Level-1 Semester-2

Pathology - MSS

BERLIN

17L.E

SCAN ME

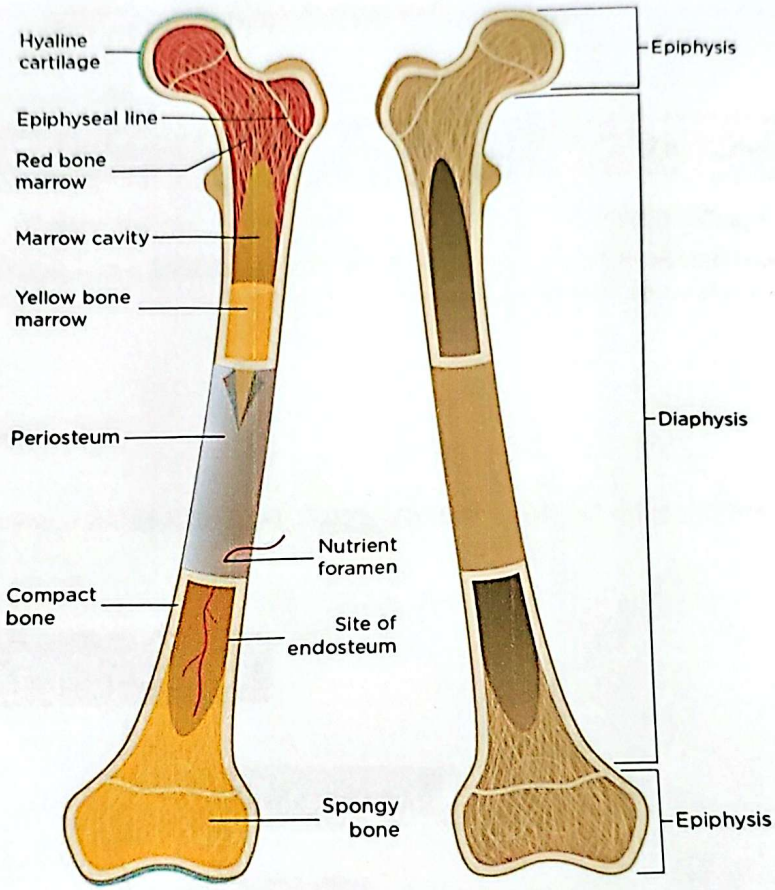
Lecture 2

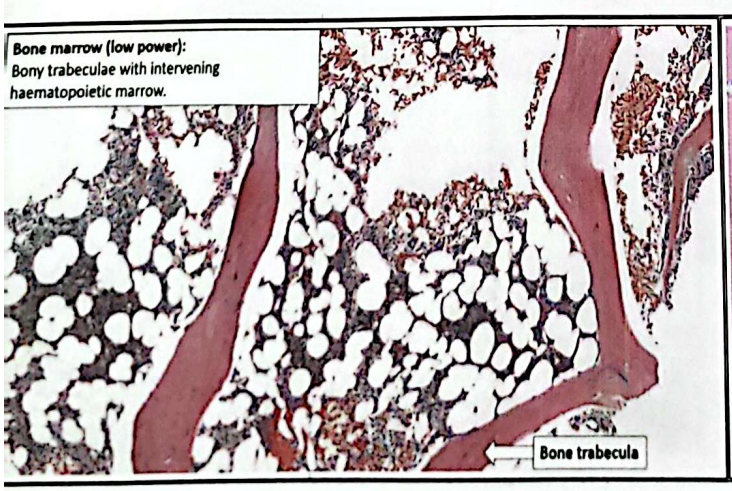
Osteomyelitis

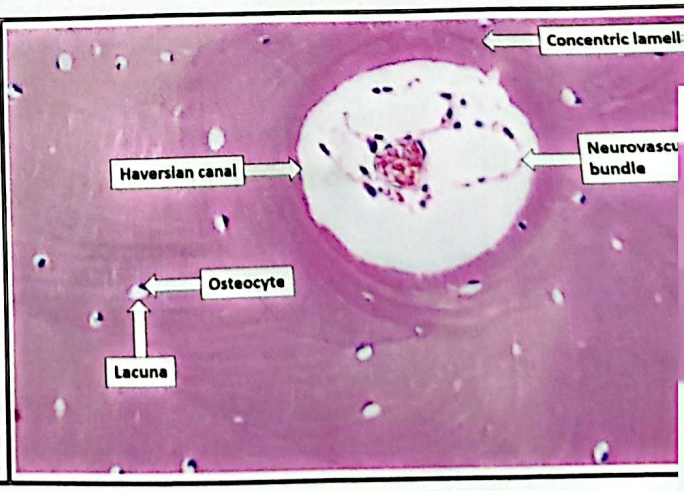
DR M. YUSUF

OSTEOMYELITIS

NORMAL BONE







OSTEOMYELITIS

Definition of osteomyelitis

- **Inflammation** of bone and bone marrow.

CLASSIFICATIONS ACCORDING TO:

