Mechanism of spread

1. **Hematogenous** spread: mainly in children

Example: Otitis media, Tonsillitis, Impetigo of the skin → bacteria in blood (bacteremia) → acute pyogenic osteomyelitis.

- Manifestations: Fever, malaise (loss of appetite), chills, **leukocytosis** (increased WBC count), Throbbing pain locally and it is a characteristic of presence of **pus**.

\*\*In infants the presentation is subtle, with only unexpected fever. In adults it appears as a local pain

2. Extension **from a contiguous site**: mainly in adults.

Example: diabetic foot with severe ulcers patient, infections and gangrenes in the lower limb → bacteria goes to underlying bone.

3. **Direct implantation after compound fractures and orthopedic surgeries**

Example:

I. A patient with a compound fracture in which the fractured bone is communicating with the overlying skin and becomes exposed to environmental bacteria that might enter and cause **secondary osteomyelitis**.

II. A patient with a closed fracture in which the skin was intact needed a surgery, and during the surgery the bone might have got infected.

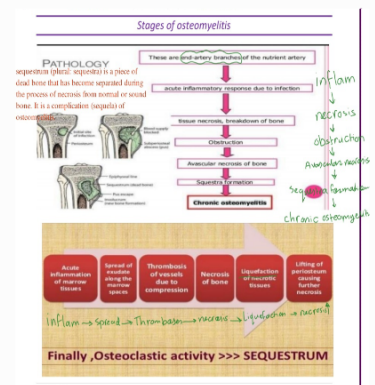
Note: previous improper administration of antibiotic, cause improper diagnosis and treatment that interferes with your blood culture results → (False Negative result)

- **Long bones get infected more often.**

• in adults: Metaphysis & epiphysis

• in children: Metaphysis Or epiphysis (not both)

**Stages:** Acute inflammation → Spread of mediators & neutrophils → Recruitment of **WBC** → Pus (exudate) → Vascular **thrombosis** → **Necrosis** of the bone → **Liquefactive necrosis** → **Lifting of periosteum**



1. **Sequestrum**: necrotic (dead) bone that is embedded in the pus / infected granulation tissue.

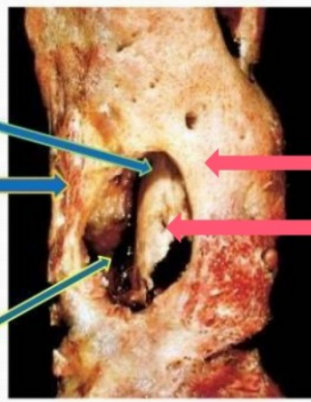
2. **Involucrum**: new bone laid down by the periosteum that surrounds the sequestra. (Involucrum: active bone-forming region)

3. **Cloaca**: is the opening in the involucrum through which Pus & sequestra make their way out.

- **Sequestrum** is the necrotic bone that is embedded in the pus/infected granulation tissue.

- **Involucrum** is the new bone laid down by the periosteum that surrounds the sequestra.

- **Cloaca** is the opening in the involucrum through which pus & sequestra make their way out.



Reactive (viable) bone

Dead bone

## Diagnosis:

1. **Biopsy** and bone **cultures** are required
2. **X-ray**, X-ray maybe normal in early phases.

\*if we see changes in the X-ray scan due to pyogenic osteomyelitis, that means the patient is in a late phase of the disease.

\*\*It is very rare to have patient with a chronic OM without them going first through the acute phase.

## Causes of Chronic Osteomyelitis

Extensive necrosis | Inadequate therapy | Weakened Host Immunity

ACUTE	→	PUS & NEUTROPHILS
CHRONIC	→	LYMPHOCYTES AND PLASMA CELLS And Macrophages

+ Different age groups get infected with different type of organisms .

- **Neonates** : *Haemophilus influenzae* & *Group B strep.*
- **Sicklers** : *Salmonella* , patients with sickle cell disease are more likely to develop *Salmonella pyogenic osteomyelitis* for some reason .

## COMPLICATIONS

Pathologic fractures | Secondary amyloidosis | Endocarditis | Sepsis | Squamous cell carcinoma of draining sinus| Sarcoma of the bone.

## Mycobacterial Osteomyelitis (chronic)

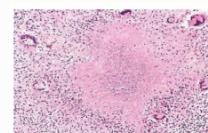
- patients with pulmonary or extrapulmonary TB can have bone involvement

- Hematogenous (spreads through the blood) or direct spread, Examples :

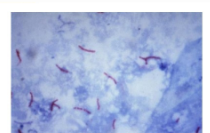
I. TB in lung can spread to ribs or humerus through the blood.

II. TB in the skin (diabetic foot) , the bacteria goes to the underlying bone.

\*Pathology: **necrotizing (caseating) granulomas**.



H&E stain shows granuloma with central necrosis (caseating)



Acid fast bacilli stain showing red snappers (Mycobacterium)  
Ziehl-Neelsen stain

## TB SPNDYLITIS (POTT DISEASE) التهاب الفقرات التصلبي

\* **chronic** osteomyelitis of the vertebral body

\*caused by TB infecting the vertebral body

\*Seen as **necrotizing granuloma**.

May lead to pathologic fractures (compression fractures) that may compress the nerves leading to neurologic deficit, scoliosis, kyphosis



دعواتكم  
-علا الأحدث