Osteomyelitis

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**General Features** of osteomyelitis → see [p. 1192 (2-3) >>](http://www.neurosurgeryresident.net/USMLE%202\Musculoskeletal%20system%20(1000-1230)\1192%20(2).jpg)

Cranial Osteomyelitis

Etiology

1. Direct extension from paran­asal sinuses, ear (e.g. *malignant external otitis* see p. [Ear40 >>](http://www.neurosurgeryresident.net/Ear.%20Otology\Ear40.%20External%20Ear%20Disorders.pdf#malignantexternalotitis))
2. Penetrating skull injury
3. Infected craniotomy flap, skeletal traction
4. Hematogenous

Gradenigo's syndrome – ***apical petrositis*** (osteomyelitis) involving **CN5 & CN6**. [see p. CN5 >>](http://www.neurosurgeryresident.net/CN.%20Cranial%20Neuropathies\CN5.%20Trigeminal%20Disorders.pdf#Gradenigo)

Clinical Features

- **pain, tenderness, swelling, warmth** at infected site.

* **drainage of purulent material** if open wound is present.
* if **systemic symptoms** are present, underlying subdural / epidural empyema is commonly present.

Diagnosis

1. **Plain skull film** (positive > 50%)
2. **CT**
3. **Technetium bone scans** (helpful if skull radiographs are negative);
   * false-positive in *old trauma* or *previous craniotomy*; H: **gallium scan** (differentiates infection from other causes of positive technetium scan).

Treatment

1. **Surgical debridement** (removal of infected bone)
   * adequate margin of normal bone is removed to minimize risk of recurrence.
   * *after at least 1 year* with no evidence of inflammation, **cosmetic / protective cranioplasty** may be performed.
2. **Antibiotics**
   * MRSA is treated with 6 weeks of vancomycin; if hardware is present (e.g. cranial mesh), add rifampin.

Vertebral Osteomyelitis (s. Infective Spondylitis)

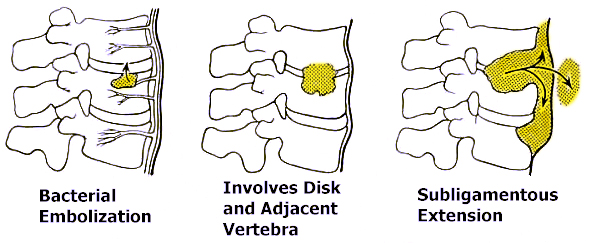
- destructive **disco-vertebral lesion**.

Infections of vertebrae usually involve disk space (vs. malignant lesions!)

* disseminated via small nutrient arteries, bacteria lodge beneath *end-plate of vertebra* (usually anteriorly) → quickly extend into *adjacent disc* and *end-plate of opposite vertebra*.

In children, because the disk is vascularized, it can be a primary site.

* complications - *paraspinal extension* (along spine, beneath paravertebral ligaments, etc) - paraspinal abscess, anterior epidural abscess;
  + paraspinal masses are large in indolent forms of infection (such as tuberculosis).



* occasionally, *nondiscogenic forms* (involving only **vertebral bodies** or **neural arches**) are encountered - difficult to distinguish from neoplasia, metastases!

Etiology

- hematogen­ous spread (rarely, direct extension\*):

1. Pyogenic bacteria - *staphylococci* are most common! (≈ 50%).
2. *M. tuberculosis* (**Pott's disease**) – one of the oldest demonstrated diseases of humankind (in 1779, Percivall Pott presented the classic description of spinal tuberculosis).

* rare in West; still a significant cause of disease in developing countries.
* affects young adults.
* 80% patients have no evidence of pulmonary involvement.
* most frequent in lower thora­cic ÷ upper lumbar vertebrae.
* tendency to involve *multiple segments* (through subligamentous paraspinal spread).
* discs frequently are spared until later in course.

\*e.g. complications of discography, lumbar puncture

Most common primary sources of infection (can be identified only in 40% patients): urinary tract, skin, lungs.

* + well-recognized risk factor - IV drug use.

Clinical Features

- course tends to be subacute (patients with *pyogenic* spondylitis usually present while infection is still confined to one disc space):

1. **Deep back pain** - exacerbated by motion (**movement restriction** by muscle spasm), may be unrelieved by rest.
2. **Spine tenderness** over involved spine segment.
3. **Fever** (25%).

N.B. all signs of infection may be absent!