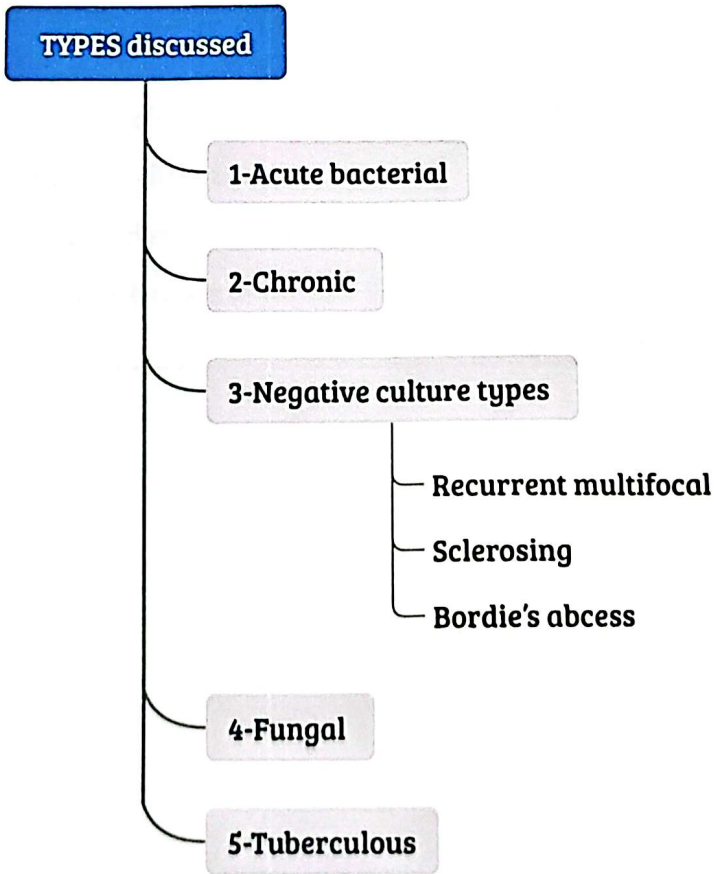
❶ Duration of illness:

	ACUTE OSTEOMYELITIS	CHRONIC OSTEOMYELITIS
DURATION	Present with a symptom duration of a **few days or weeks**	**Longstanding** infection over **months or years**

❷ Mechanism of infection:

① Hematogenous.

② Non-Hematogenous: Direct **extension** from contiguous site - Direct contamination



