Do Not Miss This Diagnosis: Discitis/Osteomyelitis

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Emergency/Critical Care Imaging Simulation

- 8 hour simulation of 65 emergent & critical care cases of varying degrees of difficulty, including normal studies
- Presentation via full DICOM image sets
- Free responses are typed into text boxes labelled
  - Critical findings
  - Incidental findings
  - Acuity ranking

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Emergency/Critical Care Imaging Simulation

- Computer aided online simulation (SIM) of emergency imaging studies
- Designed to test residents for readiness for call
- Providing proficient & objective assessment of resident competence in the emergency /critical care imaging & affirmation of Milestone achievements

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Emergency/Critical Care Imaging Simulation

- SIM was taken by 127 first (R1) & second (R2) year residents from 16 USA radiology training programs
- Case 1: Discitis/osteomyelitis (DO) presented on plain film
  - 92% of residents failed to detect the findings
  - 8% of residents noticed an abnormality & suggested further evaluation with CT or MRI

Conclusion: Significant **observational** gap exists in detecting indirect signs of discitis & osteomytlitis

Emergency/Critical Care Imaging Simulation

- Case 2: DO was presented on CT
  - 32% of residents made all correct findings, however failed to make the correct diagnosis
  - 68% of residents noticed only a few or incorrect findings without a correct diagnosis and suggested further evaluation with MRI

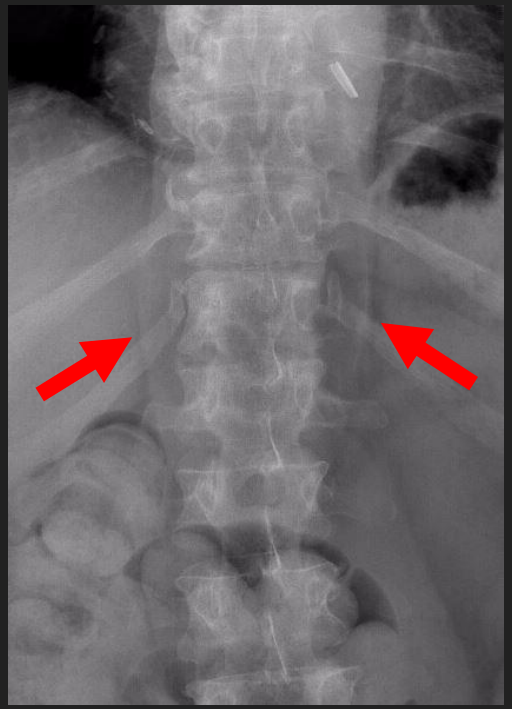
Conclusion: Significant cognitive gap exists in **<u>interpreting</u>** imaging findings of discitis & osteomyelitis

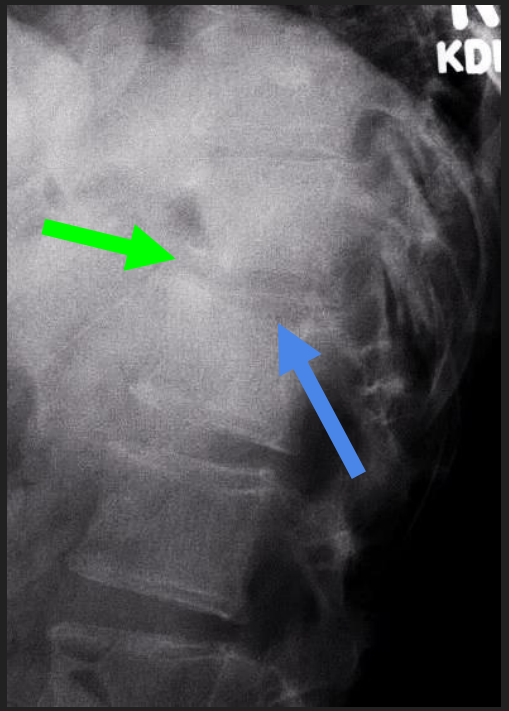
SIM Case 1: Complicated Discitis/Osteomyelitis (DO)

History: Back pain.

