

# OSTEOMEYLITIS

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## Definition:

❓ Acute or chronic inflammation of the bone, bone marrow , and its structures secondary to infection.

# Classification:

DURATION	MECHANISM	HOST RESPONSE
ACUTE	HEMATOGENOUS	PYOGENIC
SUBACUTE	EXOGENOUS	GRANULOMATOUS
CHRONIC		

# ROUTES OF INFECTION

## HEMATOGENOUS

? (endogenous osteomyelitis): caused by hematogenous dissemination of a pathogen

? Episode of bacteremia

## EXOGENOUS

- caused by a spread of bacteria (typically multiple pathogens) from the surrounding environment <sup>[4]</sup>
  - Posttraumatic: infection following deep injury (penetrating injury, open fractures, severe soft tissue injury)
  - Contiguous: spread of infection from adjacent tissue
    - Secondary to infected foot ulcer in **patients with diabetes**
    - iatrogenic (e.g., postoperative infection of a prosthetic joint implant)



# Acute osteomyelitis

Infection of the bone including the periosteum, cortical bone, and the medullary cavity.

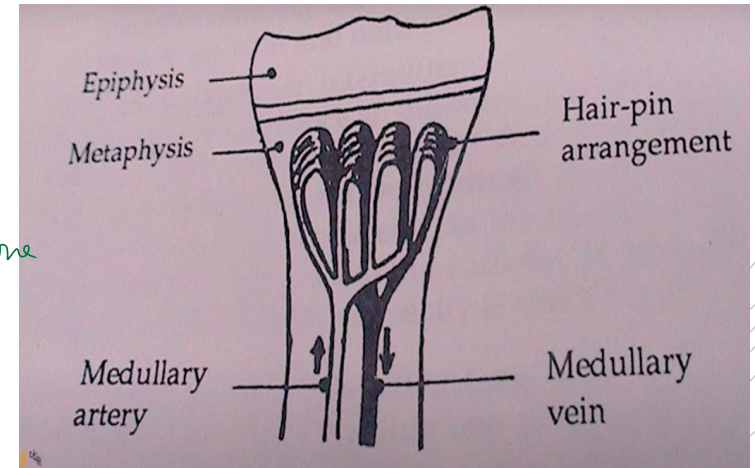
80% cases: staph aureus

Source: HEMATOGENOUS, direct extension, external

Age: CHILDREN >

BOYS > GIRLS

SITE: METAPHYSIS



[ Sluggish Blood flow ]  
↓ O<sub>2</sub>  
↓ PH

seeding start from below the metaphysis → ↑ secretion (pus) → ↑ pressure  
↓ venous system  
necrosis ← by ↑ pressure

if goes to Volkmann's canal transanally → push periosteum away from bone

Pariosteal  
Reaction

New bone formation  
Around the necrosis  
seen on x-ray

"Involucrum"