1 ACUTE BACTERIAL OSTEOMYELITIS

ETIOLOGY

1	CAUSATIVE ORGANISM	① **Coagulase** positive **staph aureus** (90%). ② **Pseudomonas** (post-traumatic).		
2	MECHANISM		① HEMATOGENOUS	② DIRECT (NON-HEMATOGENOUS) (Spread from septic focus or from infected compound fracture)
		AGE	In **children**	In **adult**
		BONE TYPE	**Long Bone**	**Flat Bone**
		SITE	**Metaphysis** (why?) 1) Vascular 2) Wide sinuses 3) Blood stasis	**Diaphysis**
3	RISK FACTORS	① HEMATOGENOUS SPREAD		② NON HEMATOGENOUS SPREAD
		1) **Endocarditis** 2) **Indwelling catheters** (vascular catheters – cardiovascular devices) 3) **Orthopedic hardware** 4) **Injection drug use** 5) **Hemodialysis** 6) **Sickle cell disease**		1) Direct inoculation ▪ Trauma ▪ Bite wound ▪ Surgery 2) Contiguous spread ↳ **Infection to bone from adjacent soft tissues & joints:** ▪ Diabetic foot wounds. ▪ Vascular disease. ▪ Decubitus ulcer.

SITES

<table>
<tr><th colspan="3">HEMATOGENOUS SPREAD</th><th>DIRECT EXTENSION (NON-HEMATOGENOUS)</th></tr>
<tr><td colspan="4">INCIDENCE</td></tr>
<tr><td colspan="3">Most common cause</td><td>Less common</td></tr>
<tr><td colspan="4">SITE</td></tr>
<tr><td>In Children</td><td>In Adult</td><td>In elderly</td><td>May affect vertebral column</td></tr>
<tr><td>Long tubular bones</td><td>Flat bones</td><td>In diabetes</td><td>Affects small bones in feet</td></tr>
<tr><td colspan="2">Metaphyseal in both</td><td colspan="2">---</td></tr>
<tr><td colspan="4">ASSOCIATION</td></tr>
<tr><td colspan="3">—</td><td>☑ May be associated with:
▪ Trauma
▪ Rarely iatrogenic implantation of infectious material
▪ Systemic urinary tract infection
▪ Diabetes
☑ In younger adults, associated with:
▪ Immunodeficiency
▪ Intravenous drug abuse</td></tr>
</table>

TYPE OF BACTERIA

☑ **80% of known cases** are due to **Staphylococcus aureus.**

ALL PEDIATRIC AGE GROUPS	☑ **Most common:** Staphylococcus aureus. ☑ **Next** most common: ① Group A streptococci ② Streptococcus pneumoniae ③ Kingella kingae
NEONATAL AGE GROUPS	① Staphylococcus aureus, ② Streptococcus agalactiae, ③ Escherichia coli
SICKLE CELL PATIENTS	☑ **Salmonella**
INTRAVENOUS DRUG ADDICTS	① Staphylococcus aureus ② Coagulase negative Staphylococcus
↓ AFFECTING	① Clavicle ② Sternoclavicular joint ③ Spine ④ Pelvis
POSTTRAUMATIC CASES	① Pseudomonas ② Mixed bacteria
OTHER KNOWN ORGANISMS	① Escherichia coli ② Pseudomonas ③ Klebsiella

Pathogenesis

1	Trauma	☑ Extravasated blood & bacteria in medullary cavity ☑ Spread of suppuration to: ① **Periosteum** → Subperiosteal abscess. ② **Epiphysis** (which is avascular and resistant).
2	Necrosis of sup. Cortex	☑ **Due to:** ① Ischemia & Thrombosis ② Bacterial toxins
3	Granulation tissue formation with suppuration	
4	Sequestrum	☑ Separation of **septic necrotic bone** surrounded by **granulation tissue.**
5	Involucurum	☑ **New bone** laid by **cambium layer of periosteum** which surrounds **sequestrum**

Clinical features

Onset	▪ Gradual onset of symptoms over several days
Symptoms	① Dull pain at the involved site ② Fever - rigors may also be present
Signs	① Tenderness ② Warmth ③ Erythema ④ Swelling

Diagnosis

☑ **Diagnosis of osteomyelitis is established via:**

① **Culture** obtained from **biopsy** of the involved bone.

② **Histopathology** consistent with **osteomyelitis** in the absence of positive culture data.

③ Typical **clinical and radiographic** findings together with **persistently elevated inflammato markers** in the absence of positive culture and no biopsy interpretation.

