

Bone Diseases

ACUTE HAEMATOGENOUS OSTEOMYELITIS

* Incidence :

- It is a **rare** disease nowadays due to wide use of **antibiotics** .
- More in **boys** and usually affecting **poor** children 5-15 years old with bad health condition .

* Aetiology:

A. Predisposing factors:

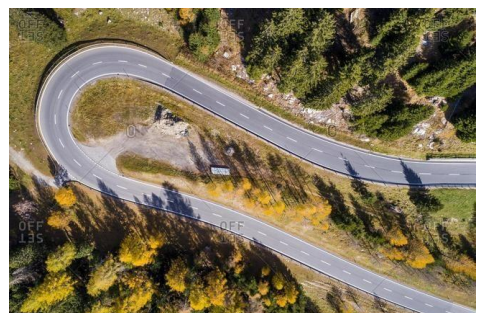
- General weakness, poor immunity and immuno-suppressive therapy .
- Septic foci: e.g. tonsillitis.
- Metaphyseal trauma.

B. **Route of infection:** Infection is blood born.

C. **Causative organisms:** Usually staph. aureus (80%) & less commonly gram positive cocci or gram negative bacteria .

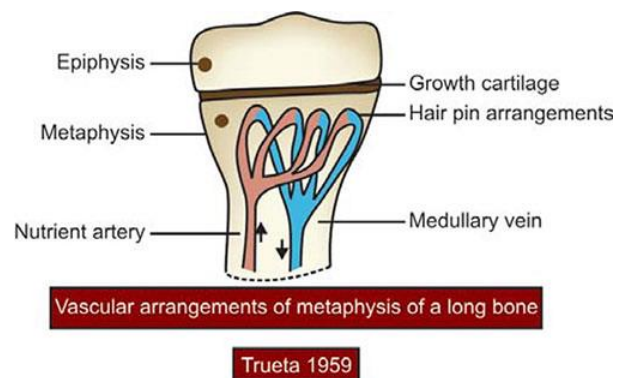
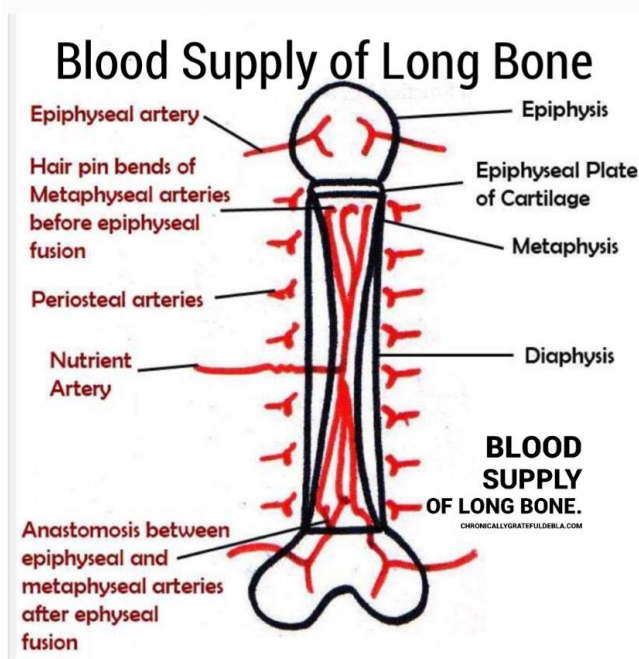
* Pathology:

- The **initial lesion** is usually **metaphyseal** because:
 1. In children before epiphyseal fusion the metaphysis is highly vascular part, supplied by end arteries which forming hairpin bend which leads to vascular stasis → bacteria or infected emboli easily trapped .
 2. The most liable part to trauma .
 3. It consists of immature vascular bone.



* N.B :

- ♣ In adults , after epiphyseal fusion , anastomosis occurs between epiphyseal and metaphyseal vessels and no more end arteries in the metaphysis which becomes not liable for osteomyelitis .
- ♣ **Nowadays** , acute osteomyelitis usually follows open fracture or bone operations

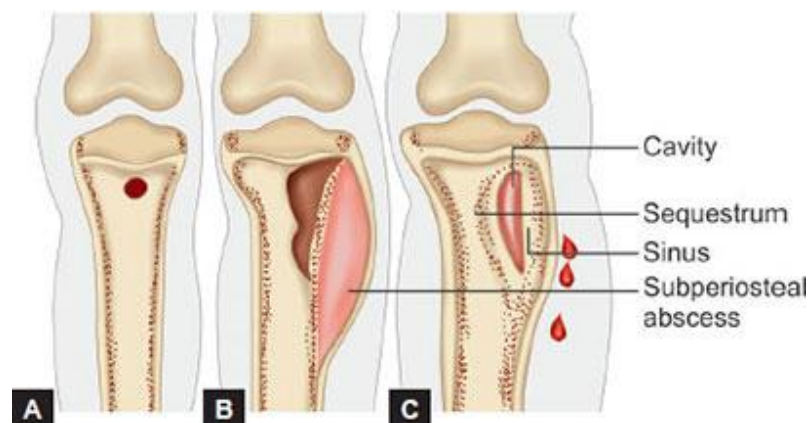


- Trauma to the metaphysis → metaphyseal haematoma → traps the circulating bacteria → acute inflammatory reaction with congestion & exudation → metaphyseal abscess by the 2nd or 3rd day → rise of intra-osseous pressure → severe pain & obstruction of blood flow.
- The bone around the infected area is osteoporotic (due to hyperaemia).
- **Extension of infection in the following directions:**
 - A. orizontal extension** through **Volkman's canals** leading to subperiosteal abscess → obliterate the subperiosteal vessels → small sequestra (dead bones) formation.

- Rupture of the subperiosteal abscess may occur into:
 1. The skin → sinus discharging pus & small sequestra.
 2. The near by joint → septic arthritis.