Exam: AP & lateral spine x-ray

Findings: Enlarged paraspinal stripe bilaterally with loss of endplate definition & disc space narrowing at T12/L1



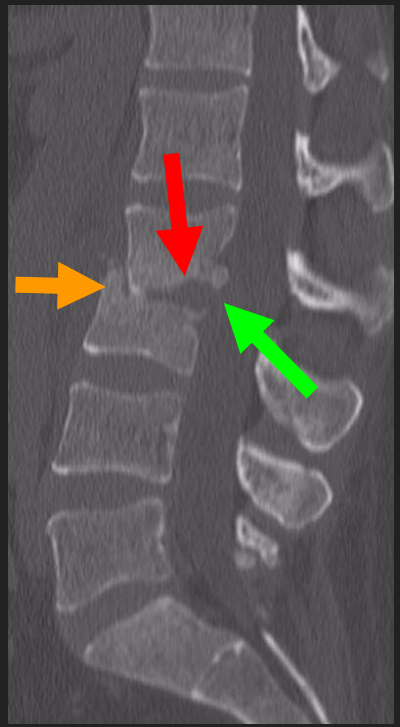


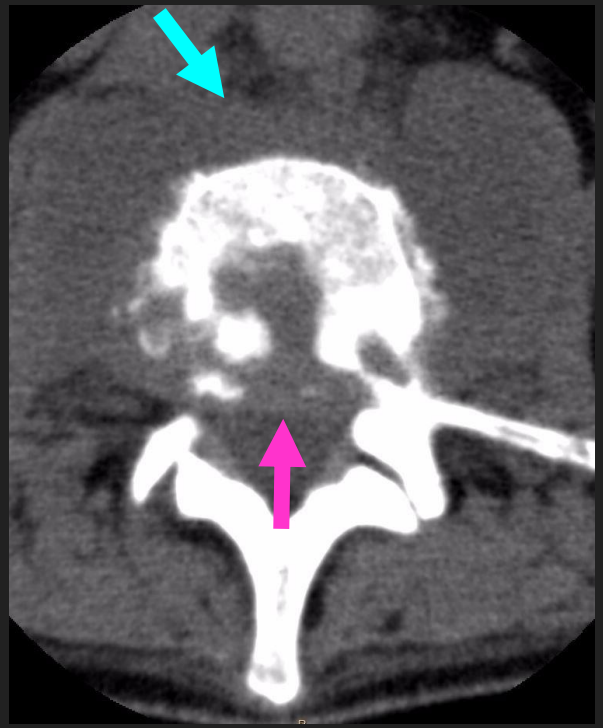
SIM Case 2: Complicated Discitis/Osteomyelitis (DO)

History: Increasing back pain. Reported abnormal radiograph from outside institution.

Exam: CT L-spine without contrast

Findings: Cortical erosion of L2 endplate with retrolisthesis of L2 on L3, disc space narrowing, prevertebral soft tissue thickening & epidural extension.





Purpose of this exhibit

To close the educational gap through

- Discussion of the spectrum of imaging findings of DO
- Familiarization of the radiologist with clinical & imaging features of mimics of DO to improve radiologist's diagnostic competence
- Prevent delayed treatment of DO and potential adverse outcomes

