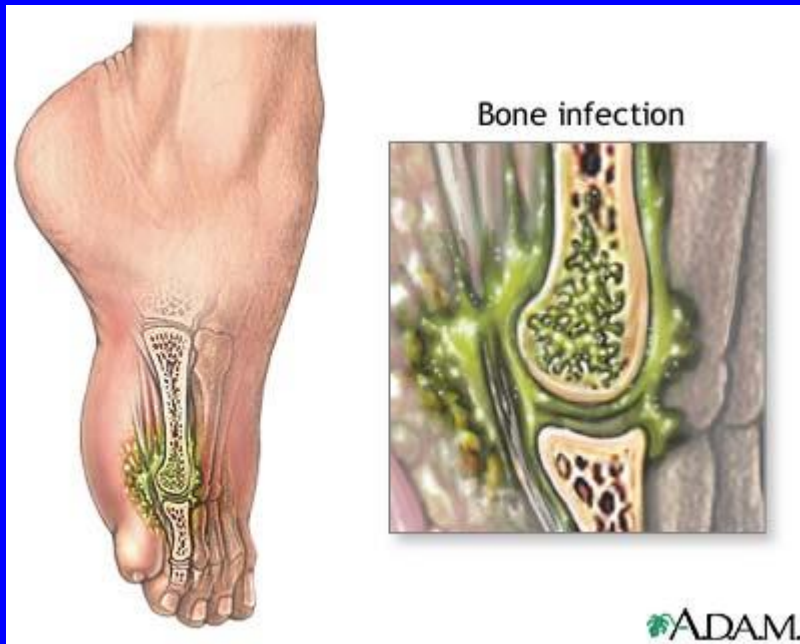
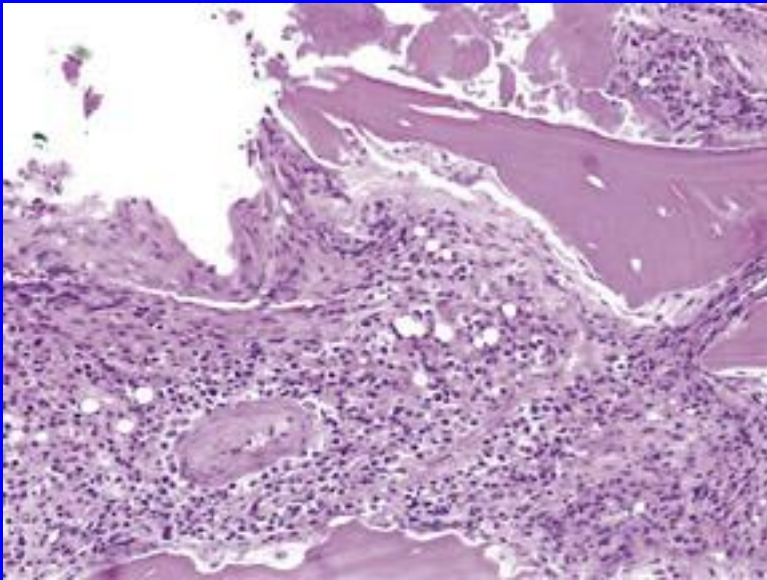


Osteomyelitis



- Nelaton credited with introducing the term osteomyelitis in 1844



Osteomyelitis

Definition: Infectious process involving the various components of bone characterized by progressive inflammatory destruction of bone, necrosis and new bone formation

- **Acute osteomyelitis**
- **Chronic osteomyelitis**

How Common Is Osteomyelitis?

- Chronic osteomyelitis occurs in about 2 in 10,000 adults. Children have the acute form of the disease more often than adults do, at a rate of about 1 in 5,000. People who have diabetes, who have had a traumatic injury recently, or who use intravenous* drugs are at greatest risk for chronic infection.

Mortality/Morbidity

- Mortality from osteomyelitis was 5-25% in the preantibiotic era. Presently, the mortality rate is approaching 0%.
- Complications of osteomyelitis include
 - (1) septic arthritis,
 - (2) destruction of the adjacent soft tissues,
 - (3) malignant transformation (eg, Marjolin ulcer [squamous cell carcinoma], epidermoid carcinoma of the sinus tract),
 - (4) secondary amyloidoses, and
 - (5) pathologic fractures.

Classification

- 1) The duration - acute, subacute and chronic
- 2) Mechanism of infection – exogenous or hematogenous
- 3) The type of host response to the infection- pyogenic or non pyogenic

Cierny-Mader Staging System for Osteomyelitis

- **Anatomic type**

Stage 1: medullary osteomyelitis

Stage 2: superficial osteomyelitis

Stage 3: localized osteomyelitis

Stage 4: diffuse osteomyelitis

- **Physiologic class**

A host: healthy

B host:

Bs: systemic compromise

Bl: local compromise

Bls: local and systemic compromise

C host: treatment worse than the disease

- **Factors affecting immune surveillance, metabolism and local vascularity**

- Systemic factors (Bs): malnutrition, renal or hepatic failure, diabetes mellitus, chronic hypoxia, immune disease, extremes of age, immunosuppression or immune deficiency

- Local factors (Bl): chronic lymphedema, venous stasis, major vessel compromise, arteritis, extensive scarring, radiation fibrosis, small-vessel disease, neuropathy, tobacco abuse

- Adapted with permission from Cierny G, Mader JT, Pennick JJ. A clinical staging system for adult osteomyelitis. Contemp Orthop 1985;10:17-37

Routes of infection

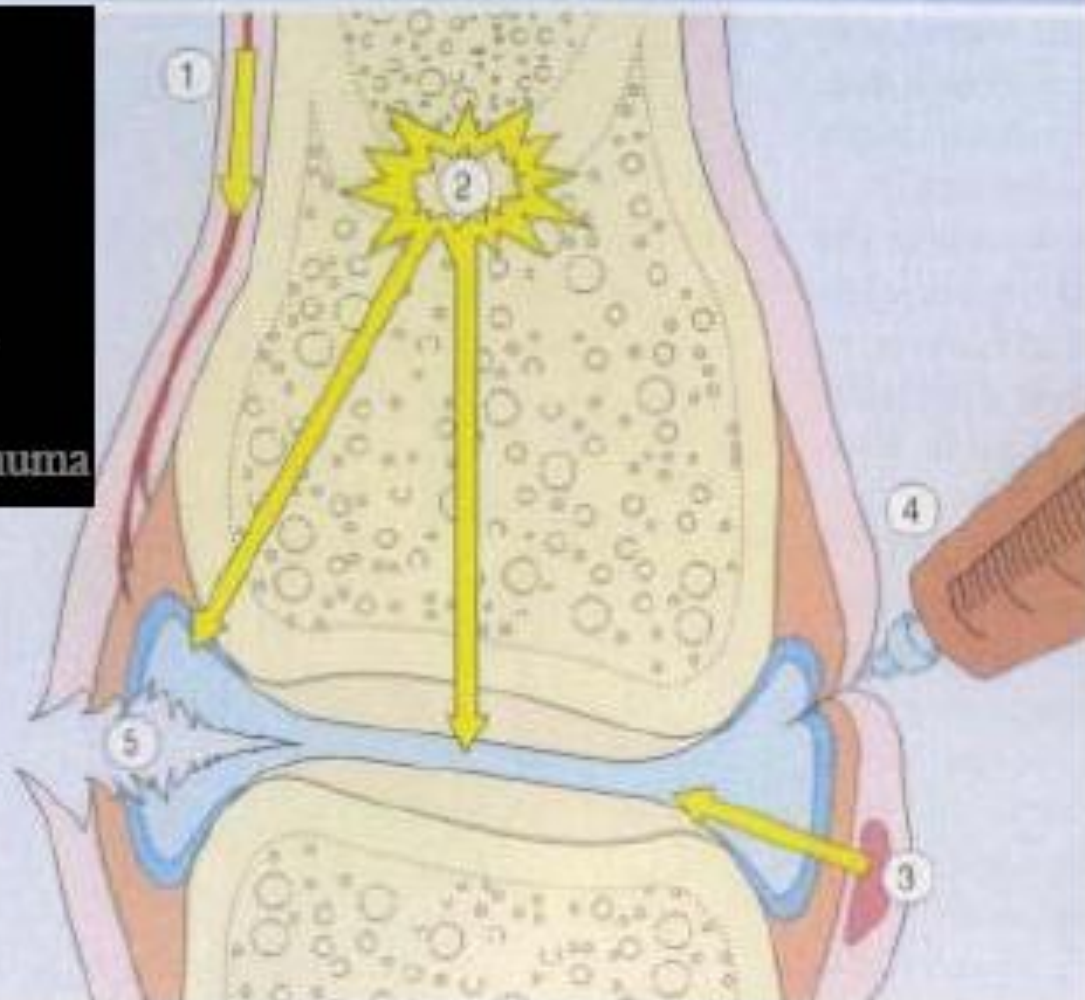
Hematogenous spread

Extension from a contiguous site

Direct implantation

ROUTES BY WHICH BACTERIA CAN REACH THE JOINT

- 1 Hematogenous route
- 2 Dissemination from osteomyelitis
- 3 Spread from adjacent soft tissues
- 4 Diagnostic or therapeutic measures
- 5 Penetrating damage or trauma



Organisms Commonly Isolated in Osteomyelitis Based on Patient Age

- **Infants (<1 year)**
Group B streptococci
Staphylococcus aureus
Escherichia coli
- **Children (1 to 16 years)**
S. aureus
Streptococcus pyogenes
Haemophilus influenzae
- **Adults (>16 years)**
Staphylococcus epidermidis
S. aureus
Pseudomonas aeruginosa
Serratia marcescens
E. coli
- Adapted with permission from Dirschl DR, Almekinders LC. Osteomyelitis. Common causes and treatment recommendations. Drugs 1993;45:29-43.