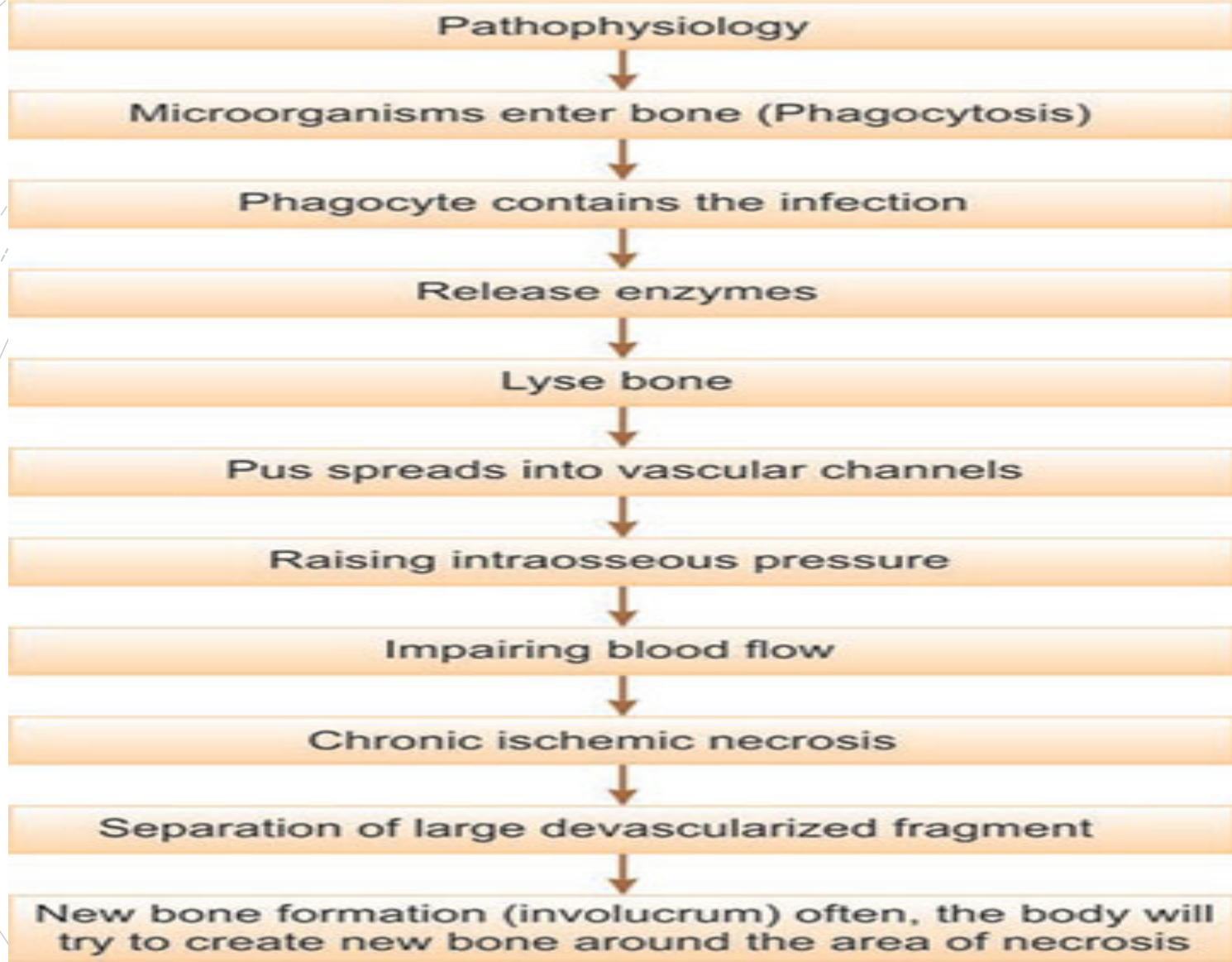
sequestrum is the death  
of bone cells with the  
pus



- **Infants < 1 year** – Group B streptococci  
Staph aureus  
E.coli
- **1- 16 years** – S. aureus , S. pyogenes , H. Influenza
- **> 16 years** – S.aureus , S.epidermidis , Gram –ve  
bacteria

## Frequent causes of osteomyelitis

Associated condition	Mode of infection	Most frequent pathogen	Typical location
Boys	Hematogenous seeding during an episode of bacteremia	<i>Staphylococcus aureus</i>	Long bones
Sickle cell	Hematogenous seeding to infarcted bone	<i>Salmonella</i> <i>seeds from the GI tract + they have Asplenic</i>	Long bones
Pott disease	Hematogenous seeding from lungs	<i>Mycobacterium tuberculosis</i>	vertebrae
Diabetes mellitus	Contiguous spread from infected foot ulcer	Polymicrobial	Bones of the feet
Recumbent patients with impaired mobility	Contiguous spread from pressure sores	Polymicrobial	Sacrum and heels
Recent trauma or orthopedic emergency	Direct inoculation	Polymicrobial	Variable