B. Vertical extension through medullary cavity leading to :

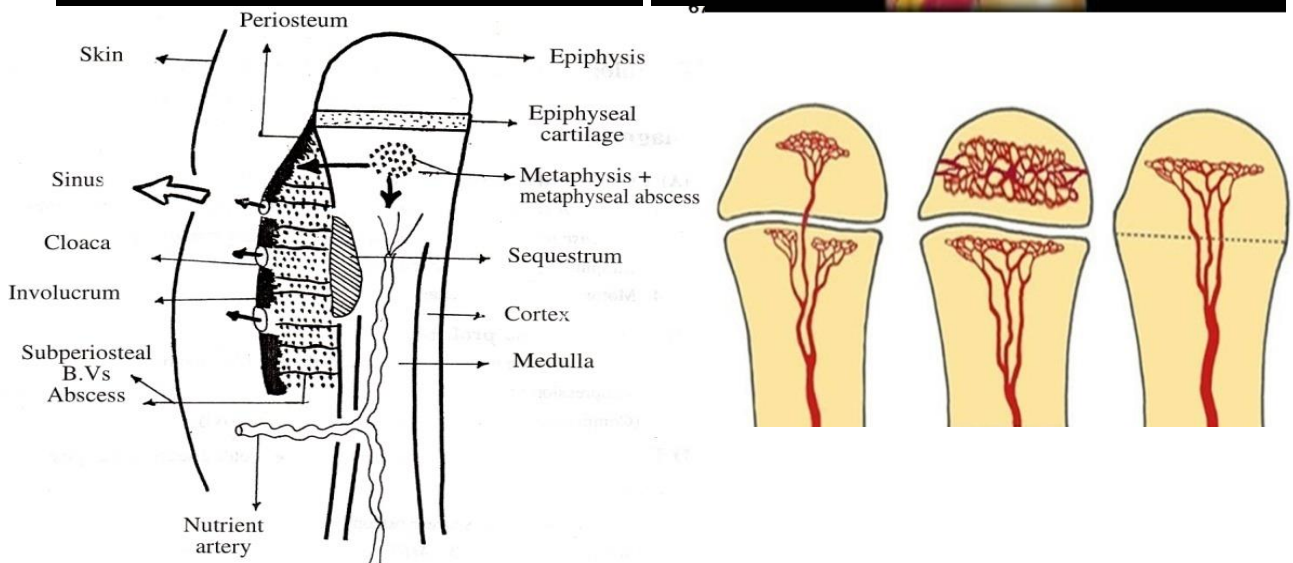
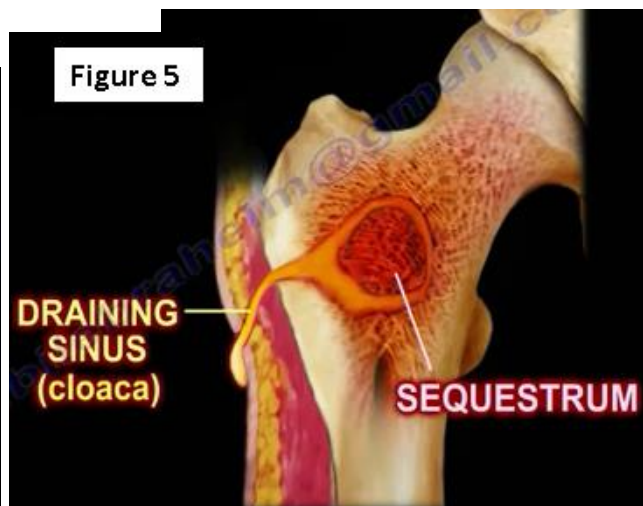
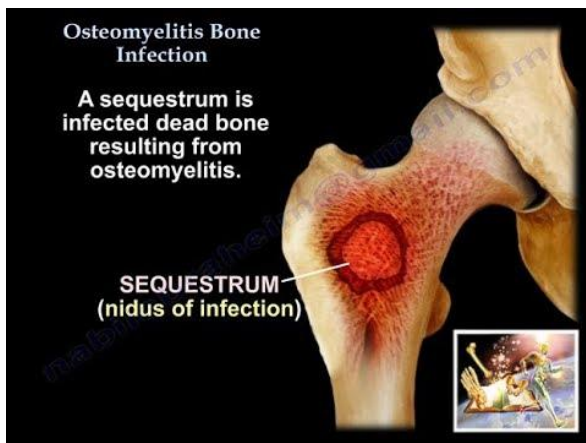
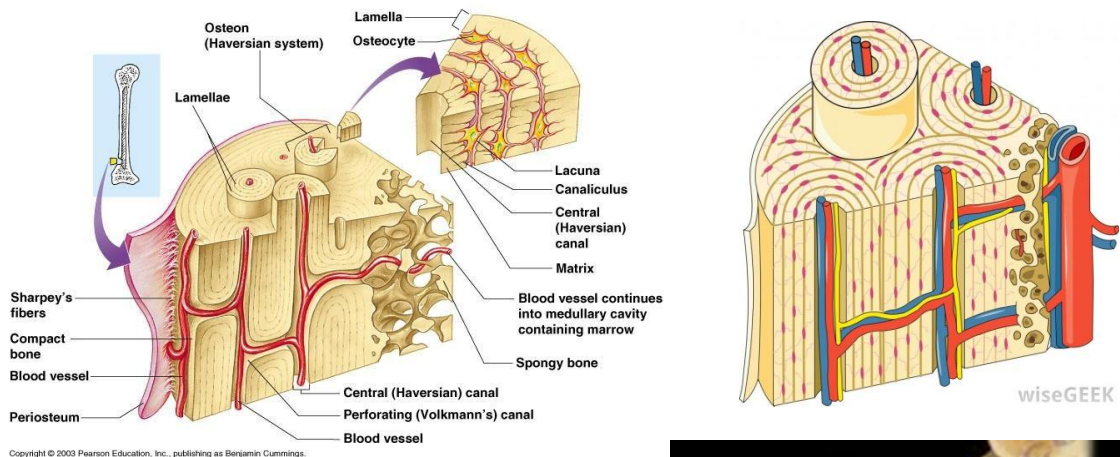
- Thrombosis of main nutrient vessels → sequestrum in the shaft.
- Sequestrum is avascular , smooth, white, devoid from periosteum.
- **Fate of sequestrum :**
 - ♣ **Small part** : absorption by phagocytosis .
 - ♣ **Large part** : partial absorption of peripheral part by phagocytosis → separation of sequestrum .
- **Evidence of sequestrum separation:**
 - ♣ **X-ray:** Complete black ring surrounds the sequestrum.
- Bone destruction → **multiple irregular cavities** filled with pus and sequestra.
- **New bone formation in 2 sites :**
 - 1. Subperiosteal :** Raising of the periosteum by pus → stretch of the subperiosteal vessels → subperiosteal new bone formation around the inflammed bone called the **involucrum**.
 - 2. Around the Haversian canals** resulting in bone sclerosis .
- **Fate :**
 1. **Abortion of infection** if proper antibiotic is given in the first 2 days
 2. **Resolution :**



- With early proper treatment, healing occurs by fibrosis and new bone formation results in sclerosis and thickening of the bone which undergo one of the followings :

♣ **Sound healing:** Remodeling & restore the normal contours.

♣ **Unsound healing:** results in permanent premature deformed bone.



Pathology of Acute And Chronic After Acute Osteomyelitis

* **Complications:**

II) General : Toxaemia, pyaemia, septicaemia or metastatic pyaemic abscesses .

III) Local :

1. Chronicity is the rule if the case is neglected. It is rare nowadays due to the use of antibiotics and early release of increased intra-osseous pressure.

2. Septic arthritis :

- **In infants**, metaphyseal blood vessels penetrate the epiphyseal cartilage. This allows spread of infection into the epiphysis and to the joint.
- **In children** the avascular epiphyseal cartilage prevents this spread to the joint except where the **metaphysis is intracapsular** e.g. hip joint.
- **In adults**, the epiphysis is closed and infection may spread to the nearby joint.

3. Pathological fracture.

4. Altered bone growth due to destruction of epiphyseal cartilage.

* **Clinical picture:**

A. General: Fever , headache , anorexia , malaise , septic focus & poor health.

B. Local:

1- Characteristic incidence:

- More common in boys 5-15 years (more exposed to trauma).
- Usually at the metaphysis of the lower end of femur , upper end of tibia or upper end of humerus.

▪ **In adults** it occurs as a result of debility disease or drugs & more common in the thoraco-lumbar vertebrae.

2. History of minor trauma (if severe → fracture) or recent infection.

3. Pain: Sawing or dull aching, increasing by night & movement.

4. Swelling in the metaphysis of a long bone which is red, hot, tender.

5. Painful limitation of active **movements** but passive movements are free.

6. Sympathetic **effusion** of the near by joint may occur later on.

Acute osteomyelitis



* **D.D:**

1. Acute suppurative arthritis:

- Maximum pain & tenderness on the joint line.
- Limitation of both active & passive movements (muscle spasm).