Major Pathogens in Osteomyelitis

Neonates:

- *S. aureus*, streptococci

Infants:

- *S. aureus*

Later in life:

- *S. aureus*
- “Mixed infections”



Special Pathogens in Osteomyelitis

- *Salmonella* - immunocompromised, sickle cell disease
- *Pasteurella multocida* - cat bites
- *M. tuberculosis* - hematogenous spread during primary disease
- Fungi - intravenous device infections or immunosuppression

Organisms once localized in bone

Bacteria proliferate and induce inflammatory reaction and cause cell death.

Bone undergoes necrosis within first 48 hours

Bacteria and inflammation spread within the shaft of the bone and may percolate throughout the haversian systems and reach the periosteum

Subperiosteal abscess

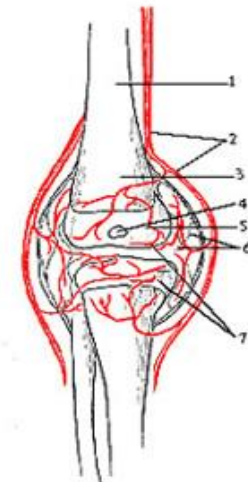
Segmental bone necrosis → sequestrum (dead piece of bone)

Rupture of periosteum leads to an abscess in the surrounding soft tissue and the formation of draining sinus.

- The anatomical age features of the structure and blood supply of the bones play a significant role in the development of osteomyelitis in children:
 - the richly developed network of blood vessels;
 - the autonomous supply of blood to the epiphysis, metaphysis, and diaphysis;
 - the presence of a great number of small vascular branchings stretching radially through the epiphyseal cartilage to the ossification nucleus.
 - The epiphyseal system of blood supply prevails in children under the age of 2 years, the metaphyseal system begins developing after this age. The epiphyseal and metaphyseal systems are isolated but there are anastomoses between them. The common vascular network forms only after ossification of the epiphysis.

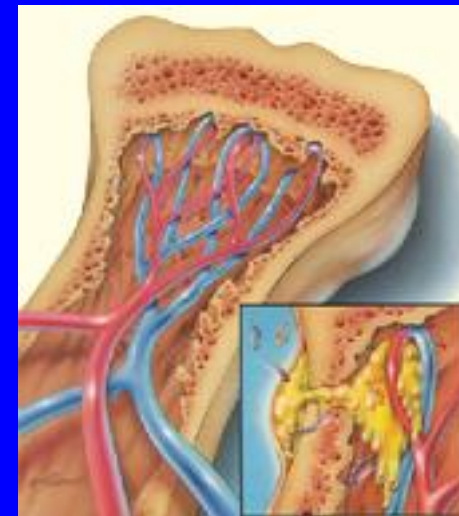
- Affection of the epiphyseal zone is characteristic of children under the age of 2-3 years.

КРОВΟΣНАБЖЕНИЕ КОЛЕННОГО СУСТАВА И
ОКОЛОСУСТАВНОЙ ОБЛАСТИ У НОВОРОЖДЕННОГО

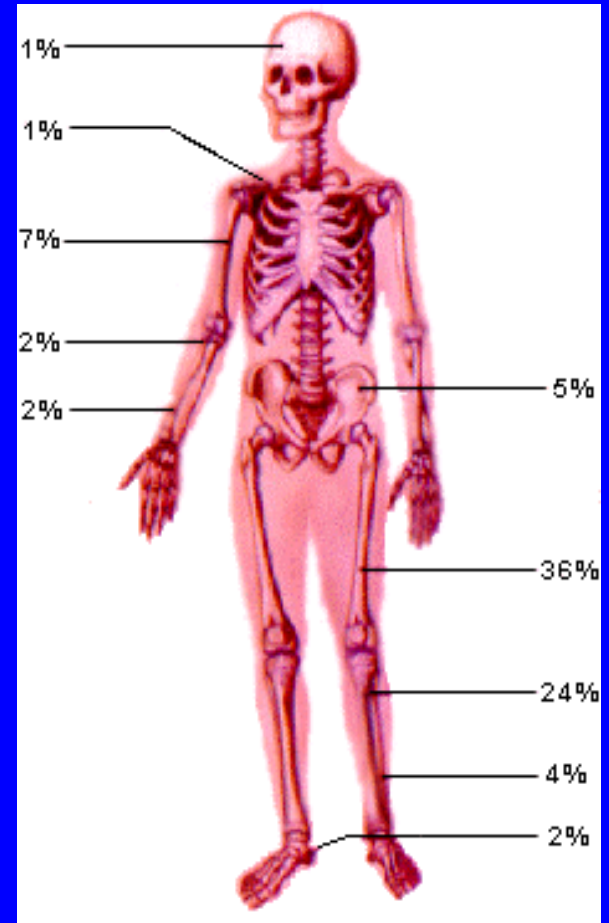
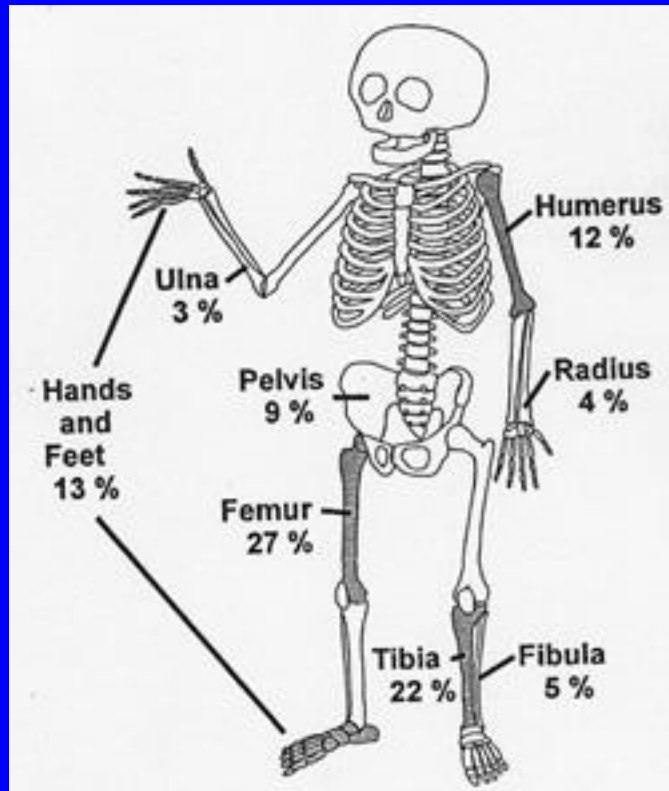


- 1 - диафиз;
- 2 - артериальные сосуды;
- 3 - метафиз;
- 4 - ядро окостенения;
- 5 - эпифиз;
- 6 - синовиальная оболочка и ее затворы;
- 7 - анастомозирующие артериальные ветви

- With age, when the system of blood supply to the metaphysis begins developing intensively, it is the metaphysis that predominantly becomes affected.