Neurological involvement - late and inconstant feature (≈ 1% cases; but in 40% of cases caused by tuberculosis!) by:

* 1. intraspinal extension of infection (epidural abscess)
  2. spine instability and fractures

Diagnosis

1. ESR↑ (!!!), CRP↑, WBC↑ (30%)
2. **X-ray** (changes may take weeks ÷ months to appear!):
   1. progressive *narrowing of disk space*
   2. erosion and *destruction of adjacent vertebral end-plates* → *body collapse* → wedging, subluxations, sharp kyphosis (gibbus).
   3. *paravertebral soft-tissue masses*:

*cervical spine* - focal swellings of retropharyngeal soft-tissue stripe;

*thoracic spine* - displacement of paraspinal lines;

*lumbar spine* - lost psoas muscle shadow.

Radiographic changes of spinal tuberculosis on plain films:

1. Lytic destruction of anterior portion of vertebral body
2. Reactive sclerosis on a progressive lytic process
3. Enlarged psoas shadow with or without calcification; fusiform paravertebral shadows suggest abscess formation

In contrast to pyogenic disease, calcification is common in tuberculous lesions!

1. Vertebral end plates are osteoporotic.
2. Intervertebral disks may be shrunk or destroyed.
3. Vertebral bodies show variable degrees of destruction → collapse with anterior wedging
4. Bone lesions may occur at more than one level.
5. **MRI** (diagnostic method of choice – highly sensitive and specific! – changes are seen 2–3 weeks earlier than on plain X-rays):
6. low T1 signal (high signal on T2) throughout disc and in adjacent vertebral bodies.
7. thinning, fragmentation (and eventual loss) of dark line of vertebral end-plates.
8. IV Gd-DTPA → diffuse enhancement in areas showing signal change.

N.B. in *degenerative disk disease*, changes are less uniform, disk is desiccated and bone destruction is absent, no paravertebral soft-tissue masses.

Specific MRI findings of tuberculous spondylitis:

* 1. thin and smooth enhancement of the abscess wall (vs. pyogenic spondylitis - thick and irregular enhancement of abscess wall)
  2. well-defined paraspinal abnormal signal (vs. pyogenic spondylitis - ill-defined paraspinal abnormal signal).

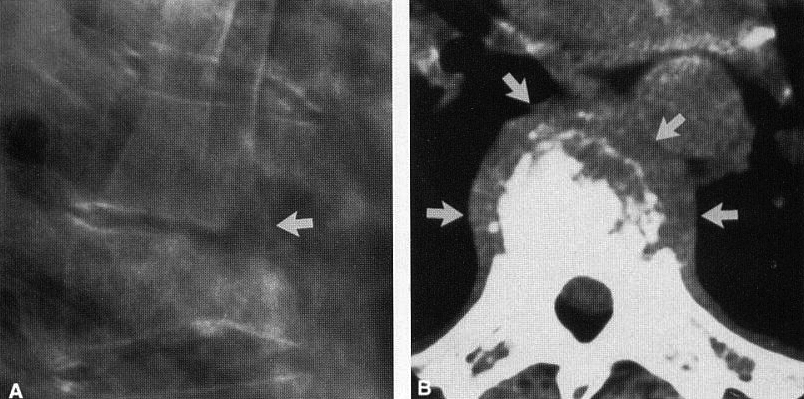
1. **CT** (less sensitive and specific; better tolerated by some patients with severe back pain): punched-out erosions of bone adjacent to involved disc (“moth-eaten” appearance), small dense sequestra, prominent sclerosis.
2. **Bone scan** with technetium, gallium.
3. **CT-directed needle biopsy** of affected vertebrae; **open biopsy** may be necessary to obtain adequate tissue for culture.

|  |  |
| --- | --- |
| Discovertebral osteomyelitis, L4-5 (sagittal T1-MRI): diffuse low intensity throughout L4/5 vertebral bodies, and even lower signal from intervening disc space (which is barely visible because of loss of dark line of vertebral end-plates); little epidural soft-tissue thickening suggesting extraosseous extension.D:\Viktoro\Neuroscience\Inf. Infection\00. Pictures\Vertebral osteomyelitis (MRI).jpg | Staphylococcal discovertebral spondylitis (axial CT): vertebral end-plate shows typical *moth-eaten appearance* (*upper arrows*) and another focus of infection is visible in inferior articular process (*lower* *arrow*):  D:\Viktoro\Neuroscience\Inf. Infection\00. Pictures\Vertebral osteomyelitis (CT).jpg  [Source of picture: Ronald G. Grainger, David J. Allison “Grainger & Allison’s Diagnostic Radiology: A Textbook of Medical Imaging”, 4th ed. (2001); Churchill Livingstone, Inc.; ISBN-13: 978-0443064326 >>](http://www.amazon.com/gp/product/0443101639) |

Infectious spondylitis at T6-7:

A) lateral radiograph - disc space narrowing, erosion of adjacent vertebral end-plates (*arrow*), reactive sclerosis in inferior vertebra.