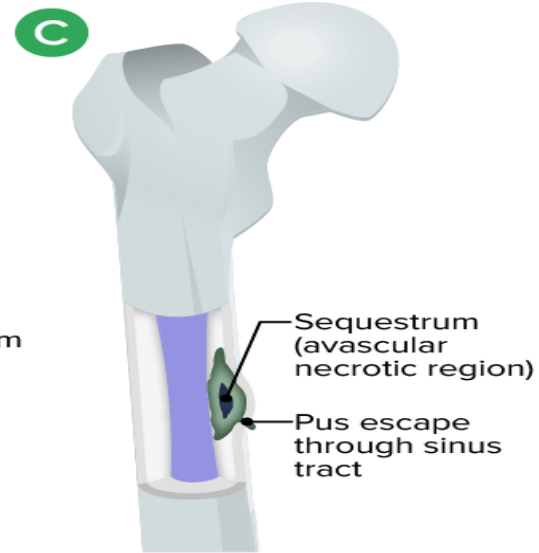
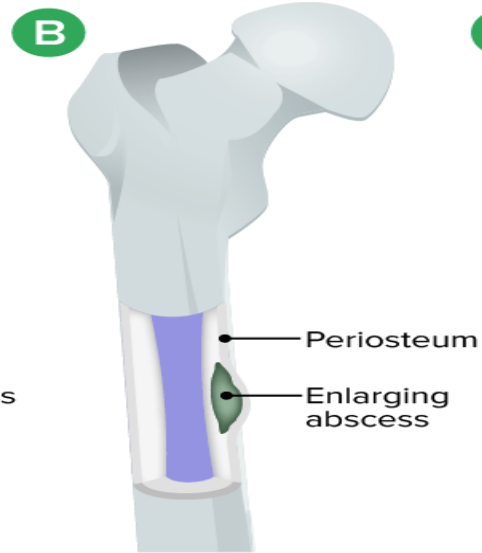
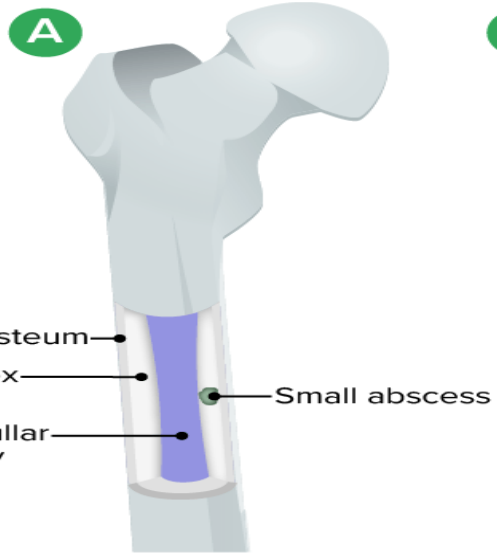
Inflammation

Suppuraion

Necrosis

New bone

resolution



Clinical  
Presentation  
Acute  
osteomyelitis

- Onset may be gradual.
- Signs and symptoms: Fever
- Looks ill
- Pain
- chills
- Localized swelling
- Warmth
- Erythema
- Dull pain
- The limb is held in (pseudoparalysis), may be mild or absent in neonate

- **Cellulitis:** this is often mistaken for osteomyelitis. There is widespread redness and lymphangitis. A source of skin infection may not be obvious and should be searched for (e.g. between the toes). If doubt remains about the diagnosis, MRI will help to distinguish between bone infection and soft-tissue infection.
- **Sickle-cell crisis:** patients with sickle-cell disease may present with features like those of acute osteomyelitis. Where Salmonella is endemic it would be wise to treat these patients with suitable antibiotics until infection is definitely excluded.

 Differential diagnosis:

- **Rheumatic fever** : Onset is more gradual, pain and tenderness are less intense. Involvement is polyarticular. Response to salicylates and ACTH is dramatic.
- **Acute suppurative arthritis** : Pain and tenderness are , limited to the joint, joint movements is greatly restricted, muscle spasm is intense, and aspiration reveals purulent synovial fluid.



Investigations :

**Laboratory studies** [10]

• **Routine studies**

- CBC: thrombocytosis, possible leukocytosis [5]
- Inflammatory markers: ↑ CRP, ↑ ESR (sensitive but not specific) [12]
- Blood cultures: positive in half of the patients
  - May be positive in hematogenous osteomyelitis (see “Causative pathogens in osteomyelitis”)
  - Typically negative in exogenous osteomyelitis

• **Additional studies** (as needed)

- Features of sepsis present: full diagnostic workup for sepsis
- Purulent wounds/sinuses: Consider culture of purulent material.