Localization

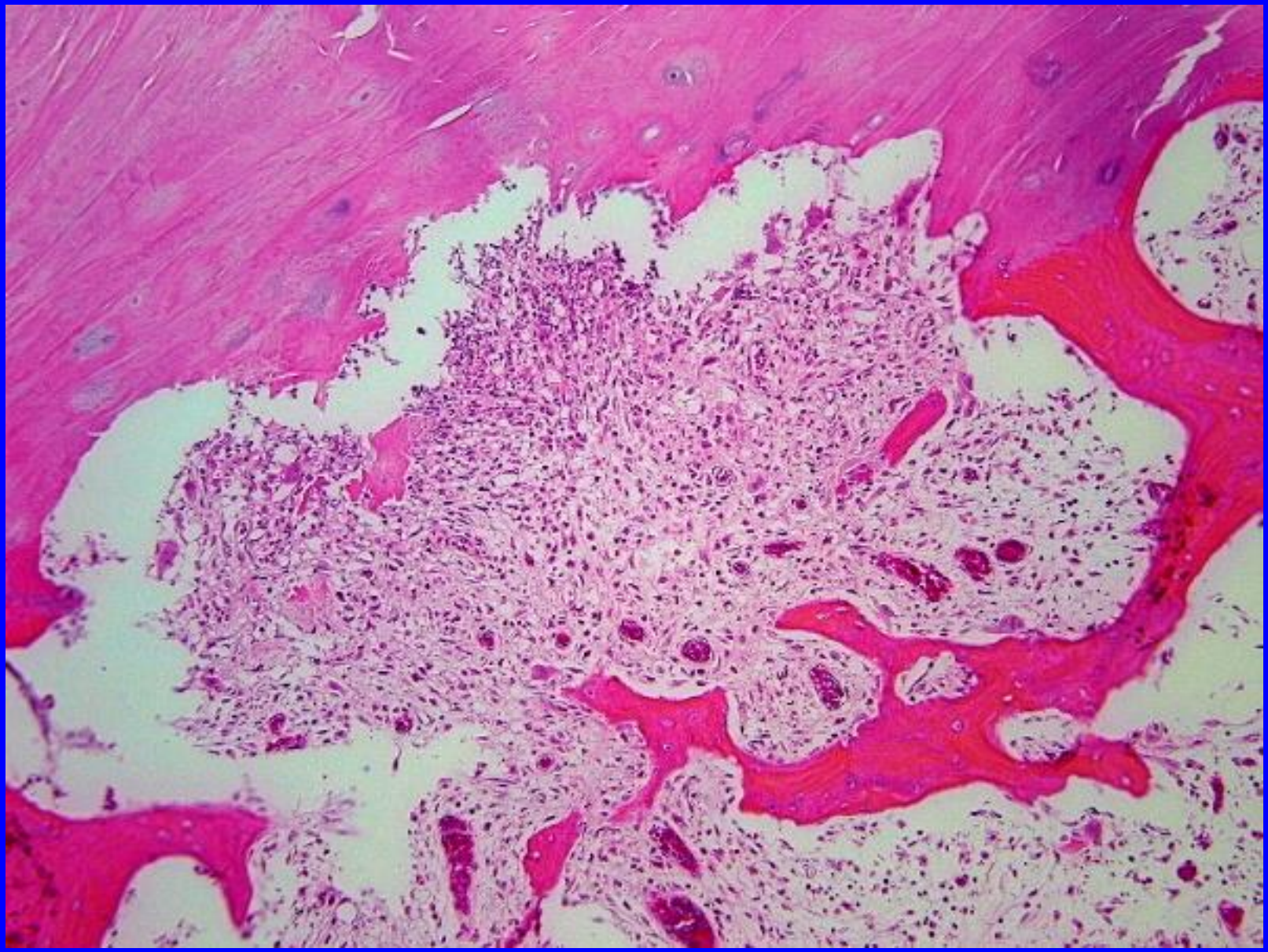


Pathophysiology of Osteomyelitis

- **Hematogenous spread**
 - Children – distal femur, proximal tibia
 - Adults – axial skeleton
- **Contiguous spread**
- **In association with vascular insufficiency**

Pain

- which is a consequence of hypertension in the marrow cavity, is indirect proof of this interpretation of the circulatory disorders in the bone. Intraosseous pressure in acute osteomyelitis reaches 300-500 mm water (normal value in healthy children, 60-100 mm water).



Clinical picture

- *The toxic (adynamic) form* follows an extremely violent course with signs of endotoxic shock. A state of collapse is observed as a rule, with loss of consciousness, delirium, high body temperature (up to 40-41 °C), and sometimes with convulsions and vomiting.
- Dyspnoea is found but without any clear clinical picture of pneumonia.
- The cardiovascular abnormalities include disorders of central and peripheral circulation, reduced arterial pressure, with the development within a short time of cardiac insufficiency and signs of myocarditis.
- Punctate extravasations are often seen on the skin.
- The tongue is dry and with a brownish coating. The abdomen is usually distended and tender in the upper parts. The liver is enlarged.

Septicopyaemic form

The onset of the disease is also acute:

- body temperature rises to a high level (39-40°C),
- signs of toxicosis increase, and the activity of vital organs and systems is disturbed.
- Confused consciousness, delirium, and euphoria are sometimes encountered.
- Pain is experienced in the affected limb from the first days of the disease and becomes very intense due to the development of intraosseous hypertension.
- Septic complications caused by the spread of the purulent foci to various organs (the lungs, heart, and kidneys, as well as to the other bones) often occur.

The localized form

- characterized by the predominance of local signs of purulent inflammation over the general clinical manifestations of the disease

Diagnosis of Osteomyelitis

History

- Presence of risk factors
- Symptoms of inflammation

Physical examination

- Signs of inflammation
- Decreased range of motion
- Drainage, sinus tracts, ulceration



The main constant local signs of osteomyelitis



- sharp local tenderness to palpation and particularly to percussion over the site of the lesion.
- Oedema and tenderness extend also to the adjoining areas.
- Such signs as hyperaemia of the skin and fluctuation in the region of the lesion are **very late signs** and are evidence of neglected osteomyelitis

The main constant local signs of osteomyelitis

- Considerable diagnostic difficulties arise in osteomyelitis of bones forming the hip joint. The local signs are indistinct on the first days of the disease due to the powerful muscular casing in this region.
- On careful inspection it can be seen that the lower limb is slightly flexed at the hip joint; abduction and mild external rotation.
- Movements at the hip joint are painful. The joint itself and the overlying skin are oedematous .

Findings in infants include the following:

- Failure to thrive
- Drowsiness but irritability
- Minimal constitutional symptoms
- Effusions into neighboring joints (60%)

Findings in older children include the following:

- History of preceding minor trauma to the involved limb and/or recent infection, eg, upper respiratory tract or skin infection
- Bone pain
- Malaise, irritability, and anorexia
- Fever
- Reluctance to use the limb
- Localized swelling, redness, and warmth
- Tenderness to finger pressure at a particular point
- Pain on moving an adjacent joint
- Regional lymphadenopathy

Diagnosis of Osteomyelitis

Radiographic studies

- routine radiographs
- bone scan
- computed tomography (CT scan)
- magnetic resonance imaging (MRI)

The X-ray signs

of acute haematogenous osteomyelitis are manifested **no earlier** than on the 14th-21st day of the disease.



Radiographs

Soft tissue swelling

Periosteal reaction

Bony destruction
(10-12 days)



Radiographic Findings of Osteomyelitis

Salmonella

osteomyelitis of the
tibia:

- cortical destruction
- new bone formation
- fissure in cortical
bone



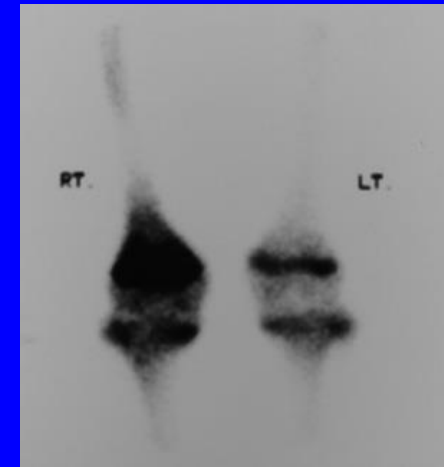
The X-ray signs

- Reduced density of the bone shadow and blurring of its contours are usually found, osteoporosis in the region corresponding to the zone of the inflammation can also be detected. The spongy substance of the bone produces a macromacular pattern due to resorption of the bony trabeculae and merging of the intertrabecular spaces as the result of intensified resorption.



Nuclear medicine

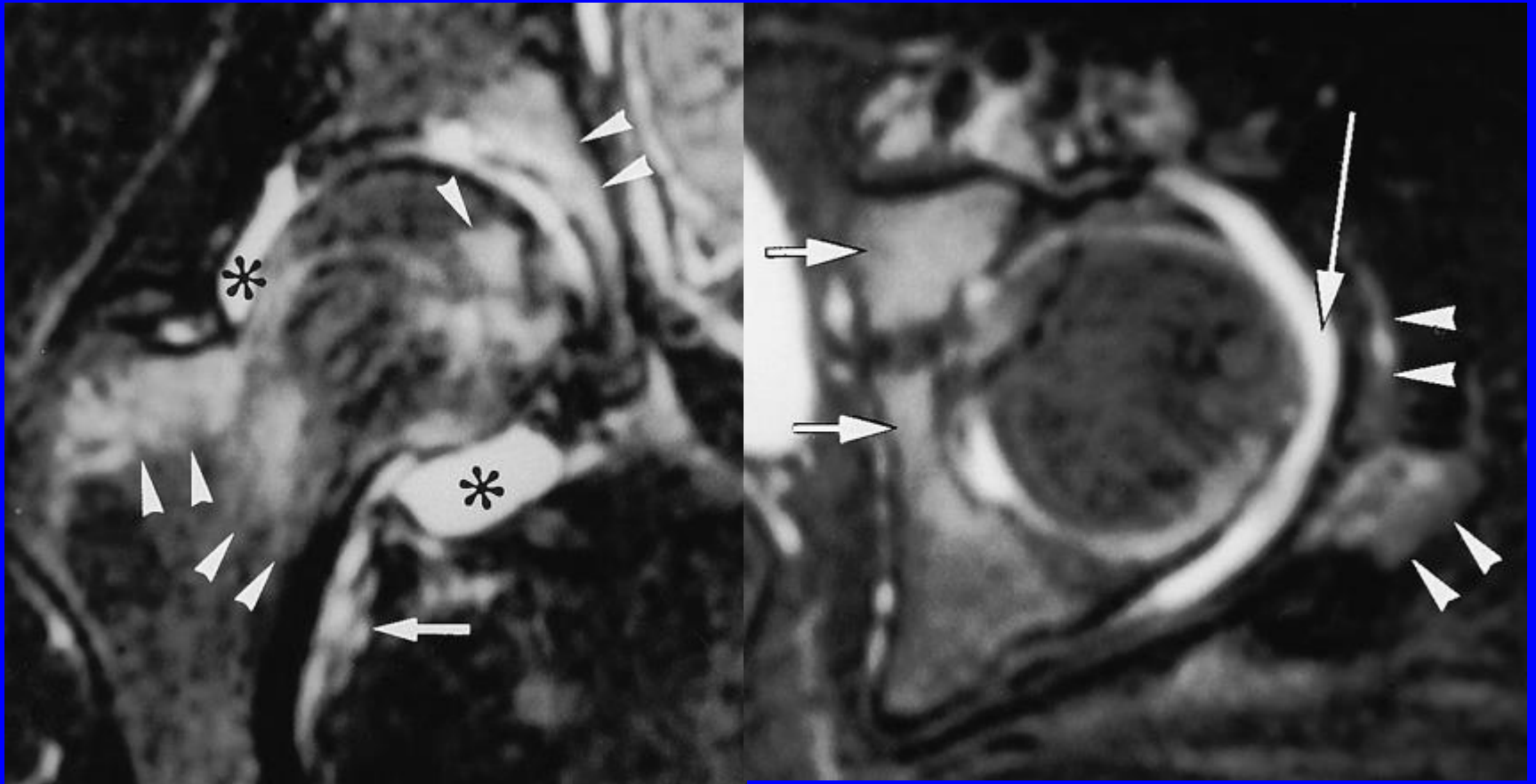
Nuclear medicine bone scans are a highly sensitive (>90%) modality in the diagnosis of osteomyelitis. This procedure is done in 3 parts. Technetium Tc 99m is used to create images to determine areas of infection and bone remodeling dependent on local blood flow. The sensitivity of bone scans is often helpful when the exact site and extent of the infection is not known.