Nematodes affecting human

1) **Cutaneous larva migrans, larva currens**
(Ancylostoma duodenale, strongyloides stercoralis
African eye worm)
ulus
Worm (dracunculus medinensis)
VA MIGRANS
larvae in the tissues of un-natural
orable conditions.
velopment but
oma.

LABORATORY

① **Leukocytosis** on complete blood count

② **Elevated inflammatory markers:**
1) Erythrocyte sedimentation rate (ESR)
2) C reactive protein (CRP)

③ **Blood cultures** are positive in **50 - 60%** of cases.

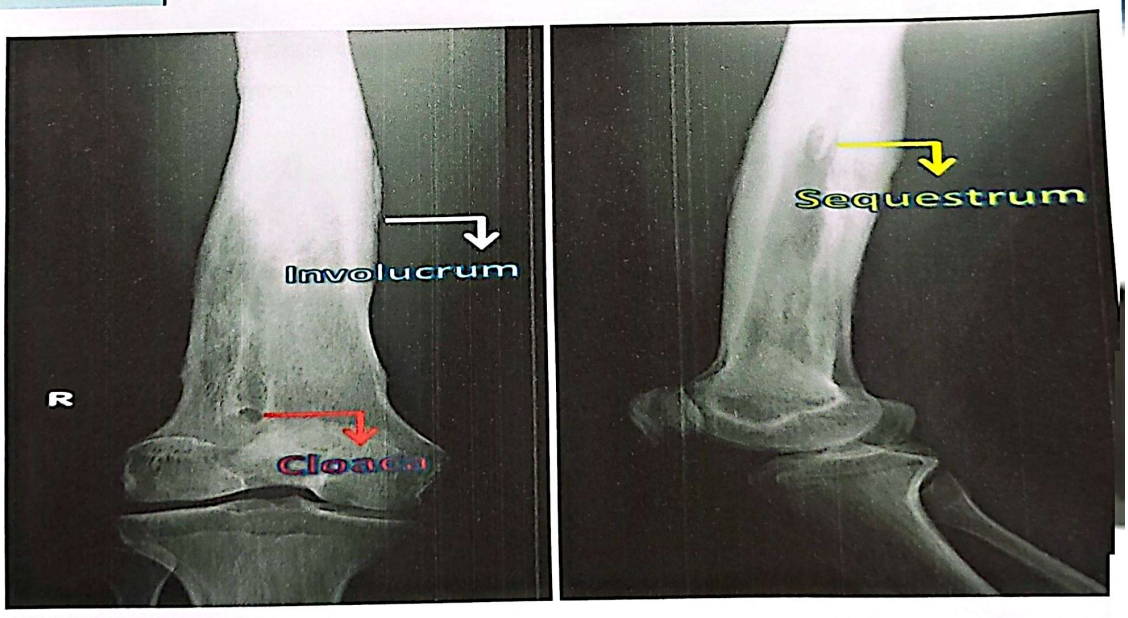
④ **Bone aspirate cultures** may be positive when blood cultures are negative.

RADIOLOGY

CONVENTIONAL RADIOGRAPHY

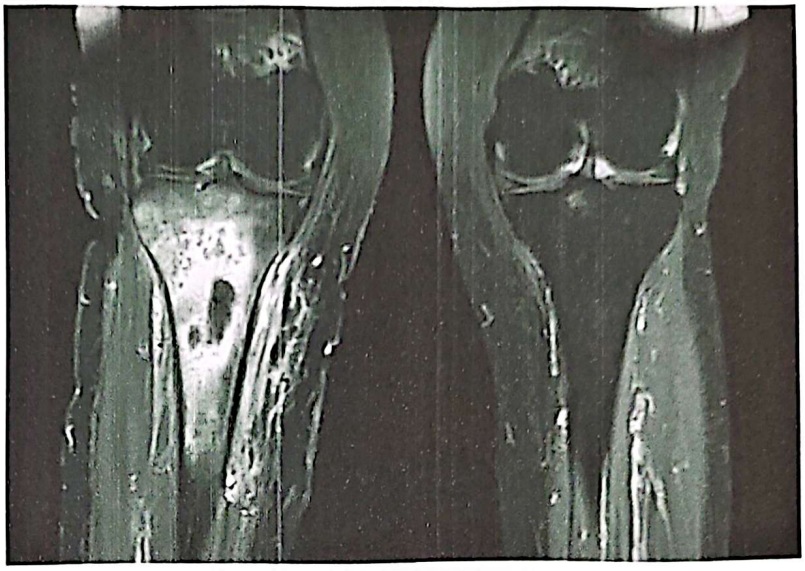
☑ Not for **early** detection of osteomyelitis.
☑ Reasonable **initial imaging** modality with **≥2 weeks** of clinical symptoms.
☑ **Findings:**
① **Soft tissue swelling**
② **Osteopenia**
③ **Cortical loss**
④ **Bony destruction** (radiolytic lesion)
⑤ **Periosteal reaction** (Late images show prominent periosteal reaction resembling neoplasm).