# Imaging

## Routine imaging <sup>[10][13][14]</sup>

*if you do see changes when you are too late*

- **X-ray:** low sensitivity and specificity for osteomyelitis <sup>[15]</sup>
  - Indication: initial evaluation as can also exclude differential diagnoses of osteomyelitis
  - Characteristic findings
    - Acute osteomyelitis: typically no pathological findings <sup>[5]</sup>
    - Subacute/chronic osteomyelitis: bone destruction, sequestrum formation, periosteal reactions <sup>[15]</sup>
- **MRI with and without IV gadolinium:** most sensitive study <sup>[15]</sup>
  - Indications
    - Suspected acute osteomyelitis (evidence of inflammation can be seen  $\leq 5$  days after onset of infection)
    - Negative x-ray but high clinical suspicion <sup>[13]</sup>
    - Evaluation of the extent of osteomyelitis
  - Characteristic findings <sup>[15]</sup>
    - Acute/subacute osteomyelitis: cortical destruction, bone marrow inflammation, soft-tissue involvement
    - Chronic osteomyelitis: fibrotic scarring of the marrow



**2.2 Acute osteomyelitis – x-rays** During the first 2 weeks the x-ray looks normal; later the bone may look mottled and there are increasing signs of periosteal new bone formation.

**1-AAA(Antibiotics,Analgsic,antipyritic)**

**2-Drainage**

**3-Follow up**

Treatment

Specific Antibiotics

→ you have to Drain and send to culture Give empirical then change the tto Antibiotic

## Antibiotic therapy

Empiric antibiotic therapy is rarely required.

- Start most patients directly on pathogen-directed antibiotics based on culture results.
- Consider switching to oral antibiotics after an initial IV course.

• Duration of therapy is normally 4-8 weeks. → longer than septic Antibiotics

### • **Empiric antibiotic therapy for osteomyelitis**

• Indications

#### • Signs of sepsis

- Severe or rapidly progressing infection
- Consider in diabetic foot osteomyelitis.

• Empiric regimens for adults should cover:

• S. aureus (e.g., with vancomycin )

• AND gram-negative bacilli, including Pseudomonas; recommended regimens include

• Meropenem

• OR cefepime PLUS metronidazole

• For empiric regimens in children, see "Osteomyelitis in children."

osteomyelitis

Give Antibiotics, if no Response Drain it the study it "surgical intervention"

## Drainage

- **If antibiotics are given within the first 48 hours after the onset of symptoms, drainage may not be necessary.**
- **However, if the clinical features do not improve within 36 hours of starting treatment, or even earlier if there are signs of deep pus (swelling, oedema, fluctuation), and most certainly if pus is aspirated, the abscess should be drained by open operation under general anaesthesia.**
- **If pus is found – and released – there is little to be gained by drilling into the medullary cavity. However, if there is no obvious abscess, it is reasonable to drill a few holes into the bone in various directions; if there is an intramedullary abscess, drainage can be best achieved by cutting a small window in the cortex.**
- **The wound is closed without a drain and the splint (or traction) is reapplied.**

- **Once the signs of infection subside, movements are encouraged and the child is allowed to walk with the aid of crutches. Full weightbearing is usually possible after 3–4 weeks.**
- **At present about one-third of patients with confirmed osteomyelitis are likely to need an operation; adults with vertebral infection seldom do**

so to dx it  
early

[early MRI + ↓ threshold to dx osteomyelitis]

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## **COMPLICATIONS OF ACUTE OSTEOMYELITIS**

- Bone abscess
- Septic Arthritis
- Septicemia
- Fracture
- Growth arrest
- Overlying soft-tissue cellulitis
- Chronic infection



## Brodie abscess

- **Definition:** subacute osteomyelitis characterized by an intraosseous abscess; commonly affects the distal femur and proximal tibia
- **Pathophysiology:** hematogenous seeding of a distant infectious focus → subacute or chronic pyogenic infection of the bone → fibrous and granulation tissue formation around pyogenic focus → localized abscess
- **Clinical features**
  - Frequently asymptomatic or only mild symptoms
  - Localized pain
- **Diagnostics:** well-circumscribed, thick-walled cystic lesion in the metaphysis and epiphysis of long bones on x-ray and contrast-enhanced MRI
- **Treatment:** surgical drainage and antibiotics

SUBACUTE OSTEOMYELITIS



A circumscribed, oval cavity surrounded by a zone of sclerosis at the proximal tibia (**Brodie's abscess**)



This is a lateral view X-ray of left tibia and fibula. There is a marked periosteal reaction at the diaphysis.