2. Acute rheumatic arthritis: Fleeting, less pain & toxaemia and may be heart lesion.

3. Ewing's tumour: Diaphyseal lesion & X-ray is diagnostic.

4. Cellulitis: Superficial inflammation with no bone tenderness.

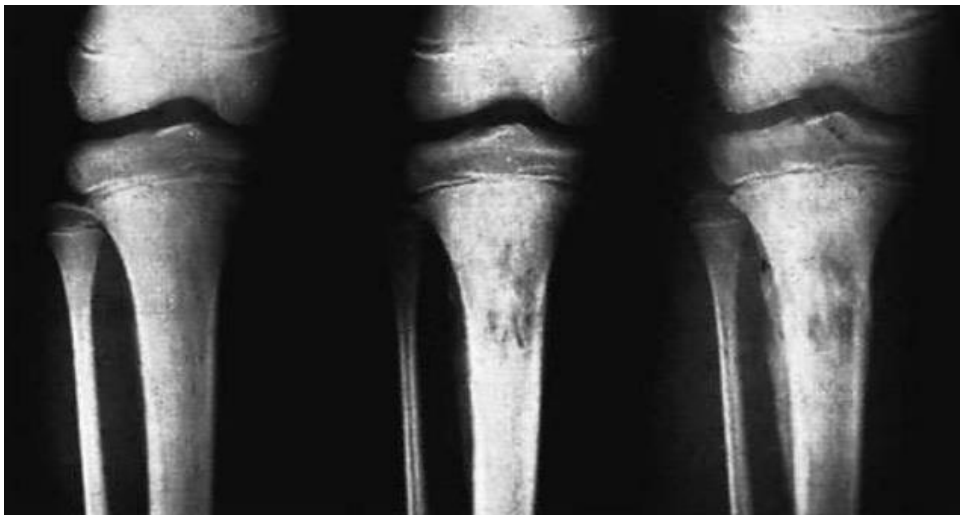
* **Investigations:**

1. Blood picture: reveals leucocytosis.

2. ESR is elevated.

3. C-reactive protein is positive .

4. **Blood & pus culture** before any antibiotic therapy.
5. **Diagnostic bone aspiration** reveals pus is the most diagnostic investigation.
6. **Plain x-ray:** Positive only after 2 weeks showing rarefaction and subperiosteal new bone formation .
7. **MRI** can detect osteomyelitis before appearance of radiological changes in plain x-ray .It is contraindicated if there is metallic implants .
8. **CT scan** if MRI is contraindicated .
- 8- **Radioactive isotopic scanning** reveals increased activity in early stages but it is not specific .



Acute osteomyelitis The first x-ray, 2 days after symptoms began, is normal .
metaphysealmottling and periosteal changes were not obvious until the second film, taken 14 days later.
eventually much of the shaft was involved.

* **Treatment:**

- Once osteomyelitis is clinically suspected, treatment should start immediately.
- The patient is admitted to hospital .

A. General:

1. Bed rest, analgesics, IV fluid , blood transfusion, good diet with high protein & vitamins.
2. Broad spectrum antibiotic: (Most important)
 - It should be started early as soon as possible after taking blood and pus samples for culture & sensitivity .
 - It should be against gram positive and negative organisms as **third generation cephalosporins** and can be changed according to culture result .
 - It is given IV for 2 weeks then orally for 4-6 weeks.

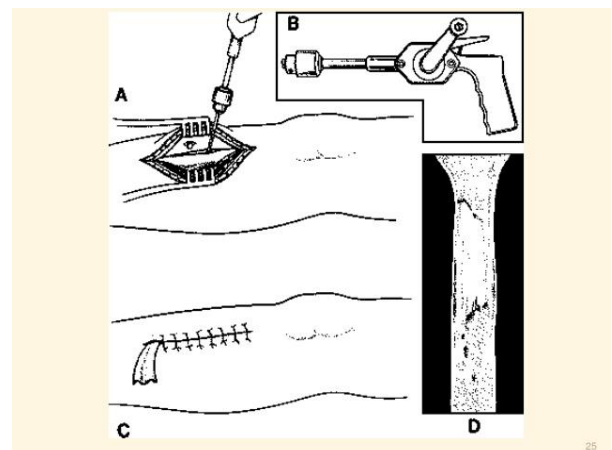
B. Local:

1. The limb is **splinted** until X-ray show no risk of pathological fracture.

2. Surgical drainage :

- **Indication:** If no improvement within 48 hours of antibiotic treatment , this denote pus formation .
- **Method :**
 - ♣ Under general anaesthesia , the inflamed bone is exposed and open the periosteum to drain the pus which is sent for culture & sensitivity .
 - ♣ In severe cases , decompression of the medulla by multiple drill holes in the cortex.
 - ♣ Finally skin wound is loosely closed with drainage .

1. **Chronic cases** with separated sequestrum : (Mention in short)



CHRONIC NON-SPECIFIC OSTEOMYELITIS

1) Chronic After Acute Osteomyelitis

* **Incidence:**

- **Rare** nowadays due to wide use of antibiotics.
- **Nowadays** , it usually follows open fracture or bone operations .

* **Aetiology:**

I) Predisposing factors :

- **Bad management** of acute osteomyelitis: inadequate antibiotic, no early treatment & inadequate drainage with presence of undrained cavity containing pus and necrotic tissues..
- Neglected **sequestra** acting as F. B containing the bacteria . The sequestrum is avascular and antibiotics cannot reach the sequestrum or the bacteria .
- External **sinuses** → continuous 2ry infection.
- **Bacteria** remain dormant in the sequestrum, wall of the bone cavity, in fibrous tissue and may flare-up at any time.

II) Organisms : staph. aureus , E.coli , strept. pyogenes , B.proteus or pseudomonas .

* **Pathology:** There are:

- **Bone destruction** → multiple irregular cavities filled with pus and sequestra.
- **New bone formation:** Raising of the periosteum by pus → stretch of the periosteal vessels → circumferential subperiosteal new bone formation around the inflamed bone called the **involucrum**.

- Multiple openings called **cloaca** are formed in the involucrum discharging pus and sequestra.

* **Complications:** (As acute osteomyelitis) +

- Acute exacerbations, chronic toxaemia, anaemia & amyloidosis.

* **Clinical picture :**

1. Incidence : Usually in boys 5-15

2. History of badly managed acute osteomyelitis or history of acute exacerbations.

3. Poor **general** condition, toxaemia, fever, headache.... etc.

4. **Pain** (mention), **tenderness, swelling** and **thickening** of the affected bone.

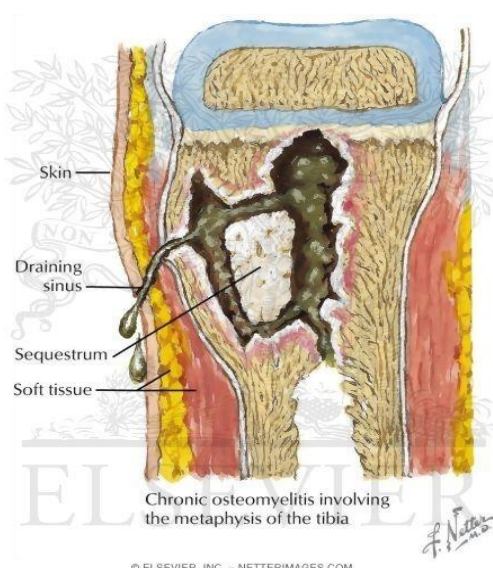
5. The chronic stage of osteomyelitis is marked by the persistence of discharging sinuses and by the repeated breaking down of wounds, which have apparently healed.

- Sinus is lined by yellowish red septic granulation tissues and discharging pus and small sequestra.