MRI

- MRI if available is another useful modality for imaging acute osteomyelitis. Findings on MRI accurately illustrate the extent and structure of the area involved in the pathologic process. Sensitivity has been reported to be 88-100%, with a specificity of 75-100%. Fat-suppression sequences allow for better detection of bone marrow edema; however, infection and inflammation cannot be differentiated. MRI may be the imaging modality of choice in infections involving the spine, pelvis, or limbs because of its ability to provide fine details of the osseous changes and soft-tissue extension in these areas.

MRI

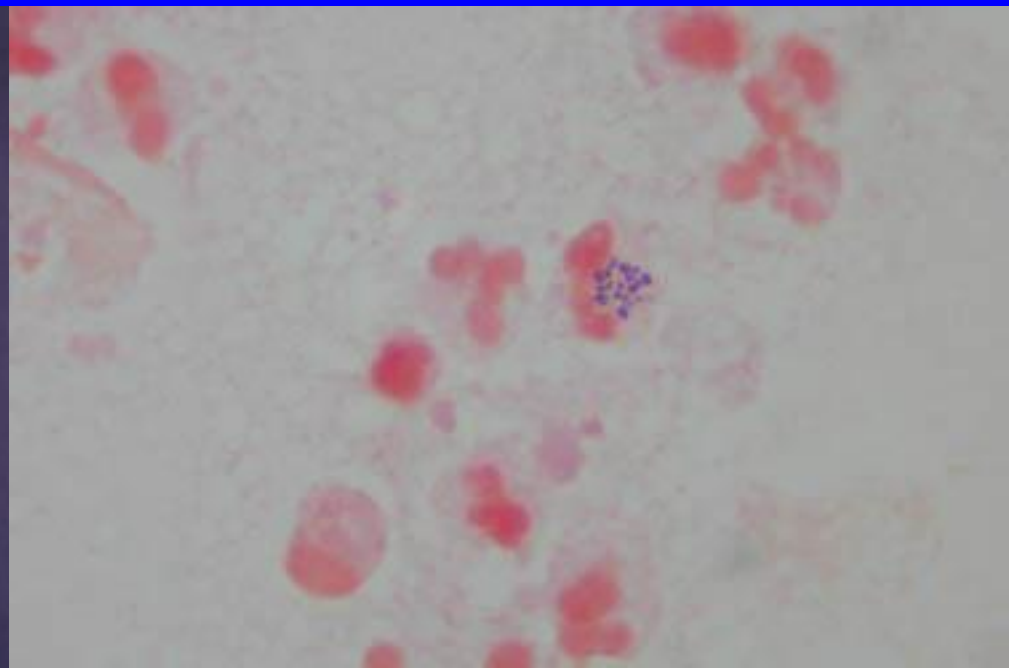


Limitations of Techniques:

- MRI has limited availability and is relatively expensive. MRI is also contraindicated in patients with certain implant devices and metallic clips, and it is not tolerated by all patients because of claustrophobia or morbid obesity. In addition, young children may require sedation. Good MRI require patient cooperation because patient motion can degrade the images.
- CT is quick and inexpensive, but exposes the patient to ionizing radiation. The risk of a reaction to radio-iodinated contrast material is low, though the detection of bone destruction or a paraspinal mass does not require the use of contrast material.
- Although radionuclide studies are sensitive, they can be time-consuming, and they have lower spatial resolution. The incidence of false-negative scans is low in neonates and in elderly patients with osteomyelitis.

Diagnosis of osteomyelitis

- Diagnostic puncture of the bone with subsequent cytological examination of the aspirated material should be carried out more extensively in questionable cases.
- Measurement of intraosseous pressure is very important in establishing the early diagnosis of acute haematogenous osteomyelitis. The discovery of intraosseous hypertension confirms the diagnosis even in the absence of pus under the periosteum and in the marrow cavity.



Diagnosis of Osteomyelitis

Bone biopsy

- **Pathology: abundant PMN**
- **Microbiology: positive culture**

Diagnosis of osteomyelitis

- Blood tests show leukocytosis (up to 30 000-40 000 per mm³) with a shift of the differential count to the left and toxic neutrophil granulation. The ESR is markedly increased (up to 60 mm/hour) and remains high for a long time.
- Marked changes are found in the blood serum protein spectrum. These are dysproteinaemia, an increase in the globulin fractions, and the development of hypoalbuminaemia. **Anaemia** caused by bone marrow inhibition by the prolonged effect of toxins develops in a persisting and severe disease.
- Disorders of the blood coagulation system are also found (the **fibrinogen concentration and the fibrinolytic activity increase**, the recalcification time and the coagulation time become shorter, the **prothrombin index increases**).

differential diagnosis

- articular form of rheumatism,
- phlegmon,
- tuberculosis of the bones,
- and injury.

- Rheumatism is characterized by shifting pains in the joints and typical changes in the heart confirmed by electrocardiography. Careful inspection and palpation of the involved region reveals that in rheumatism, in contrast to osteomyelitis, tenderness and swelling are mainly localized over the joint and not over the bone. Improvement of the local process with the prescription of salicylates is an important factor

Tuberculosis of the bones



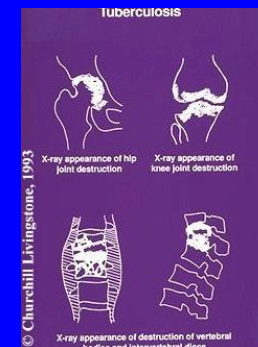
Figure 3 - Left shoulder x-ray

- Though experiencing pain in the limb, the child still uses it.
- Alexandrov's sign (thickening of the skin fold on the involved limb) and muscle atrophy are found.

The radiograph demonstrates osteoporosis (the "melting sugar" symptom,) and an indistinct periosteal reaction. This reaction, however, maybe clearly pronounced in mixed infection and in accompanying ordinary flora. The so-called acute forms of osteoarticular tuberculosis are actually cases of delayed diagnosis made when pus has already penetrated the joint. In addition to the X-ray picture, identification of the specific causative agent in material aspirated from the joint helps in establishing the correct diagnosis.



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Abscesses of the psoas muscle



Box 1: Some causes of psoas abscess

Primary

- Idiopathic
- Hematogenous seeding from an occult cutaneous source
- Suppurative lymphadenitis

Secondary

Gastrointestinal

- Crohn's disease
- Ruptured appendicitis, periappendicular abscess

Renal

- Pyelonephritis
- Renal tuberculosis

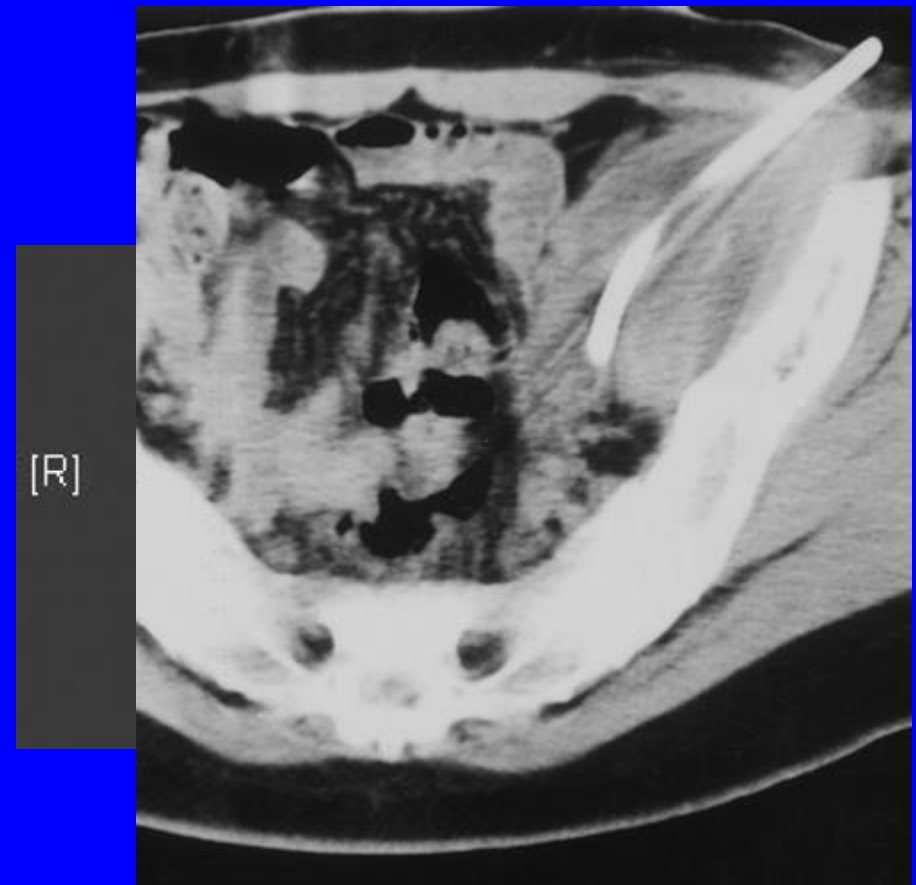
Skeletal

- Tuberculous spondylitis
- Complication of spinal surgery

The classic presentation includes fever, back pain and a limp. Common clinical signs include a positive psoas sign (pain when the hip is passively extended or actively flexed against resistance), which is attributed to inflammation causing spasm of the psoas muscle, and femoral neuropathy, which includes a limp or a flexion deformity of the involved hip.