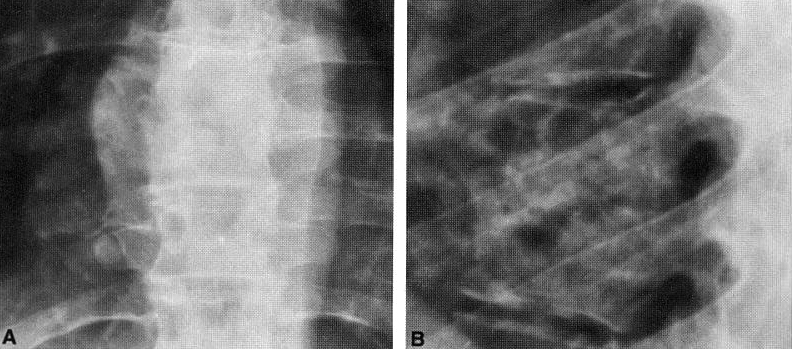
B) CT - bony destruction; note extent of associated paraspinal soft-tissue mass (*arrows*).



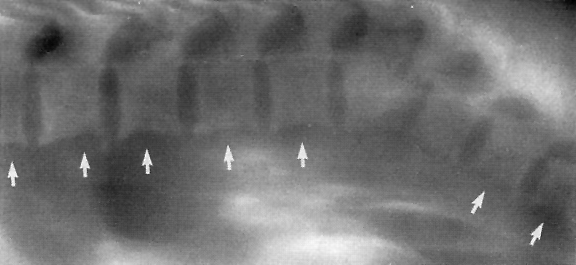
###### Thoracic tuberculous spondylitis:

###### A) paraspinal soft-tissue mass in AP radiograph; involved disc space is difficult to resolve.

###### B) disc space obliteration and destruction of adjacent vertebral end-plates.



Tuberculous spondylitis with subligamentous extension (sagittal thoracic tomogram) - obliteration of disc space and destruction of adjacent vertebral end-plates in midthoracic spine; superior and inferior subligamentous extension is manifested by erosions of anterior vertebral body margins over several levels (*arrows*):



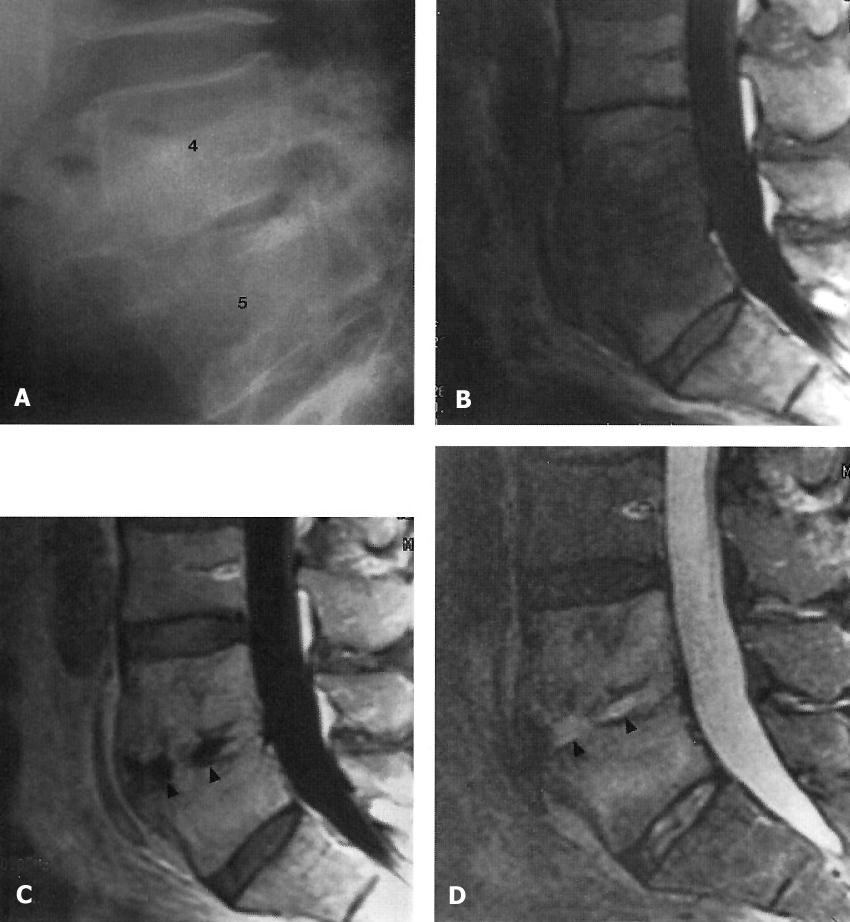
Pyogenic spondylitis:

A) lateral X-ray at L4-L5 - marked narrowing of disc space, loss of sharp vertebral end-plate margins, and mild reactive sclerosis in L4 vertebral body.

B) T1-MRI - extensive abnormal low signal within adjacent vertebral bodies and intervening disc, with loss of hypointense border at vertebral margins.

C) postcontrast T1-MRI - pronounced enhancement of involved vertebra and portions of infected disc; no epidural involvement.

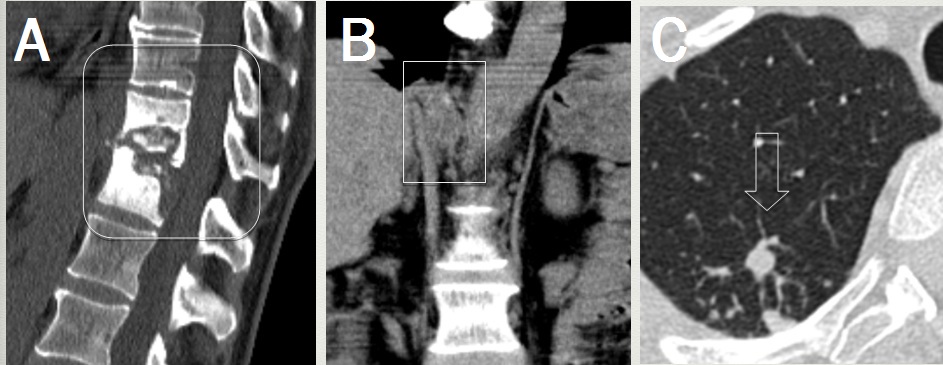
D) fat-suppressed T2-MRI - edema in vertebral bodies, abnormally bright signal in infected disc - corresponding to areas of low signal intensity in postgadolinium MRI (*arrowheads*).



Tuberculous spondylitis in 46-year old male.

A. CT shows contact interdisk Th11-Th12 vertebral body destruction, with large and spongy sequesters, prevertebral and epidural extension (surrounds a large square).

B. CT shows paravertebral tight, with calcination abscess near the right crus of diaphragm (surrounds a small square). C. CT shows accidental findings of post- primary pulmonary tuberculosis (arrow):



Treatment

1. Infection control
   * MRSA is treated with 6 weeks of vancomycin; if hardware is present (e.g. cranial mesh), add rifampin.
2. Patient comfort (bed rest, brace)
3. Operative debridement (e.g. epidural extension)
4. Prevention of further deformity.
   * **instrumentation**\* up to **corpectomy** may be indicated.

\**modern instrumentation* is titanium – does not need to be isolated from site of infection.

Infectious Diskitis

Etiology

- usually **iatrogenic** (complication of previous surgery or needle puncture of intervertebral disks) - most often staphylo­cocci!

Clinical Features

1. severe **pain**, aggravated by palpation; partially relieved by recumbency.
2. **muscle spasm**.
3. **fever**
   * interspace infections *must* be ob­served closely – risk of extradural abscesses!

Diagnosis

Early in course:

* + **X-rays** and **CT** are normal!
  + **gallium scans** may be falsely positive because of recent surgery.

Later in course - *destructive changes* along edges of disk space, *narrowing* of intervertebral space.

* + **CT** demonstrates these changes early.

**Needle biopsy** of involved interspace identifies causative bacteria (cul­tures are often sterile → **direct surgical biopsy**).

Treatment

1. **bed rest**, medication for pain and muscle spasms.
2. **antibiotic therapy** (empirically – against staphylococci).
3. *no response to conservative therapy* → **open surgery** (remove infected mate­rial from interspace).

* when infection is controlled, interspace will eventually narrow → spontaneous fusion.

Bibliography for ch. “Infections of Nervous System” → follow this [link >>](http://www.neurosurgeryresident.net/Inf.%20Infection\Inf.%20Bibliography.pdf)

[Viktor’s Notes℠ for the Neurosurgery Resident](http://www.neurosurgeryresident.net/)

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