1



② MAGNETIC RESONANCE IMAGING

- ☑ **High sensitivity** and **negative predictive** value.
- ☑ **MRI with no evidence** of osteomyelitis after **1 week** of clinical signs or symptoms is sufficient for exclusion of osteomyelitis.



PROGNOSTIC FACTORS

☑ **Chronic osteomyelitis develops in a subset of acute osteomyelitis due to:**

① **Delayed** treatment
② **Inadequate antibiotics**
③ **Incomplete surgical** debridement of necrotic bone
④ **Weakened** host **defenses**

GROSS DESCRIPTION

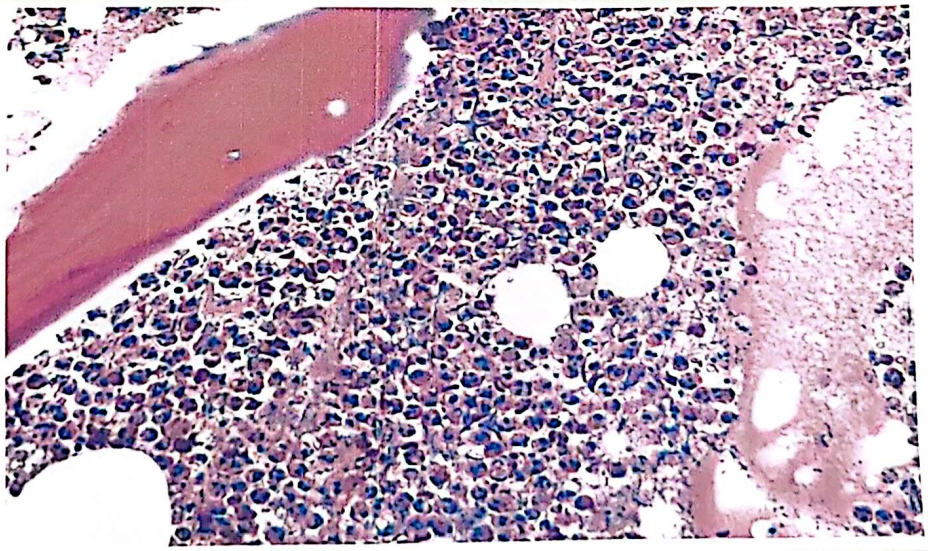
VARIES WITH PATIENT AGE

		JOINT	EPIPHYSIS	METAPHYSIS	DIAPHYSIS
OPPOSITE	INFANTS < 1 YEAR	Permanent damage		Spared	
	CHILDREN ≥ 1 YEAR	Spared	----	Damaged	----
ADULTS		Infection	Extensive bone involvement		