- When the sinus is probed , the probe reaches the bone

6. Painful limitation of **movements** → atrophy of surrounding muscles .

7. Sympathetic **effusion** in near by joint.



* **Investigations:** (as acute osteomyelitis)

1. X-ray Shows: The most important.

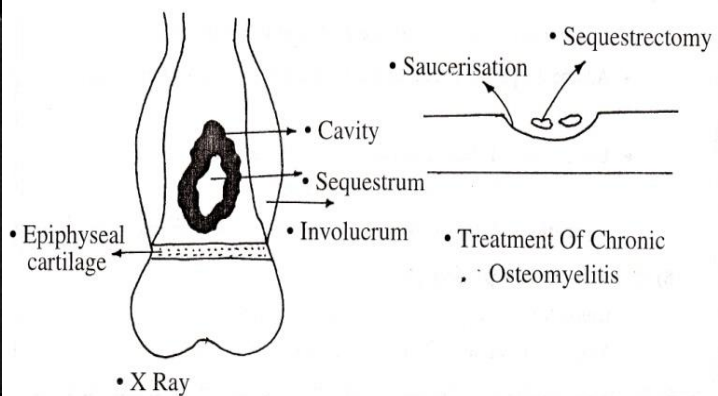
- Irregular bone cavities containing sequestra.
- Irregular sclerosis surrounds the cavity(**Involucrum**).

2. CT scan & MRI showing the extent bone involvement, cavities and small sequestra.

3. Radioactive isotopic scan may show hidden foci of infection .



MR images chronic osteomyelitis of right distal femur.

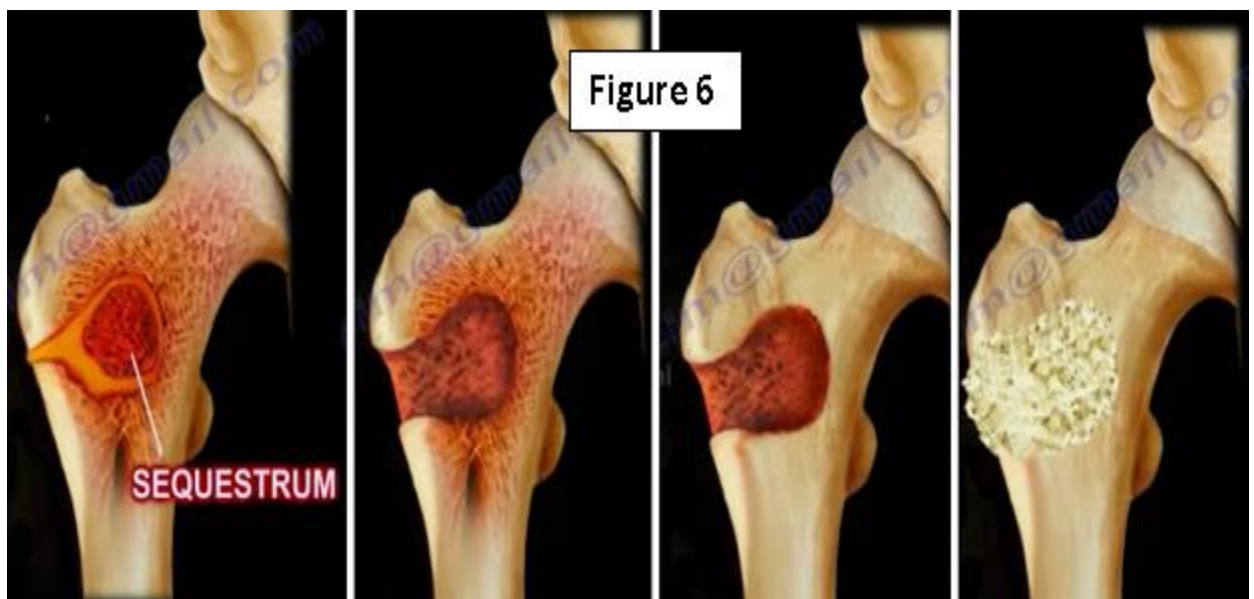


* **Treatment:**

I) General measures: (as acute osteomyelitis).

II) Local measures: Only surgical treatment by :

- **Sequestrectomy:** Excision of dead bones .
- **Saucerisation:** Deroofing of the cavity to allow free drainage.
- The **dead space** is obliterated by packing the cavity with bone chips .
- **Post-operative** splintage of the limb and avoid weight bearing until regeneration occur .
- **Antibiotics** are given with surgical drainage or in acute exacerbation.



2) Brodie's Abscess

- * **Definition:** A localised abscess due to chronic osteomyelitis.
- * **Incidence:** Usually affect adolescents and sometimes adults with good general resistance .
- * **Aetiology:**
 1. **Predisposing factors & route of infection:** (as acute osteomyelitis).
 2. **Organism:** Usually staph. albus.
- * **Pathology:**
 - A. **Site:** Usually in the metaphysis around knee but with growth it may migrate to the diaphysis.
 - B. Brodie's abscess is chronic from the start & **consists of:**
 1. A **cavity** lined by pyogenic membrane.
 2. Contains **pus** which may become sterile in the long standing case.
 3. It is surrounded by **osteosclerosis**.
- * **Complications & C/P:** (As chronic osteomyelitis after acute).
- * **Investigations:** X-ray shows small metaphyseal cavity with no sequestrum and surrounded by sclerosis.



* **Treatment:**

A. General measures: (as before).

B. Local measures: Saucerisation, curettage of the pyogenic membrane and Packing the cavity by bone chips .

Acute pyogenic arthritis

* **Incidence :**

- More common in children .
- Usually affect knee & hip joints .

* **Aetiology:**

- **Predisposing factors:** (as before in acute osteomyelitis) +
 - Extension from osteomyelitis of adjacent bone e.g. hip joint.
- **Route of infection :**
 - The most common mode of infection is blood born infection .
 - Direct inoculation of organisms may occur as a complication of intra-articular injections and surgery.
- **Organism :** Pyogenic or septic arthritis is caused by pus forming micro-organisms .Usually staph. aureus .

* **Pathology:** The condition pass through **3 main stages :**

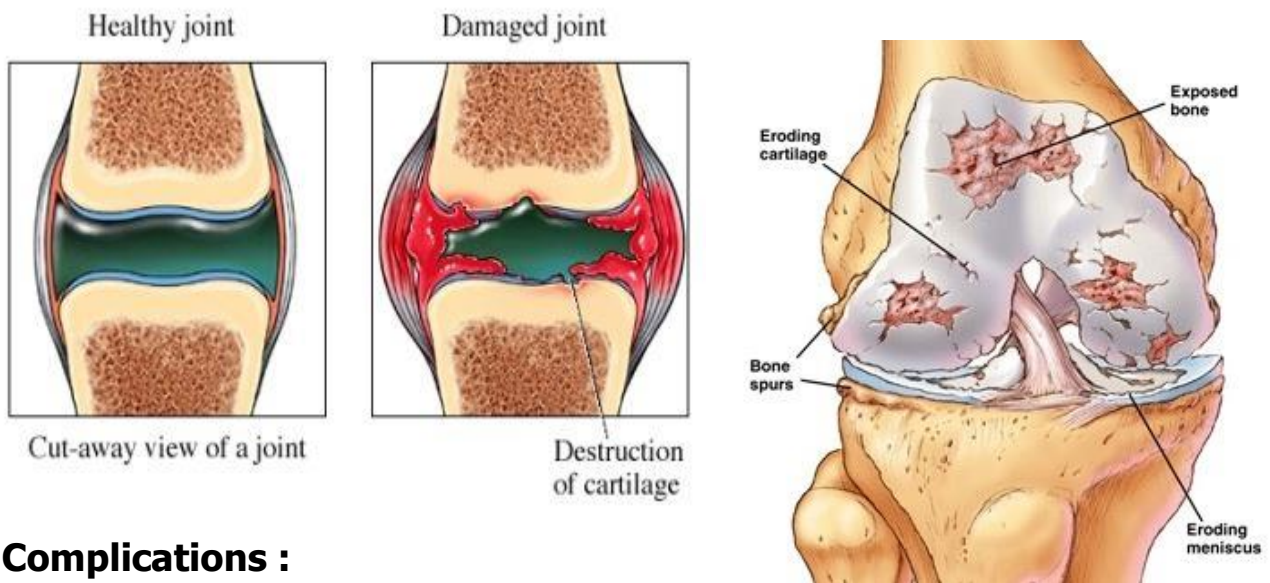
1) Stage of synovitis :