**2.3 Subacute osteomyelitis** (a,b) The classic Brodie's abscess looks like a small walled-off cavity in the bone with little or no periosteal reaction. (c) Sometimes rarefaction is more diffuse and there may be cortical erosion and periosteal reaction.

# Investigation's

- a) X-ray (may resemble osteoid osteoma / malignant bone tumour)
- b) Biopsy
- c) Fluid aspiration & culture
- d) ESR raised
- e) WBC count may be normal

## Comparison of Acute and Subacute Hematogenous Osteomyelitis

	Acute	Subacute
White blood cell count	Frequently elevated	Frequently normal
Erythrocyte sedimentation rate	Frequently elevated	Frequently elevated
Blood cultures	50% positive	Rarely positive
Bone cultures	90% positive	60% positive
Localization	Metaphysis	Diaphysis, metaphysis, epiphysis, cross physis
Pain	Severe	Mild to moderate
Systemic illness	Fever, malaise	No
Loss of function	Marked	No or minimal
Prior antibiotics	Occasional	30%–40%
Initial radiograph	Bone normal	Frequently abnormal

# Chronic Osteomyelitis

- Definition:

“ A severe, persistent and incapacitating infection of bone and bone marrow ”

*or untreated  
Acute osteomyelitis  
or improper tx*

## Factors responsible for chronicity

- Local factors: Cavity, Sequestrum, Sinus, Foreign body, Degree of bone necrosis
- General: Nutritional status of the involved tissues, vascular disease, DM, low immunity
- Organism: Virulence
- Treatment: Appropriateness and compliance
- Risk factors: Penetrating trauma, prosthesis, Animal bite



## • Pathogenesis:

- Area of bone destroyed by acute infection leaving sequestra surrounded by dense bone.
- The imprisoned sequestra provoke a chronic seropurulent discharge which escape through a sinus.

دكتور  
الربيعي  
البيدر

• Bacteria may **dormant** for year giving rise to **recurrent flares** (staph aureus , e.coli)

## Clinical Features

- a) Pain
- b) Pyrexia
- c) Redness
- d) Tenderness
- e) Discharging sinus  
(seropurulent discharge)



## Aetiological Agents

Usual organisms (with time there is always a mixed infection)

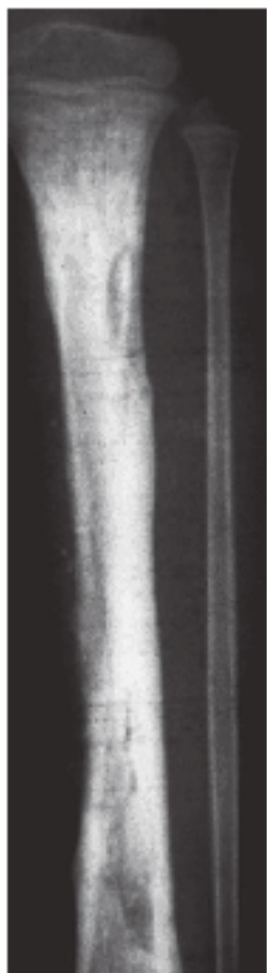
- Staph.aureus(commonest)

**Strep** .pyogenes

- E.coli
- Pseudomonas
- Staph.epidermidis

(commonest in surgical implant)