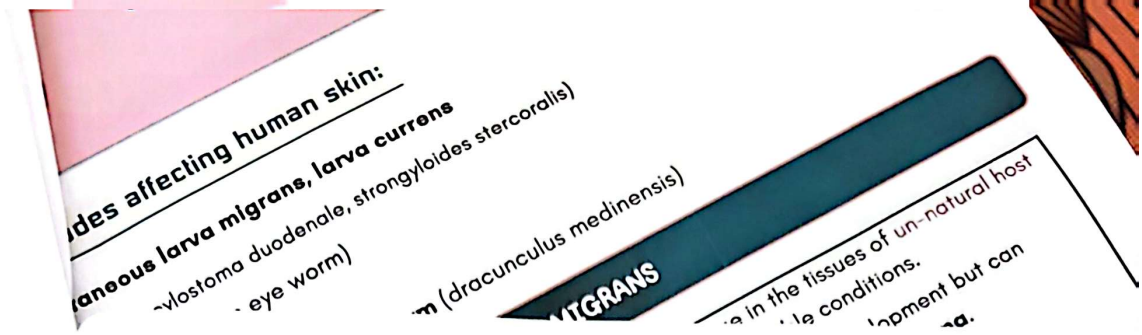
MICROSCOPIC PICTURE (BIOPSY)

PATTERNS OF ACUTE OSTEOMYELITIS

❶	OSSEOUS CHANGES	① **Osteonecrosis : Bone trabeculae** with visually empty osteocyte cavities are detectable as a **criterion** for **necrotic** bone tissue. ↳ **The bone trabeculae:** 1) Have **irregular/jagged contours** and are **fragmented.** 2) May be **fractured** & **completely necrotic** (so called bone **sequester**) ② There are **intramedullary granulocyte infiltrates** and **fibrin** exudates.
❷	INFLAMMATORY INFILTRATE PATTERN	**1. Neutrophilic infiltrate: Diffuse** and **grouped deposits** (so called **micro**abscesses, **≥5 granulocytes**) of segmented neutrophilic granulocytes in the usually highly oedematous medullary spaces. 2. **Osteoclasts** are found on the irregular trabecular surface.



NONVIABLE BONE WITHOUT OSTEOCYTES IN LACUNAE, ACUTE INFLAMMATORY INFILTRATE AND AREA OF NECROSI



COMPLICATIONS

1. **Recurrence.**
2. **Chronicity (Delayed ttt - Inadequate antibiotics - Incomplete debridement - Weakened defense).**
3. **Epidermal inclusion cyst.**
4. **Sinus** lined by sq. cells may transform to **S.C.C.**
5. **Cloaca:** cortical defect that drains pus from medulla to surrounding soft tissue.

TREATMENT

1. **Antibiotic** therapy.
2. **Surgical** debridement.

II CHRONIC OSTEOMYELITIS

Definition

- General Longstanding infection of bone lasting months to years; characterized by low grade inflammation and presence of dead bone or fistulous tract.

ESSENTIAL FEATURES

M:F	▪ 4:1
INCIDENCE	▪ Highest in **adults**, 41 - 50 years (29%)
MOST COMMON SITE	▪ **Tarsal** and **metatarsal** bones and toes (43%)
MOST COMMON ORGANISM	▪ **Staphylococcus aureus;** responsible for 80 - 90% of cases
MODE OF SPREAD	▪ **Contiguous** spread is most common

Pathophysiology

☑ **Entry of the organism into bone occurs by 3 main mechanisms:**

① **Osteomyelitis secondary to a contiguous focus of infection** (after trauma, surgery or insertion of a joint prosthesis) is **most common.**

② Secondary to **vascular insufficiency** (e.g., diabetic foot)

③ **Hematogenous seeding,** least common.

Prognostic factors

☑ **Diabetes** is a **poor** prognostic factor in patients with chronic osteomyelitis;