Abscesses of the psoas muscle

- CT scanning is an accurate, rapid and noninvasive method for diagnosing psoas abscess and delineating its cause.
- Extraperitoneal surgical drainage has been the standard method of treatment; however, image-guided percutaneous drainage has become an effective alternative.



Treatment of Osteomyelitis

INDIVIDUALIZE!

Medical and surgical modalities

Treatment “failures”

Medical Treatment of Osteomyelitis

Antibiotics

- Treats live infected bone
- Ex. *S. aureus* osteomyelitis – oxacillin +/- aminoglycoside
- Duration – long-term

Optimal management of underlying conditions (ex. diabetes)

Acute hematogenous osteomyelitis

Treatment

The two main indications for surgery in acute hematogenous osteomyelitis are:

1. The presence of an abscess requiring drainage
2. Failure of the patient to improve despite appropriate intravenous antibiotic treatment

Acute hematogenous osteomyelitis

Treatment- surgery

The objective of surgery is to drain any abscess cavity and remove all non viable or necrotic tissue

Subperiosteal abscess in an infant-several small holes drilled through the cortex into the medullary canal

If intramedullary pus is found, a small window of bone is removed

Skin is closed loosely over drains and the limb splinted

Surgical Treatment of Osteomyelitis

Debridement

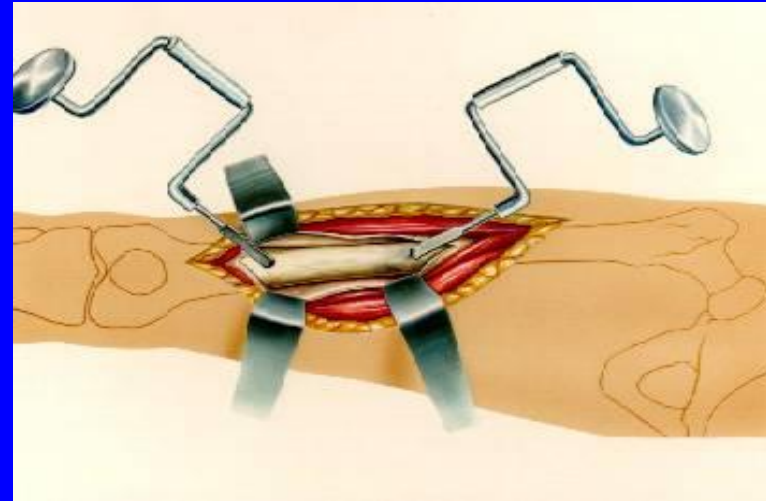
Revascularization

Ablation or amputation

Generally a 6 week course of intravenous antibiotics is given

Treatment

- In view of the fact that most severe forms of osteomyelitis are consequent upon intraosseous hypertension, early surgical intervention, osteoperforation, acquires primary importance. An incision, no less than 10-15 cm in length, is made in the soft tissues overlying the lesion and the periosteum is cut longitudinally. Two or three perforating openings 3-5 mm in diameter are made at the junction with the healthy bone. Pus is usually discharged under pressure in such cases, while in a disease of a long duration the contents of the marrow cavity may be seropurulent for two or three days. The marrow cavity is irrigated with 1 : 5000 nifrofurazone solution and antibiotics through the perforation in the bone.



Metaepiphyseal osteomyelitis

- is mostly encountered among infants, predominantly among the newborn. By the haematogenic route the infection (usually staphylococcus) enters the bone metaphysis and the inflammatory process develops here. Due to the peculiar blood supply of the metaepiphyseal junction in very young children, however, the inflammation spreads to the growth zone and epiphysis located in the joint. As a result, the main clinical symptoms are caused by the developing acute arthritis.

Septic Arthritis

Definition: Infection of the joint space

- **Monoarticular**
- **Polyarticular**
- **Suppurative**
- **Nonsuppurative**

Pathogenesis of Septic Arthritis

Hematogenous spread

Direct inoculation

Contiguous infection

Rapidly destructive process

Groups at High Risk for Septic Arthritis

Elderly

Children < 2 y of age

Injection drug users

Hemodialysis patients

Sexually active persons

Persons taking steroids

Diabetics

Patients with

- **Cancer**
- **Rheumatoid arthritis**
- **Joint prostheses**
- **Trauma**
- **Intravenous catheters**

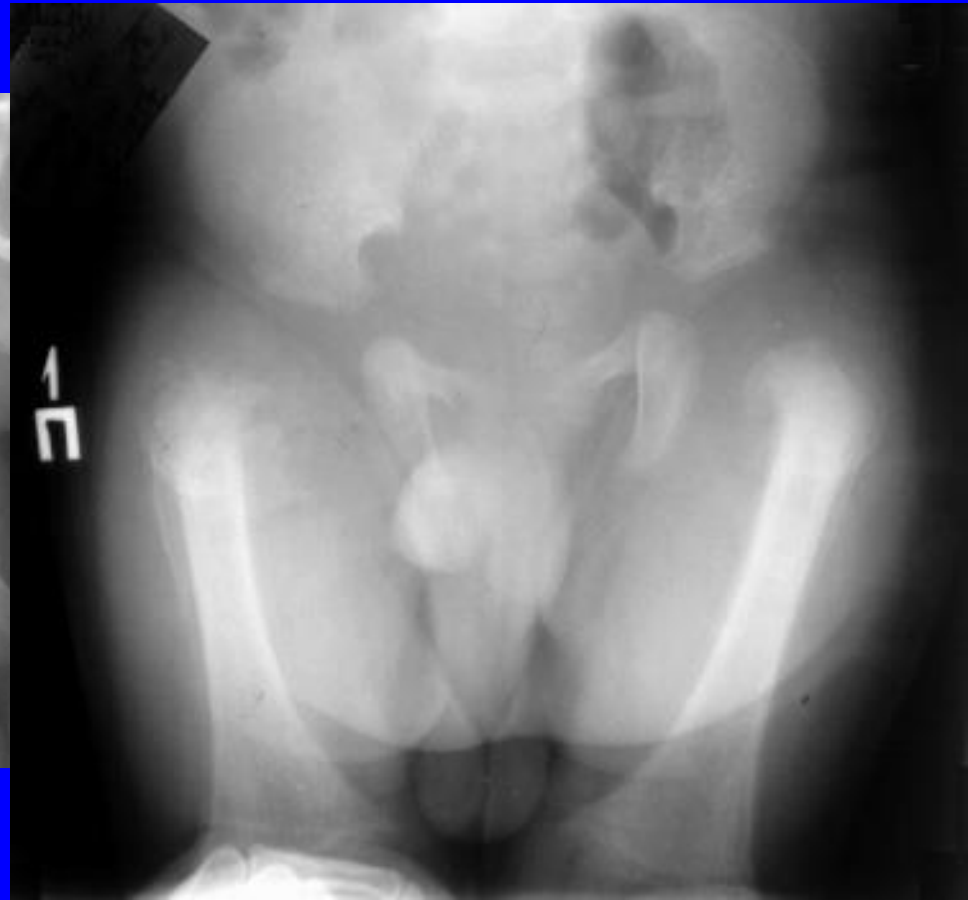


- Metaepiphyseal rule with a risk of refusal of food and limb which the
- Examination reveals swelling over the zone of affection, deformity of the adjoining joint, increase of local temperature. Hyperaemia appears later. Palpation and passive movement of the limb cause sharp pain. The "pseudoparesis" symptom (the hand or foot of the involved limb hangs and movements in it are sharply limited). The local form of osteomyelitis may be complicated by phlegmon of the soft tissues around the joint.

The X-ray signs

- are demonstrated earlier in metaepiphyseal osteomyelitis than in the other forms. Some characteristic signs can be detected as early as the 8th-10th day: thickening of soft tissues on the affected side, widening of the X-ray joint space, a fine periosteal reaction . Foci of destruction in the metaphysis are demonstrated on the radiographs only on the 3rd week after the onset of the disease, whereas the degree of destruction of the bone epiphysis

X-ray signs



Diagnosis of Septic Arthritis

History

Physical examination

Radiographs?

Laboratory Examination in Septic Arthritis

Blood Culture – 10-50% are positive

Synovial Fluid

- WBC usually $> 50,000/\text{mm}^3$
- Gram stain – 1/3 are positive
- Culture – 25-80% are positive

**Causative organisms identified in 2/3 of
cases**

Microbiology of Septic Arthritis

Gram positive bacteria (70-80%)

- *S. aureus* - most common (> 35 to 40% of cases)
- *Streptococcus* species

Gram negative aerobic rods (9-20% of cases)

Gram negative cocci – *Neisseria gonorrhoeae*

Treatment of Septic Arthritis

INDIVIDUALIZE!