- The organism first settle in the synovial membrane producing synovitis and the synovial membrane is congested ,red , swollen and distended with exudate which is first serous but later on become purulent .

2) Stage of arthritis :

- The articular cartilage is destroyed due to interference with its nutrition due to direct pressure necrosis, and by the effect of the proteolytic enzymes and other products released during phagocytosis of bacteria.
- The capsule and ligaments are fibrosed and weakened .

3) Stage of complications .



* Complications :

1) Spread of infection :

- **General:** septicaemia , toxæmia and pyaemia .
- **Local:** Pus may burst out of the joint to form abscess and sinus .

2) Chronicity .

3) Pathological **dislocation** .

4) Secondary **osteoarthritis** .

5) **Bony ankylosis & stiffness** of joints .

* Clinical picture:

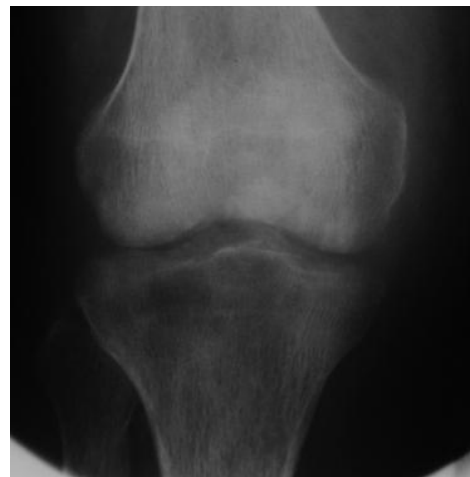
- Characteristic incidence : more common in children .
- Fever , headache , anorexia and malaise .
- **Pain**, swelling and limitation of joint movements are the main symptoms.

- **Swelling** of the joint with redness & hotness of the overlying skin .
- Moderate to marked **tenderness** on the joint line.
- Limitation of both active and passive **movements** of the joint in all directions (early due to muscle spasm and late due to ankylosis).
- **Deformity** (early position of maximum space and late due to muscle spasm).



* **Investigations : (as acute osteomyelitis) +**

1) Plain x-ray: No bony changes are seen in early stages. Later on the earliest bony change is rarefaction of the subchondral bone, followed by erosion of the juxta-articular bone and in the later stages narrowing of the joint space due to destruction of the articular cartilage.



2) Ultrasound: Is helpful in detection of joint collection .

3) Aspiration:

- Helps in confirming the diagnosis and to carry out culture and sensitivity & it should be done before starting antibiotics.

* **D.D :**

1)**Acute osteomyelitis:** pain and tenderness over metaphysis , not on joint line .

2)**Rheumatic fever :** Polyarticular , fleeting and less toxaemia .

3)**Haemarthrosis :** History of trauma & aspiration reveals blood .

4)**T.B arthritis : T.B toxaemia ,** insidious onset , chronic course , presence of cold abscess and rarefaction of bones .

* **Treatment :**

- Surgical drainage, debridement & lavage by open surgery or arthroscopic.
- High dose of **I.V antibiotic** until inflammation completely subside .
- Rest in a **splint** or **traction** to reduce pain.
- **Arthrodesis** in case of destruction of articular cartilage .

TUBERCULOSIS OF BONES

T. B. OF The Spine

(Pott's Disease)

* **Incidence:**

- T.B is still common in many areas all over the world, especially in the densely populated developing countries.
- The spine is the commonest site for bone T.B.
- T.B of bones affect extremes of age but 75% of Pott's disease usually occurs below 10 years.

* **Aetiology:**

I) Predisposing factors: (as acute osteomyelitis) +

- Chronic debilitating diseases in old patient e.g. diabetes mellitus.

II) Route of infection : T.B of bones is always secondary T.B , usually occurs due to haematogenous spread of infection from :

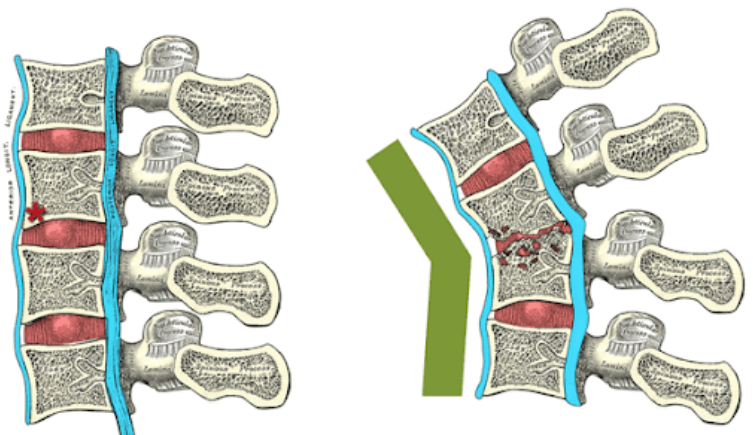
- Primary T.B focus in the lung or T.B lymphadenitis in children or
- Reactivation of latent T.B focus in old age.

III) Organism: Mycobacterium tuberculosis, human or bovine.

* **Pathology:**

I. Site: The commonest site is thoraco-lumbar region (related to cisterna chyli).

II. Usually , more than one adjacent vertebrae are destroyed with destruction of inter-vertebral disc .



III. Pathological types :

Children	Adult
<ul style="list-style-type: none"> • Common • Starts close to the intervertebral disc. • Destroy the intervertebral discs & vertebral body . • Deformity is common • Compression of the spinal cord is rare. 	<ul style="list-style-type: none"> • Rare • Starts subperiosteally along the anterior and the posterior aspect of the vertebral body. • No destruction of the vertebral body • No deformity. • Cord compression & paraplegia are common in this case.

IV. **Cold abscess** formation due to caseation & bone destruction.

- It is usually occurs in adult.
- It may travel distally, directed by fascial planes & anatomical structures to present itself away from its original site.

1. In the cervical region: This may be represented by:

- a. Midline retropharyngeal abscess.
- b. Mediastinal abscess.
- c. Abscess in the posterior triangle of the neck → along the brachial plexus → axilla → elbow → wrist.