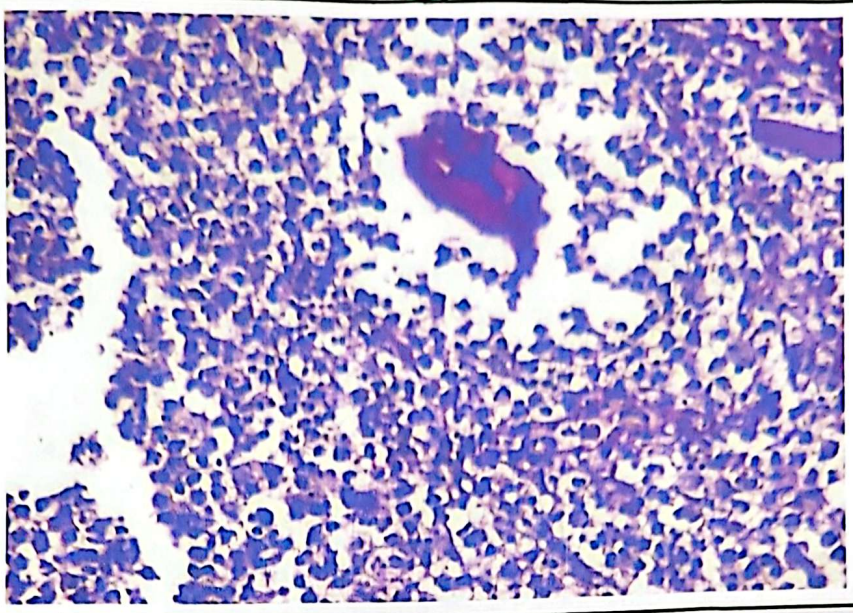
↳ poor prognosis in patients with **nutritional and systemic diseases.**

Complications

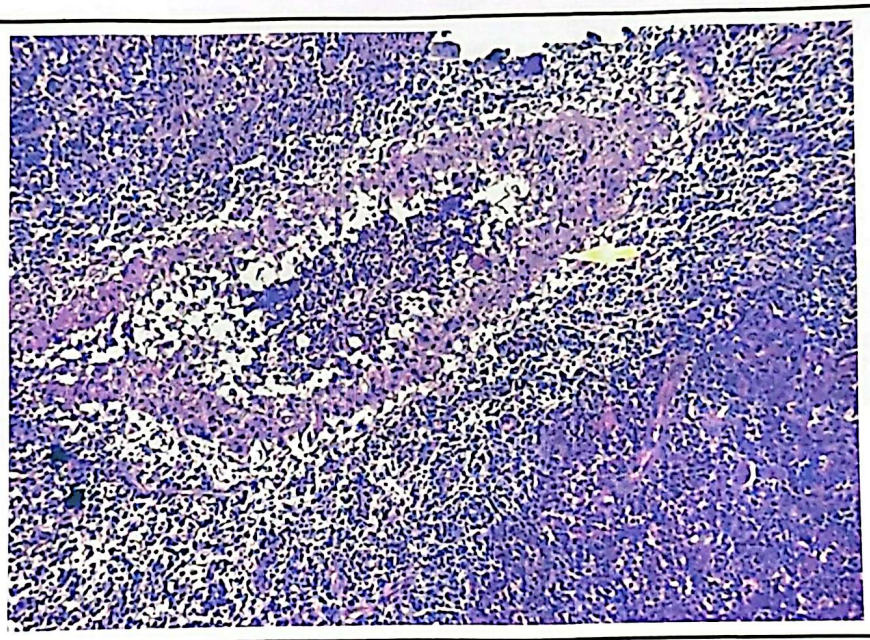
1. **Arthritis**
2. **Pathological fractures**
3. **Skeletal deformities**
4. **Amyloidosis**
5. **Malignant transformation** (squamous cell carcinoma)
6. **Pseudo-carcinomatous** squamous hyperplasia involving bone (rare)

Microscopic (histologic) description

1. **Necrotic bone**
2. **Inflammatory infiltrate rich in plasma cells**
3. **Fibrosis,** variable
4. **Granulomas,** in cases of ① **Tuberculosis** or ② **Fungal** infection.



AREA OF SUPPURATIVE NECROSIS WITH A CENTRAL DEAD BONE FRAGMENT.