Imaging Spectrum of Discitis/Osteomyelitis

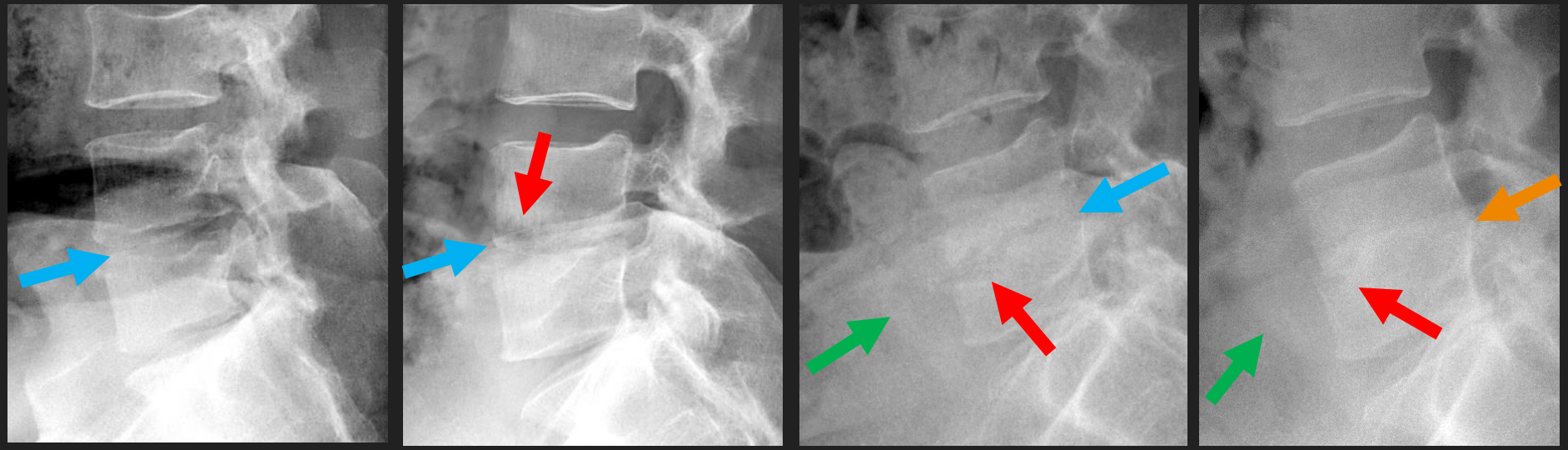
Pyogenic Discitis/Osteomyelitis

- Clinical features:
  - Fever & back pain
- General features:
  - Affects one vertebral segment, defined as one disc and its two adjacent vertebral bodies[1]
  - Most commonly affects the lumbar spine
- Complications:
  - Paravertebral phlegmon and/or abscess
  - Epidural phlegmon and/or abscess with thick and irregular walls

Pyogenic Discitis/Osteomyelitis

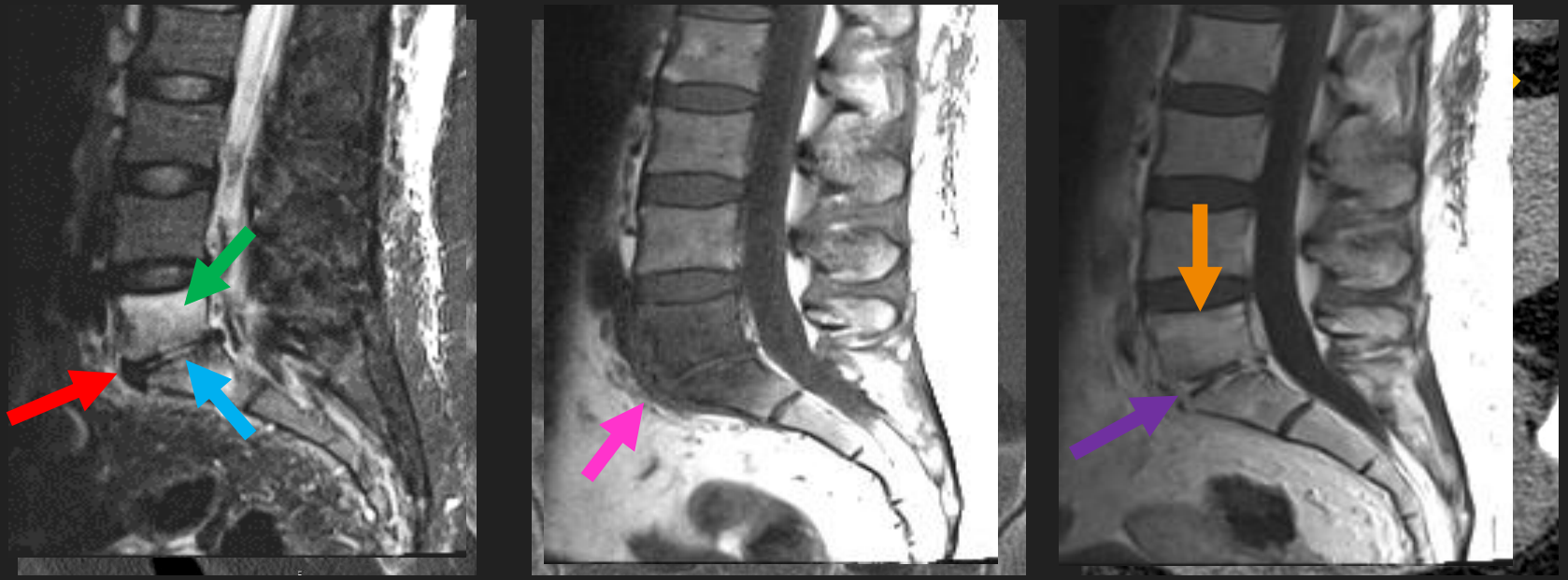
- Plain film and CT features:
  - Intervertebral disc space narrowing
  - Erosive endplate changes
  - Soft tissue thickening
- MRI features:
  - Intervertebral disc space narrowing
  - Enhancement and edema in the disc in early stages & in the adjacent vertebral bodies in later stages
  - Perivertebral and/or epidural phlegmon and/or abscess