Medical and Surgical Modalities

**Outcome related to how rapidly treatment
was instituted**

Medical Treatment of Septic Arthritis

Antibiotics

- Longterm
- Ex: *S. aureus*: oxacillin +/- aminoglycoside
- Ex: *N. gonorrhoeae*: ceftriaxone

Percutaneous arthrocentesis

Surgical Management of Septic Arthritis

Arthroscopic or open surgical drainage for:

- Poorly accessible joints (hip)**
- Suspected soft tissue extension**
- Inadequate response to antibiotics**
- Previously damaged joints (ex. rheumatoid arthritis)**



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- In the past, a plaster cast was used to immobilize the leg.



Complications





Chronic Osteomyelitis

- If the process fails to abate completely in 4 to 6 months, regular exacerbations occur, fistulae remain, and the discharge of pus continues, then it is considered that osteomyelitis has taken the chronic stage.
- This outcome depends on the severity and rate of the occurring alternative changes in the bone tissue and how early and properly is the treatment applied. A change to the chronic stage may be encountered in 10 to 30 per cent of cases.

Anatomy:

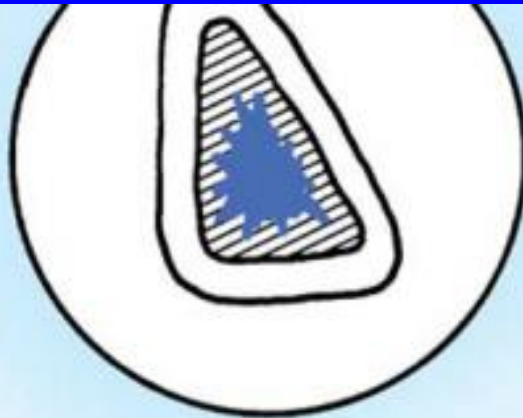
- Sharp loops of nonanastomosing are present at the capillary ends of nutrient artery and enter into large venous sinusoids. This anatomy results in slowing of circulation and reduced oxygen tension. The capillaries do not communicate because columns of calcified cartilage separate them from each other.
- Children younger than 2 years of have transphyseal vessels, which cross from metaphysis to epiphysis. This causes the spread of infection into the joint. In children older than 2 years, the transphyseal vessels are absent, and hence the epiphyseal plate acts as a barrier to the spread of infection into the joint.
- Cierny and Mader proposed an anatomic classification of chronic osteomyelitis:
 - Type 1 - Endosteal or medullary lesion
 - Type 2 - Superficial osteomyelitis limited to the surface
 - Type 3 - Localized, well-marked lesion with sequestration and cavity formation
 - Type 4 - Diffuse osteomyelitis lesions

CLASSIFICATION OF CHRONIC OSTEOMYELITIS

ANATOMICAL TYPE

I	MEDULLARY	ENDOSTEAL DISEASE
II	SUPERFICIAL	CORTICAL SURFACE INFECTED DUE TO COVERAGE DEFECT
III	LOCALIZED	CORTICAL SEQUESTRUM THAT CAN BE EXCISED WITHOUT COMPROMISING STABILITY
IV	DIFFUSE	FEATURES OF I, II, AND III PLUS MECHANICAL INSTABILITY BEFORE OR AFTER DEBRIDEMENT

Anatomical classification



Medullary



Superficial

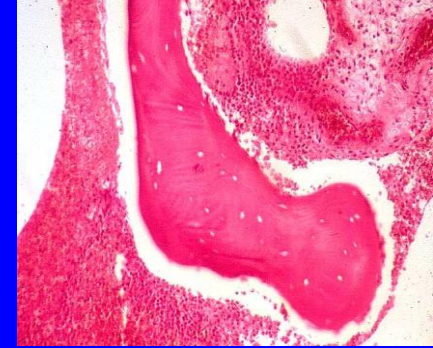


Localized

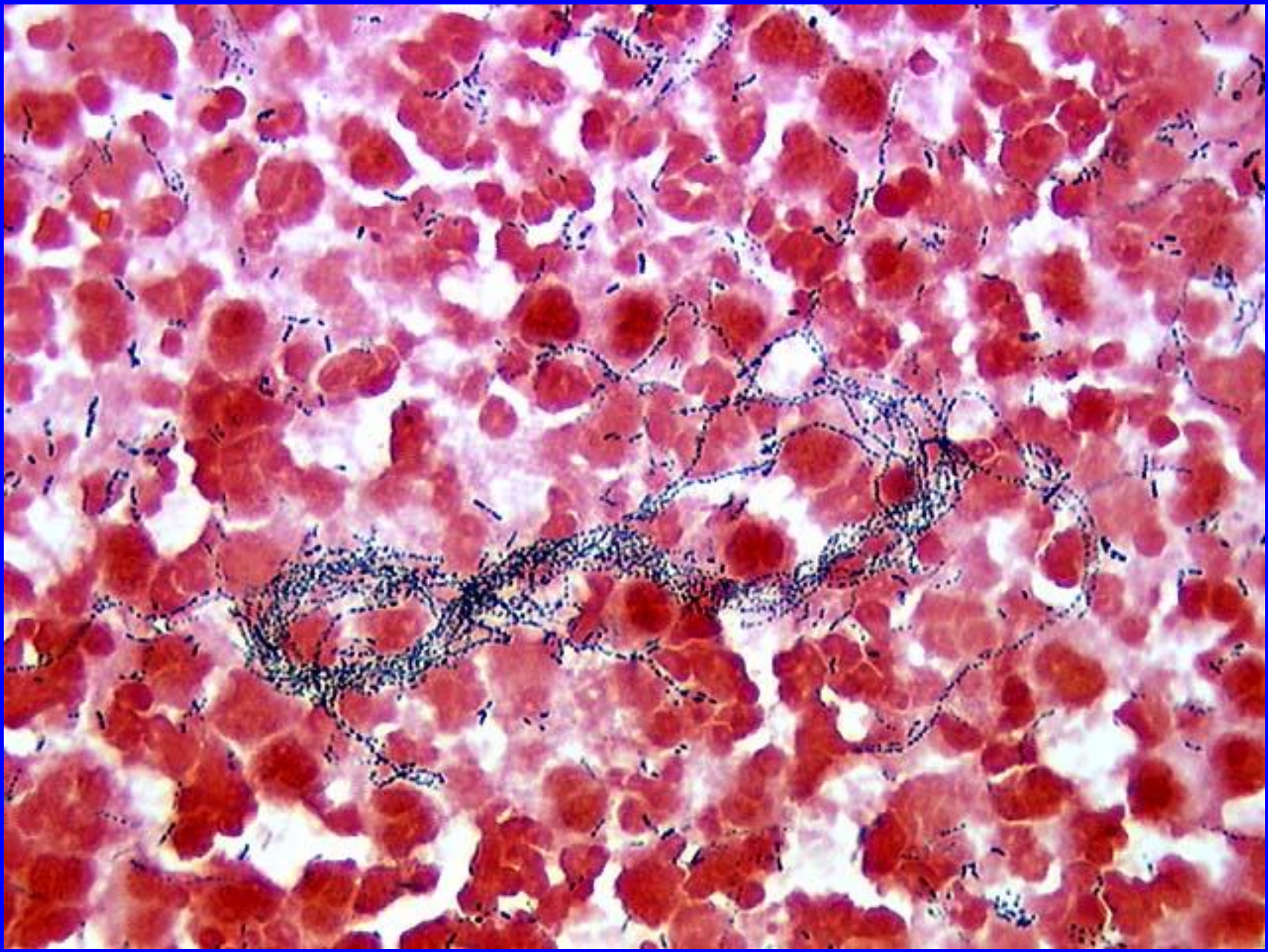


Diffuse

Chronic osteomyelitis



- Chronic osteomyelitis is marked by a prolonged course with remissions and periods of deterioration.
- Typical forms are characterized pathomorphologically by pieces of necrotic bone (sequestra), a sequestral cavity, and sequestral capsule (involucrum). Granulations and pus are usually present between the involucrum and the sequestrum.



- After the sequestrum forms the inflammatory process continues. Pus collecting in the focus is discharged through the fistulae from time to time. Small sequestra are sometimes discharged, especially in a disease of a long duration. In such cases large sequestra may break into small ones. Sharp eburnation of bone (sclerosis and hardening) occurs around the focus of chronic inflammation. The soft tissues are also sclerosed, nutrition is disturbed, and the muscles atrophied. In a severe and extensive process the periosteum may be destroyed. Bone regeneration is greatly delayed in such cases and the involucrum fails to form or is deficient as a result of which pathological fracture or pseudoarthrosis often forms



Clinical picture



- Chronic osteomyelitis is characterized by a protracted course with remissions and exacerbations.
- The fistulae may close during a remission.
- In exacerbation, body temperature increases, tenderness and toxicosis intensify.
- Pus is again discharged from the fistulae, sometimes in abundance.
- Examination of the patient reveals oedema of the soft tissues and sometimes a swelling of the limb on the level of the lesion.
- Fistulae and scars in places of previously existing fistulae are typical of chronic osteomyelitis.
- Palpation of the limb usually causes only mild tenderness and often reveals atrophy of the soft tissues and thickening of the bone.
- Pallor of the skin and signs of malnutrition are also found.
- Body temperature is subfebrile, particularly in the evening, but sometimes reaches high levels during exacerbation





Imaging studies in COM

Plain X rays

Cortical destruction

Periosteal reaction

Sequestra

Sinography

The X-ray diagnosis



- The X-ray diagnosis in typical cases with chronic osteomyelitis is quite easy. Radiographs show areas of osteoporosis and those of pronounced osteosclerosis. The involucrum containing sequestra, usually clearly outlined, is seen