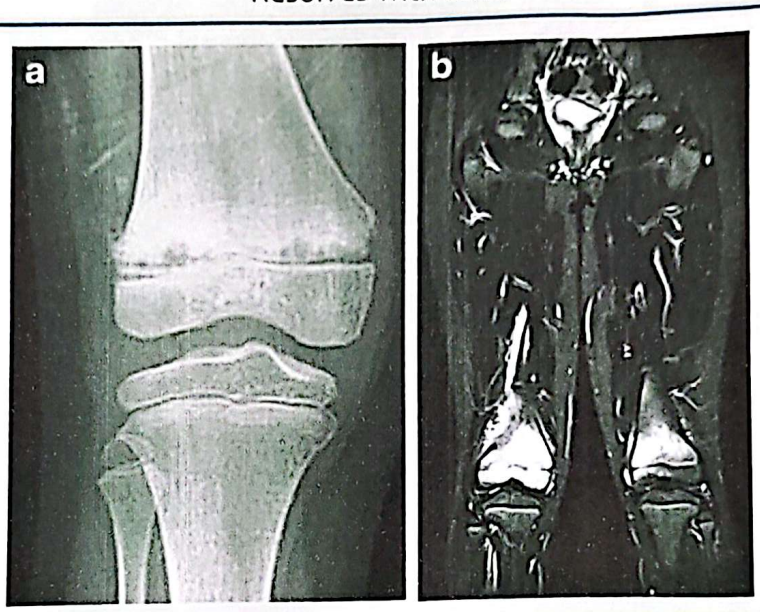
WELL FORMED GRANULOMA WITH CENTRAL AREA OF SUPPURATION AND NECROSIS (ARROW)

CLINICAL FEATURES

1. Patients with chronic **osteomyelitis** often have a **protracted course.**
2. **Fever - pain - swelling** (depending on site involved).
3. May report **interval acute episodes.**
4. Can also present with **open wound** that exposes **fractured bone** or an **indolent draining fistul**

III OTHER NEGATIVE CULTURE OM

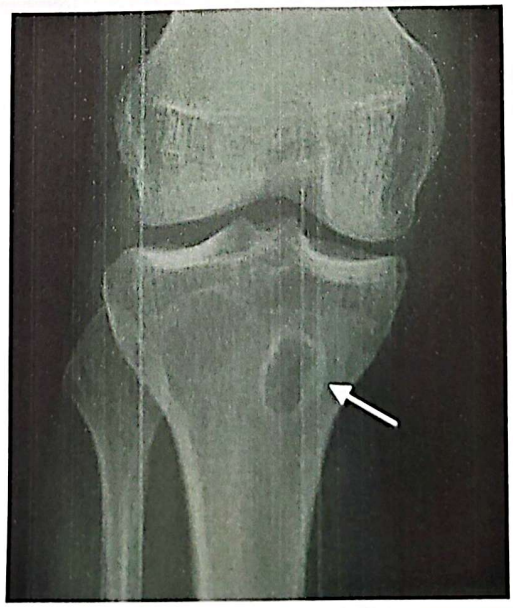
1 RECURRENT MULTIFOCAL OM

AGE	In children
C/P	☑ Associated with **inflammatory symptoms:** 1) Pain 2) Swelling 3) Erythema
FATE	Resolves with time
FIGURE	

② SCLEROSING OM OF GARRE

SITE	JAW	PUBIS
	Children	Adult
PATHOLOGY	▪ **Gradual** bone **sclerosis**	
C/P	▪ **Pain** due to extensive bone formation. ▪ **Not associated** with **inflammatory** symptoms.	
FIGURE		

③ BORDIE ABCESS

PATHOLOGY	**Localized form** of OM in **long** bone
FIGURE	

IU TB

CAN CAUSE POTTS DISEASE

SITE	Involving ① **Thoraco-lumber body** & ② **Intervertebral disc** (DD from tumor that involves the body)
MICROSCOPIC PICTURE	**Caseating** granuloma
FIGURE	

U FUNGAL

ACTINOMYCOSIS	CANDIDA
AFFECTS	
Immunocompromised patients	Non-**immunocompromised** patients via direct **trauma**

VERTEBRAL OSTEOMYELITIS	FEMORAL AND HUMORAL BONE
Most common in **adults**	More common in **pediatric**