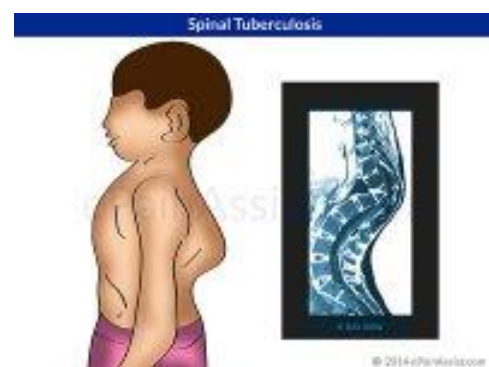
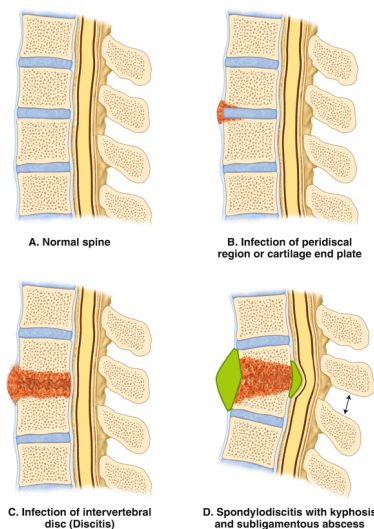
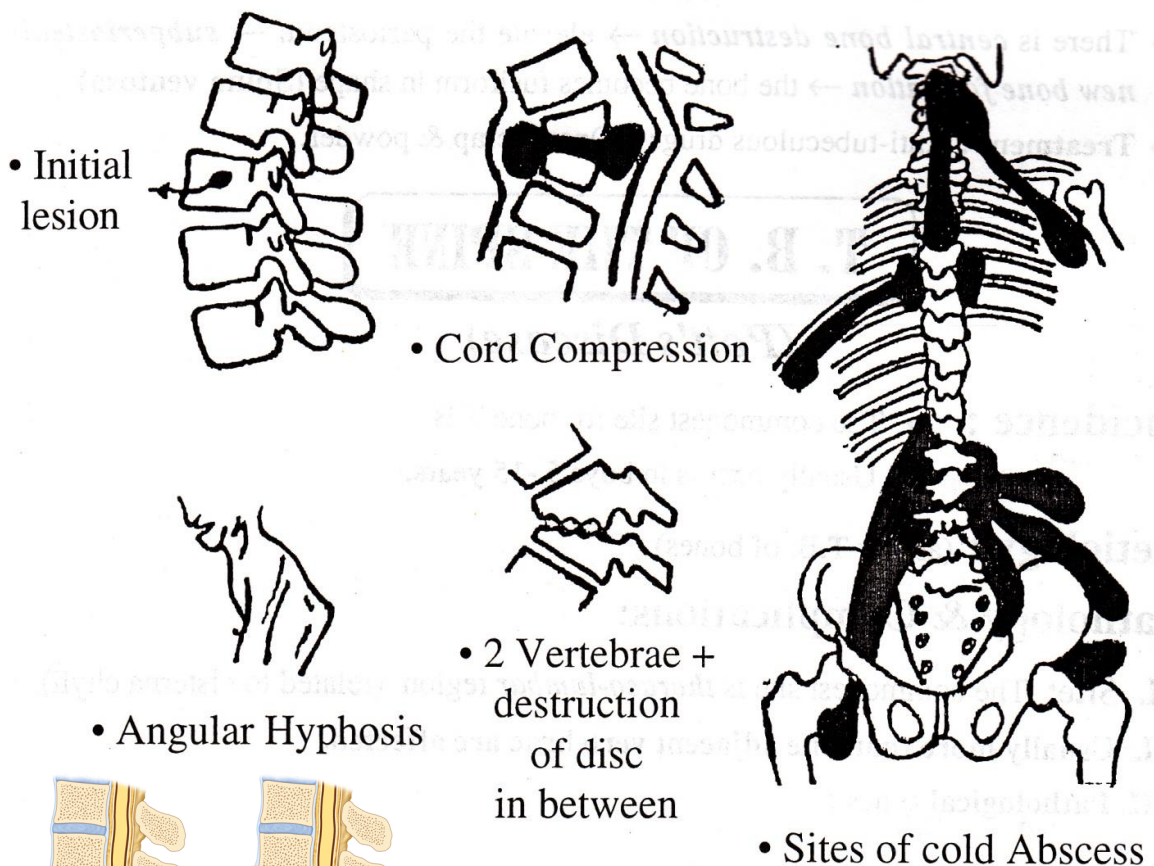
2. In the thoracic region: This is represented by:

- a. Paravertebral abscess.

b. Along the intercostal nerves → abscess along the posterior, lateral or anterior cutaneous branches.

3. In the lumbar region: This is represented by one of the following:

- a. Paravertebral abscess.
- b. Perinephric abscess,
- c. Along the gluteal nerves → gluteal abscess,
- d. From T₁₂, L_{1,2,3,4,5} → psoas abscess which may be presented above, below or both above and below the inguinal ligament.
- e. Quadratus lumborum cold abscess → swelling in the lumbar region.



V. Paraplegia may be due to:

1. Early:

- a. Compression of the cord by cold abscess & destroyed bone .
- b. Thrombosis of anterior spinal cord vessels .
- c. T.B. meningitis and myelitis.

2. Late: Angulation and friction of the cord against angular vertebrae.

VI. Level of compression of the spinal cord: Usually occurs in the upper thoracic region (narrowest part of spinal canal).

* **Complications :**

1. Deformity :

- **In children** , destruction and collapse of inter-vertebral disc and bodies of vertebrae result in deformity in the vertebral column .
- Usually the anterior part of the vertebrae is affected leading to **angular kyphosis** .
- **Rarely the lateral part** of the vertebrae is affected leading to **scoliosis** .

2. Cold abscess .

3. Paraplegia occurs in 10% of cases .

* **Clinical picture:**

A. General: T.B toxaemia.

B. Local:

1. Pain: Constant, dull aching or sawing increased by night & movements.

- Felt over the affected vertebra & radiate along compressed nerve.

2. Tenderness: detected by

- ♣ Percussion of the spines or the head.
- ♣ Ask the patient to jump leading to severe pain in the affected vertebra.

3. Limitation of movements in all directions & rigidity of the spine which can be detected by the following tests:

a. Coin test: Ask the patient to get a coin from the ground,

- ♣ Normally he can get the coin by flexion of the spine.
- ♣ Diseased patient with rigidity of lumbar spine has to flex, his knee to get the coin.

b. Passive lumbar extension :while the diseased child lying in prone position , raise the child from his feet.