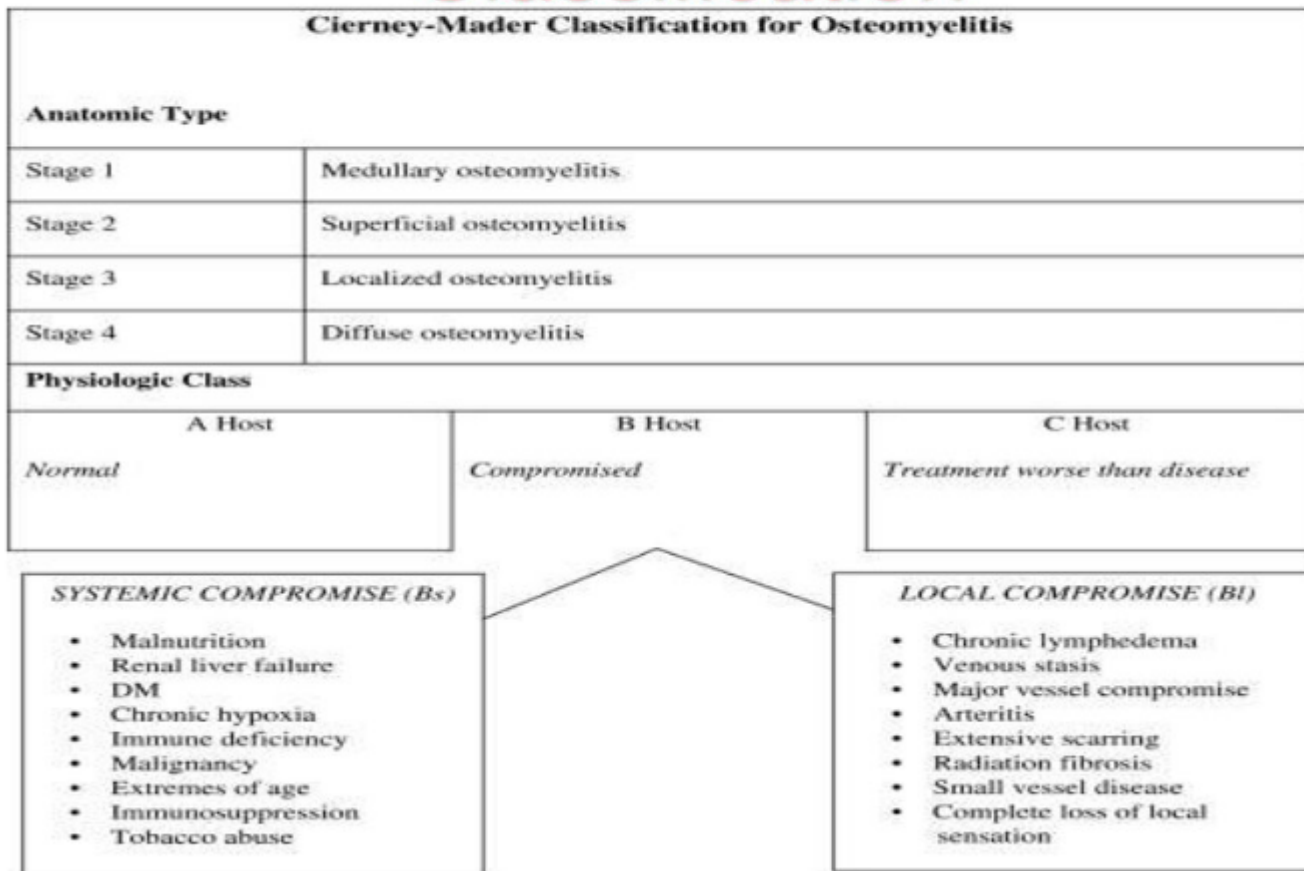


**2.4 Chronic osteomyelitis** Chronic osteomyelitis may follow on acute. This young boy in (a) presented with draining sinuses at the site of a previous acute infection. The x-ray shows densely sclerotic bone. (b) In adults, chronic osteomyelitis is usually a sequel to open trauma or operation.