Sinography



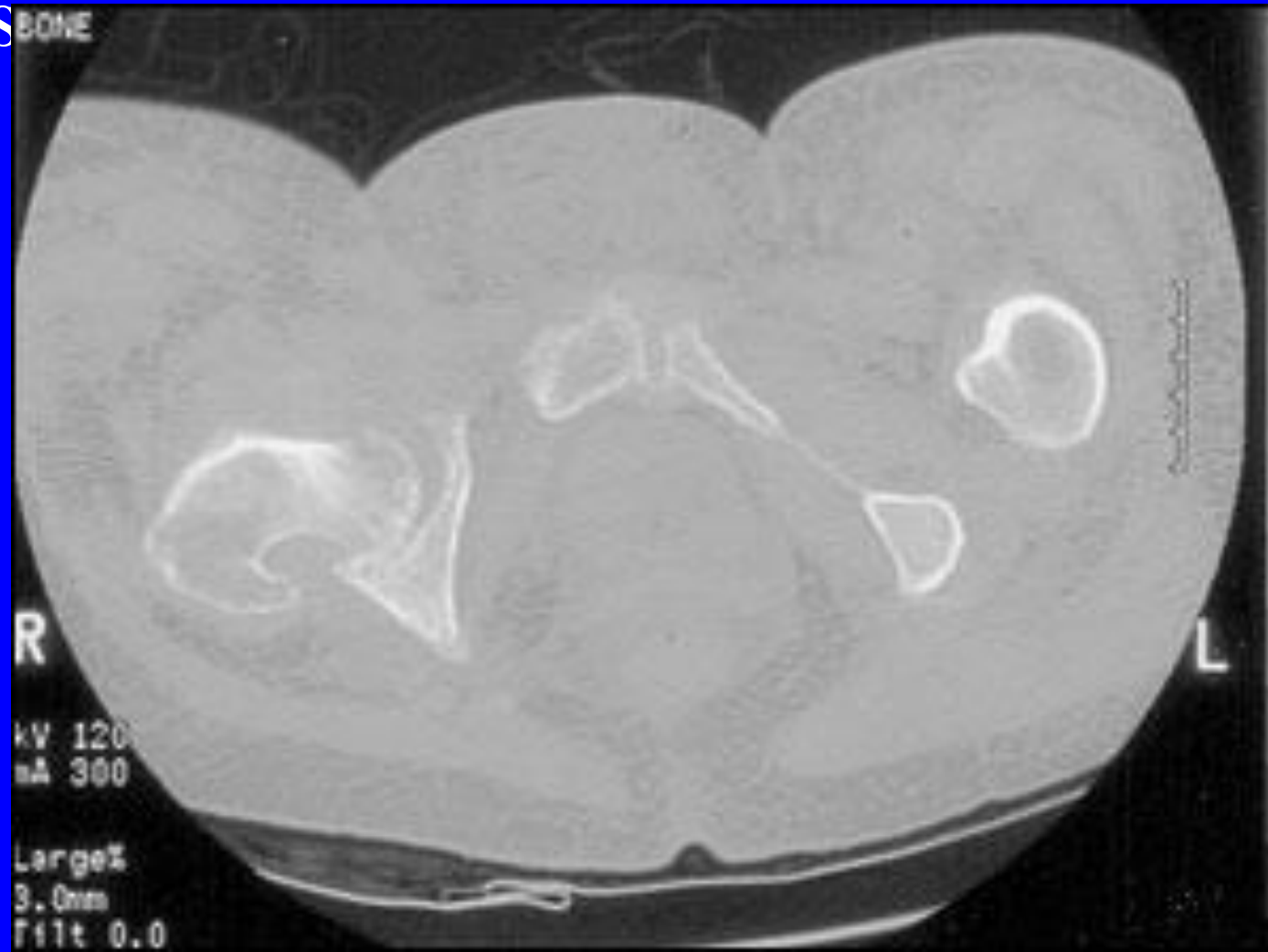
Degree of Confidence:

- Plain radiographs are inexpensive and universally available.
- For the detection of acute osteomyelitis, the sensitivity is less than 5% at presentation and about 33% at 1 week; however, the sensitivity is 90% 3-4 weeks after presentation.
- For the detection of chronic osteomyelitis, the sensitivity of plain radiography is high, though the specificity is low.

CT Scan

Identifying sequestra

Definition of cortical bone and surrounding soft tissues



CT scan

- **Findings:** CT is of definite value for studying the entire articular surface of bone and periarticular soft tissues; for delineating the extent of medullary and soft-tissue involvement; and for demonstrating cavities, serpiginous tracts, sequestra, or cloacae in osteomyelitis.
- CT scans sometimes show soft-tissue edema or bone destruction not seen on plain images, particularly in the setting of acute osteomyelitis. Sclerosis, demineralization, and periosteal reactions are usually well depicted in chronic osteomyelitis.
- CT scanning also helps in evaluating the need for surgery, and it provides vital information about the extent of disease. This data helps in planning appropriate surgery. CT is also an important modality in image-guided biopsy.



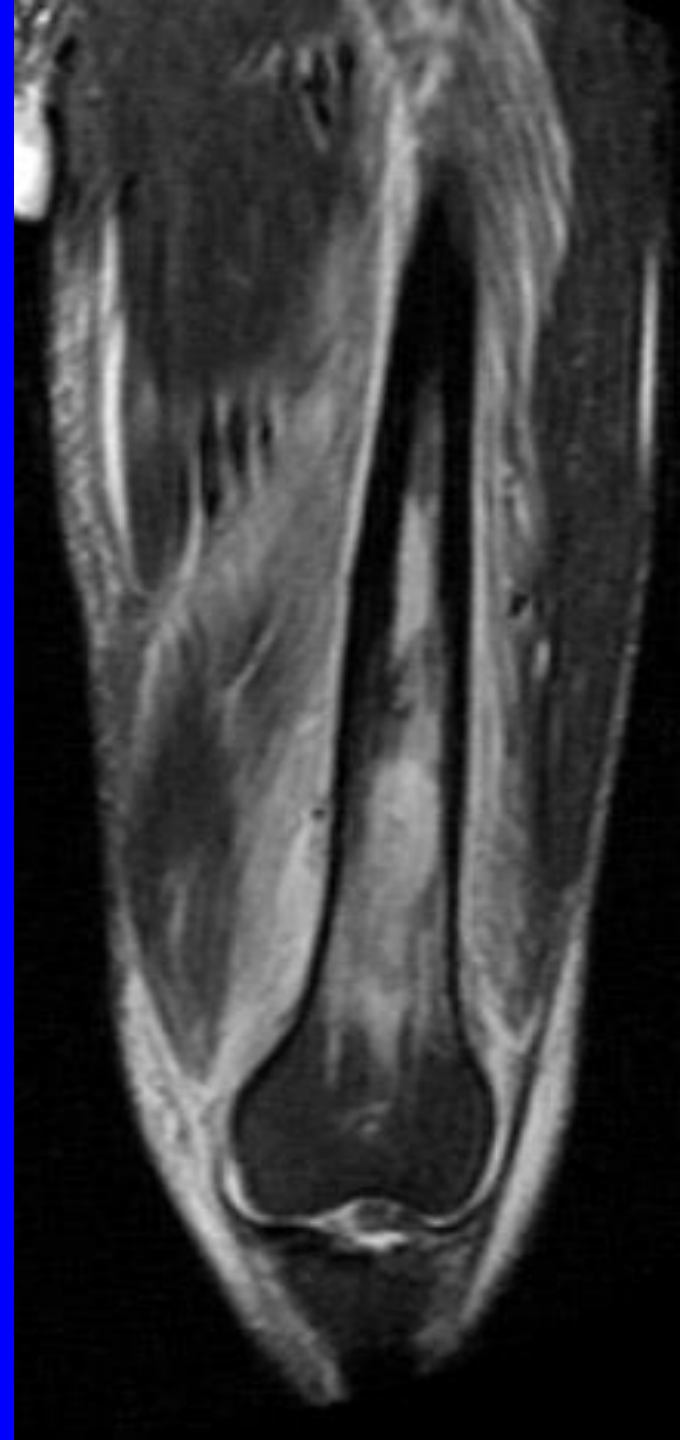
MRI

Shows margins of bone and soft tissue oedema

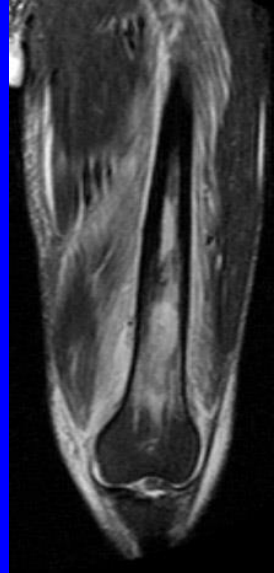
Evaluate recurrence of infection after 1 year

Rim sign- well defined rim of high signal intensity surrounding the focus of active disease

Sinus tracks and cellulitis



MRI

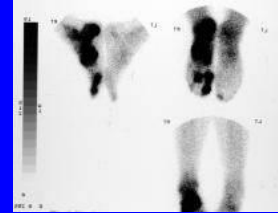


- MRI findings in osteomyelitis are usually secondary to the replacement of marrow fat with water secondary to edema, exudate, hyperemia, and bone ischemia. Findings include the following: decreased signal intensity in the involved bone on T1-weighted images, increased signal intensity in the involved bone on T2-weighted image, and increased signal intensity in the involved bone on short-tau inversion recovery (STIR) images.