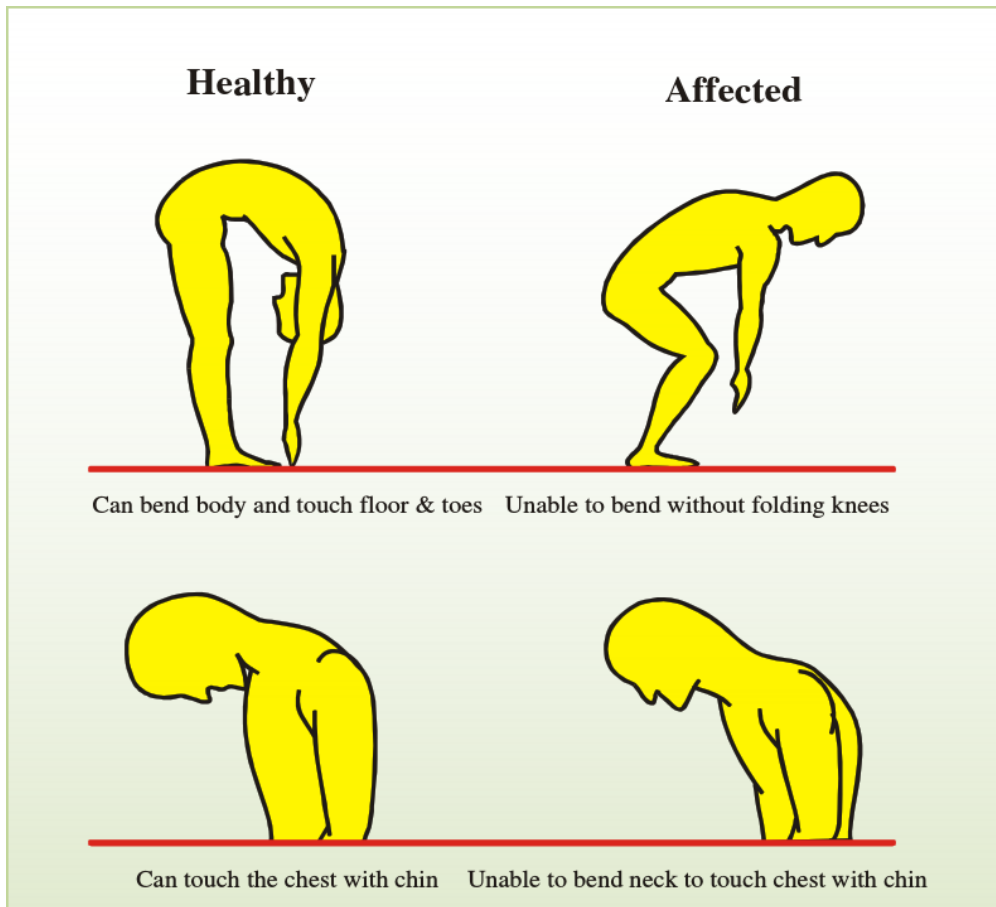
- ♣ Normally, concavity of the spines occurs. .
- ♣ In diseased child, no concavity of the spines occurs.

c. Limitation of movements in the cervical spine is detected by asking the patient to touch his chest by his chin → the patient can not bend his neck to do this movement.

4. Deformity: The commonest is angular kyphosis which is marked if the disease affect the thoracic region. In cervical & lumbar regions , the deformity is masked by normal lordosis , which is obliterated and the spine looks straight .

5. Cold abscess (mention).

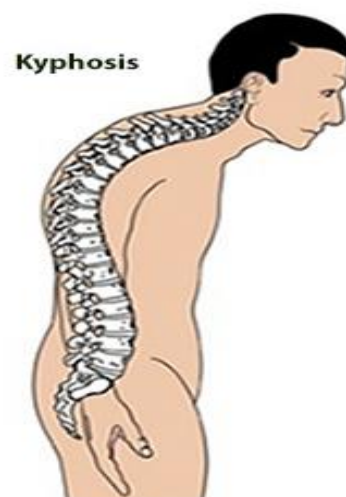
6. Complete neurological exam. , detects paraplegia.



The Passive Lumbar Extension Test



- Sensitivity=84.2
- Specificity=90.4
- LR+ =8.78
- LR- =0.17



* **Investigations:** (as in any T. B) +

1. Routine investigations for any T.B

2. Plain x-ray of the spines: antero-posterior & lateral views show:

- a. Bone destruction with no new bone formation of 2 or more vertebrae .
- b. Destruction of the intervertebral discs.
- c. Paravertebral abscess.
- d. Deformity.

3. C.T scan & MRI (to detect cord compression) .



Plain x-ray



CT scan



MRI

* **D.D.:**

- 1. Rickety kyphosis:** gentle curve & no limitation of movements.
- 2. Neglected fracture spine:** history of trauma, affect one vertebra only intervertebral disc & space are intact, no toxemia & X-ray.
- 3. Secondaries in the spine:** history of the cause, irregular bone destruction & intact disc.
- 4. T.B of hip joint:** limitation of movements of hip joint in all directions.

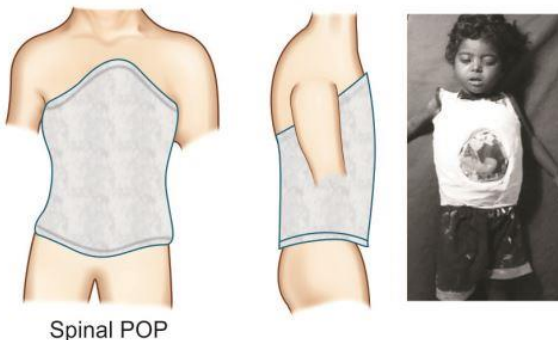
5. D.D. of Psoas cold abscess: from hydronephrosis &. femoral hernia.

6. D.D. of Cold abscess on chest wall: from T.B osteitis & empyema necessitans.

* **Treatment:**

I) Conservative treatment : (The main line of treatment)

- Anti- T.B drugs for 9 months
- Rest & good diet.
- Spinal support by plaster jacket for 3 months followed by spine brace .
- Under conservative treatment most cases are cured .



Spinal POP



II) Surgical treatment :

• **Indications :**

- Failure of conservative treatment .

- **Pott's paraplegia** : Failure of recovery with 4 weeks or deterioration of neurological signs .
- Marked progressive **kyphosis** .

•**Aim** :

- Drainage of the abscess and excision of the diseased tissues .
- Decompression of the spinal cord .
- Correction of spinal deformities.
- Solid spinal fusion to obtain stable vertebrae .
- Early rehabilitation and restoration of function .

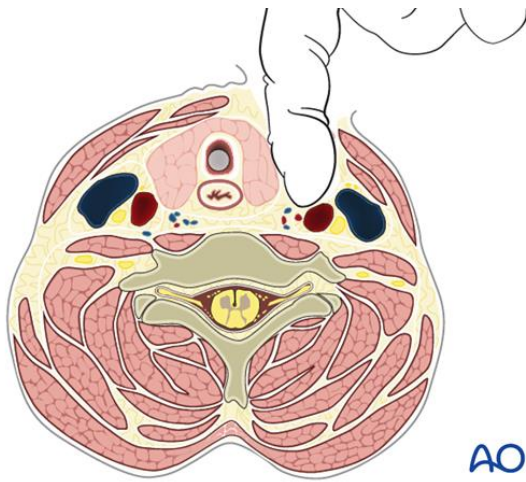
•**Methods** : One of the following operations can be done by open surgery but **nowadays minimal invasive endoscopic spinal surgery** is more popular :

1) Anterior radical debridement operation:

- Diseased bone and discs are excised and a strut iliac bone graft (or a titanium mesh filled with bone graft) is inserted, through one of the following approaches:
 - ♣ In the **cervical spine**, the approach is between the sternomastoid and carotid sheath laterally and the thyroid, trachea and esophagus medially.
 - ♣ In the **thoracic spine**, through a thoracotomy.
 - ♣ In the **lumbar spine**, through a retro-peritoneal approach.
- **Additional** anterior plating and screws or posterior pedicle screws and rods enhance stability and fusion. It also allows early mobilization and rehabilitation.

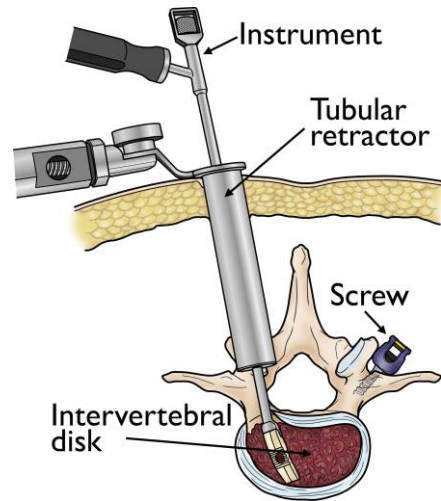
2) One-stage posterior operation: The same principles of the previous operation are done through a posterior exposure .