## Staging Of Osteomyelitis:

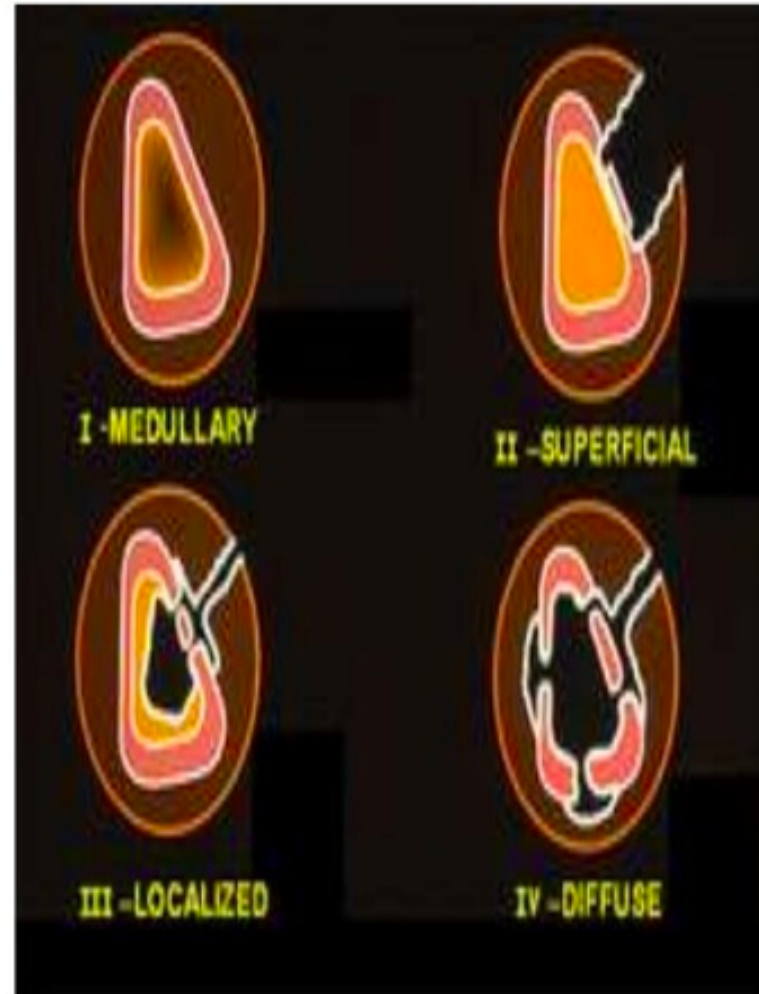
- The **Cierny-Mader** staging system.
- It is determined by the status of the disease process.
- It takes into account the state of the bone, the patient's overall condition and factors affecting the development of osteomyelitis.

# The Cierny-Mader Classification



- **1: Medullary Osteomyelitis** - Infection confined to medullary cavity.
- **2: Superficial Osteomyelitis** - Contiguous type of infection. Confined to surface of bone.
- **3: Localized Osteomyelitis** - Full-thickness cortical sequestration which can easily be removed surgically.
- **4: Diffuse Osteomyelitis** - Loss of bone stability, even after surgical debridement.

→ still stable →





# Radiographic Findings

## 1) X-ray examination

- Usually show **bone resorption** (patchy loss of density / osteolytic lesion)
- **Thickening & sclerosis** around the bone
- Presence of **sequestra**
- Occasionally it may present as a Brodie's abscess surrounded by vascular tissue and area of sclerosis

## 2) Radioisotope scintigraphy

- Sensitive but not specific
- Technetium labelled hydroxymethylene diphosphonate (99mTc-HDP) may show increased activity in both perfusion phase and bone phase

## 3) CT scan & MRI

- Show the extent of bone destruction, reactive oedema, hidden abscess and sequestra



AP & lateral view of the left wrist show a lobulated osteolytic lesion with well-defined borders and surrounding sclerosis at the distal radius. Minimal expansion, mild periosteal reaction and soft tissue swelling are present.

# Complications

\* Main Htt of osteomyelitis  
is Antibiotic, if chronic  
you have to interfere bec  
the Antibiotic won't work  
+  
prolonged  
suppressing  
Antibiotics

## 1) Pathological Fracture

- This occurs in the bone weakened by chronic osteomyelitis

## 2) Deformity

- In children the focus of osteomyelitis destroys part of the epiphysis growth plate.

## 3) Shortening/ lengthening

- Destruction of growth plate arrest growth.
- Stimulation of growth plate due to hyperemia.

# Treatment - Antibiotics

# Surgical Treatment

- Chronic infection is seldom eradicated by antibiotics alone.
- Bactericidal drugs are important to:
  - a) *Stop the spread of infection to healthy bone*
  - b) *Control acute flares*
- Antibiotics used in treating chronic osteomyelitis  
(Fusidic acid, Clindamycin, Cefazolin)
- Antibiotic (IV route) is given for 10 days prior to surgery.
- After the major debridement surgery, antibiotic is continued for another 6 weeks (min) but usually >3months.  
[treat until inflammatory parameters (ESR) are normal]

- After 10 days of antibiotic administration, debridement is done to remove:
  - a) All the infected tissue
  - b) Dead / devitalised bone (Sequestrectomy)
  - c) Sinus tract
- Wound is left open EXCEPT:
  - a) Compromised hosts (Class B host); ankle, hand, spine
  - b) Type II lesions (primary soft tissue reconstruction and/or host alteration)
  - c) Minimal necrosis osteomyelitis