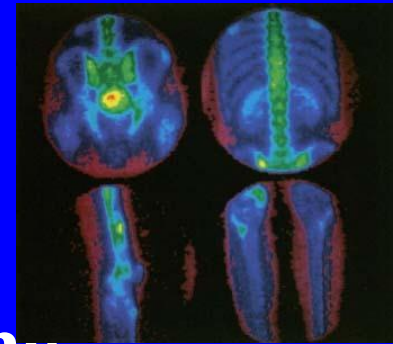
Degree of Confidence:

- MRI has sensitivity and specificity higher than those of plain radiography and CT, and it is particularly good at depicting bone marrow abnormalities. On MRI, marrow signal abnormality is more sensitive than lytic changes on plain images, and findings become positive earlier with MRI than with radiography. Intramedullary bone pathology can be directly visualized with MRI, and in osteomyelitis marrow, these findings may precede bone changes.
- However, MRI findings of osteomyelitis are nonspecific, and similar changes can occur as a result of tumors, fractures, and a variety of other intramedullary or juxtamedullary processes that may cause bone marrow edema.
- The sensitivity and specificity has been reported as 92-100% and 89-100%, respectively. Prior fracture changes due to surgery or the fracture itself are difficult to differentiate from infection.

NUCLEAR MEDICINE



- **Technetium-99m diphosphonate bone scanning**
- **Gallium-67 scanning**
- **Indium-111 WBC and 99mTc hexamethylenepropyleneamineoxime scanning**
- **2-[Fluorine 18]-fluoro-2-deoxy-D-glucose positron emission tomography**



Imaging -

Isotopic bone scanning more useful in acute than in chronic osteomyelitis

Gallium scans increased uptake in areas where leucocytes and bacteria accumulate.
Normal scan excludes osteomyelitis

DIFFERENTIALS

- Chronic osteomyelitis has to be differentiated from other diseases in some cases, namely, from tuberculosis and sarcoma.
- In contrast to osteomyelitis, tuberculosis sets in gradually, with no high temperature. Atrophy and contracture of the joint occur early. The fistulae are usually connected with the joint and have flacid and glass-like granulations. Processes of osteoporosis prevail on the radiograph and there are neither large sequestra (the sequestra seen usually resemble melting sugar) nor pronounced periostitis. Restoration of bone trabeculae (which at first are tangled) imperceptibly continuous with the normal tissue and diminution of osteoporosis are seen in the stage of reparation.



- Ewing sarcoma is a malignant bone tumor that typically occurs in the diaphysis of long bones in children and young adults.
- The X-ray of the femur shows a lytic lesion with a characteristic "onion-skin" appearance, consisting of multiple layers of sclerotic bone.
- It is characterized by a soft tissue mass that is often associated with a pathologic fracture.
- Histologically, it is composed of small, round, blue cells with scant cytoplasm and hyperchromatic nuclei, arranged in nests or cords.
- The tumor is highly vascular and has a tendency to metastasize to the lungs and other sites.
- The prognosis is generally poor, but early diagnosis and treatment with chemotherapy and surgery can improve outcomes.

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Findings in syphilis include the following:

- Pain, refusal to move the affected limb
- Restriction of movement in an adjacent joint
- Pain in the bone
- Local swelling, redness, and warmth
- Fever
- Nausea
- General discomfort, uneasiness, or ill feeling (malaise)
- Drainage of pus through the skin (in chronic osteomyelitis)



Treatment

Surgical treatment mainstay

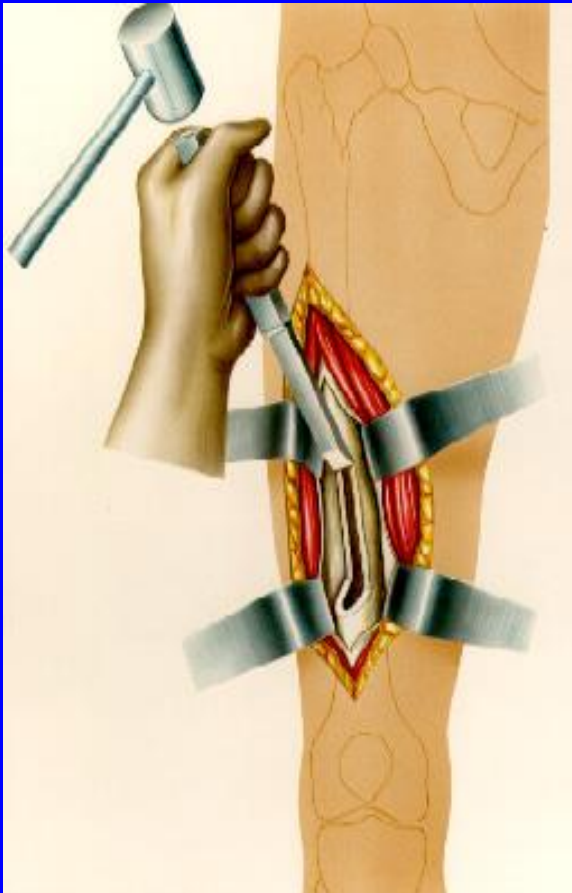
Sequestrectomy - removal of the sequestrum

Resection of scarred and infected bone and soft tissue

Radical debridement - curettage of the purulent granulations

Resection margins >5mm

"Trough" resection



- "Trough" resection of the bone is therefore advisable in an extensive lesion. With this type of resection the possibility of sequestration of the overhanging bone edges is less, whereas the soft tissues adjoining closely the surface of the bone improve its nutrition

Resection of a segment of affected bone may be necessary to control infection

With techniques of bone and soft tissue transport, massive resections can be performed and reconstructed without significant disability.

Surgical treatment of COM

Adequate debridement leaves a dead space that needs to be managed to avoid recurrence, or bony instability

- Skin grafts,

- Muscle and myocutaneous flaps

- Free bone transfer

- Papineau technique

- Hyperbaric oxygen therapy

- Vacuum dressing

Antibiotic duration is controversial

- 6 week is the traditional duration

- 1 week IV, 6 weeks of oral therapy

Amputation for osteomyelitis

Amputation indications include

- Arterial insufficiency

- Major nerve paralysis

- Non functional limb-stiffness, contracture

- Malignant change

Prevalence of malignancy arising from COM reported as 0.2 to 1.6% of cases.

Most are squamous cell carcinoma, also reticulum cell carcinoma, fibrosarcoma



- **Sir Benjamin Collins Brodie (1783-1862)** Sir Benjamin Brodie was one of the most recognized surgeons at St. George's Hospital in London during the nineteenth century. He first described a chronic abscess of the tibia in 1832 that has since been named Brodie's abscess.
- Brodie abscess: is a small intraosseous abscess that frequently involves the cortex and is walled off by reactive bone

Atypical Forms of Osteomyelitis

- **Brodie's abscess** is marked by a protracted course, mild aching pains in the region of the lesion, and moderate increase of temperature. The proximal tibial, distal femoral, and proximal humeral metaphyses are the favoured sites. It can be seen on examination that the limb is moderately swollen and mildly tender to intense palpation.
- X-ray shows a round zone of destruction with pronounced perifocal sclerosis. Sequestra and fistulae do not usually form. A band of diminished density, a "strip" connecting the focus with the growth zone, can often be seen



Ollier's albuminous osteomyelitis.

- This is a very rare disease. The clinical manifestations are similar to those of other forms of atypical osteomyelitis though in some cases they are more pronounced. The bone is sclerosed and the marrow canal, which contains White or yellow fluid, is narrowed.
- *Treatment* consists in trephination of the bone with removal of albuminous fluid and tight filling of the cavity with antibiotics.

Sclerosing osteomyelitis of Garre'

Bone is thickened and distended,
but abscesses and sequestra are
absent.

Cause unknown

Thought to be caused by a low grade,
possibly anaerobic bacterium



- **Scclerosing osteomyelitis of Garré** most commonly affects the mandible and appears with a focal sclerosing periosteal reaction on radiologic studies.
- Chronic recurrent osteomyelitis is benign self-limiting condition that primarily affects long bones in children and adolescents. The metaphysis of long bones are usually affected, and changes may be symmetrical. The appearances are those of confluent areas of bone lysis.

- In sickle cell anaemia, approximately 50% of all cases of infection are caused by a salmonella bacteraemia spreading from the intestinal tract. In sickle cell anaemia, however, considerable sterile bone destruction can occur without an associated infection. This is due to the multiple bone infarcts associated with cutting off of the cortical blood supply to the bone. Massive thrombosis to the arterioles supplying the bone occurs. If, at the same time the child has a bacteraemia, infection of the bone affected is likely. In the X-ray illustrated, the baby had sickle cell anaemia. She had no fewer than 9 bones infected at one time by a salmonella typhimurium. Note the multiple pathological fractures and osteomyelitis affecting both radius and ulna.



Chronic recurrent multifocal osteomyelitis (CRMO)

- . Diagnostic criteria for CRMO have been proposed to include all of the following:
- (a) the presence of two or more radiographically confirmed bone lesions,
- (b) a prolonged course of at least 6 months with characteristic exacerbation and remission,
- (c) radiographic and nuclear scintigraphic evidence of osteomyelitis,
- (d) a lack of response to antimicrobial therapy of at least 1 month's duration, and
- (e) the lack of an identifiable etiology .
- A definitive role for steroids or long term antibiotics has not been established. Supportive management with anti-inflammatory medication is recommended, as the typical course of CRMO is self-limited.