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AO

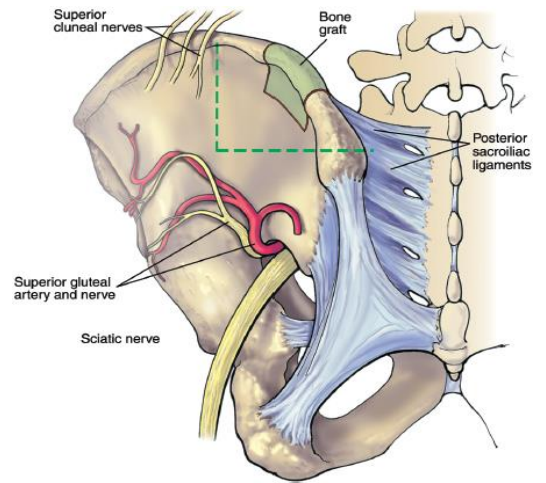
Anterior cervical approach



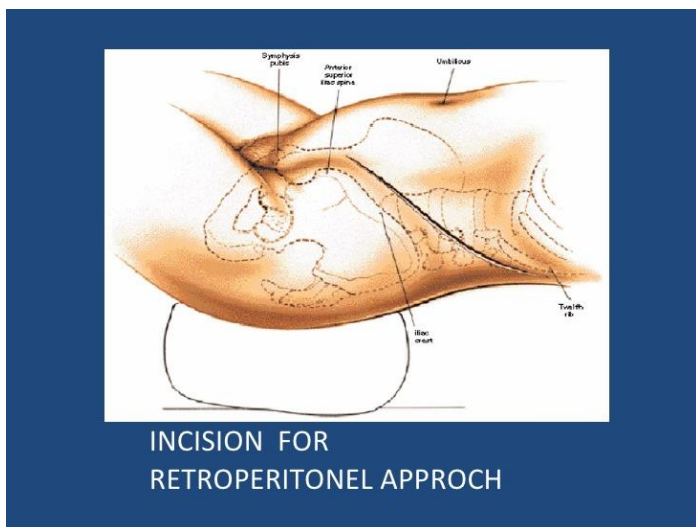
Minimal invasive surgery



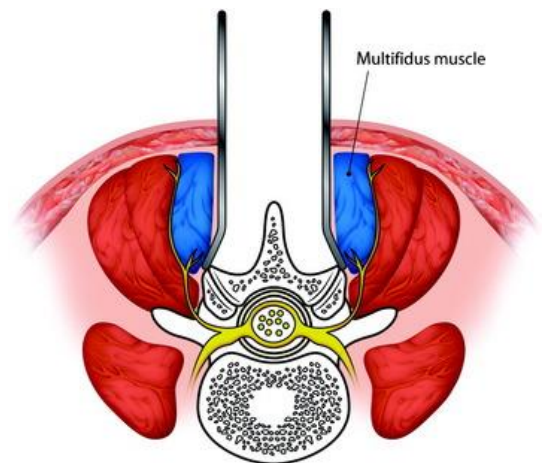
Thoracotomy



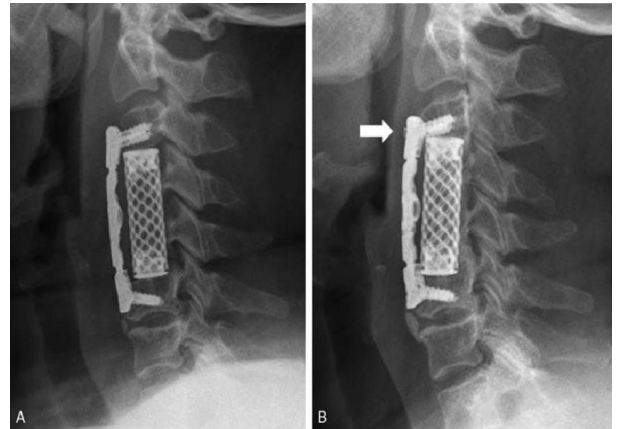
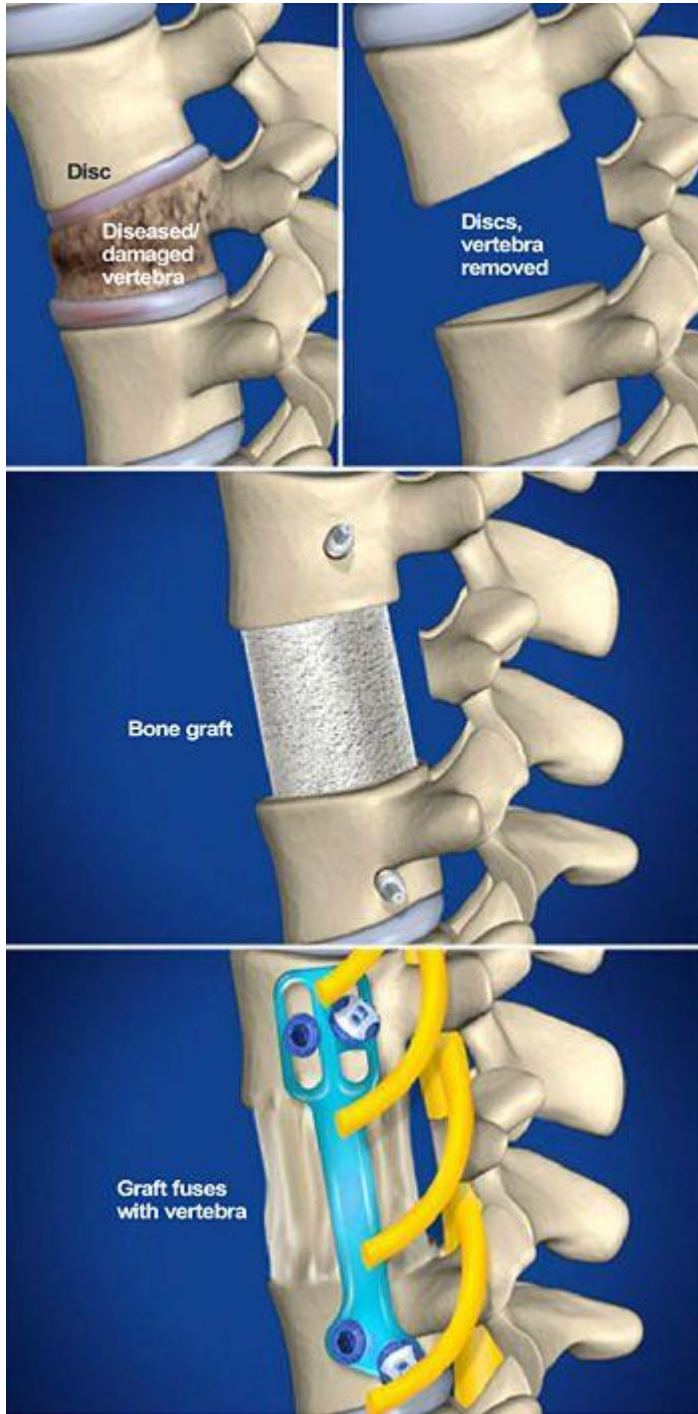
Strut iliac bone graft



INCISION FOR RETROPERITONEL APPROCH



Posterior exposure



**Titanium mesh filled
with bone graft**

**Posterior pedicle
screws and rods**