Pyogenic Discitis/Osteomyelitis



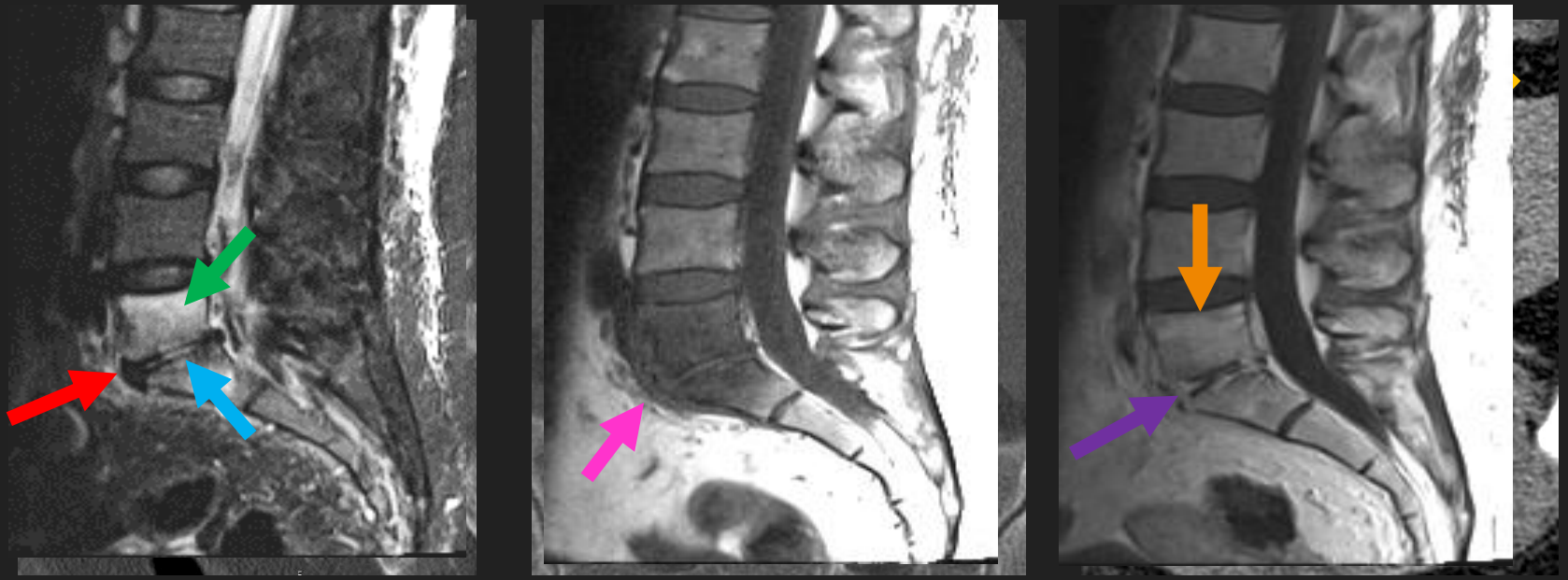
From left to right, temporal serial lateral radiographs of the lower lumbar spine in the same patient reveal progressive disc space narrowing with complete loss of the disc space over time, progressive endplate destruction and soft tissue thickening.

Uncomplicated Discitis/Osteomyelitis



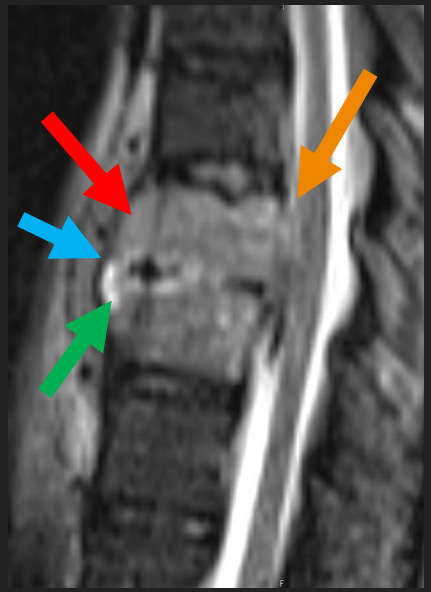
In a separate patient, sagittal STIR image shows marked disc space narrowing, fluid within the disc and marrow edema in the adjacent vertebral bodies without cortical erosions. Sagittal T1 and T1+Gd reveal focal enhancement of the central disc & adjacent vertebral bodies with subtle prevertebral soft tissues thickening. These findings are typical for early DO with small prevertebral phlegmon formation.

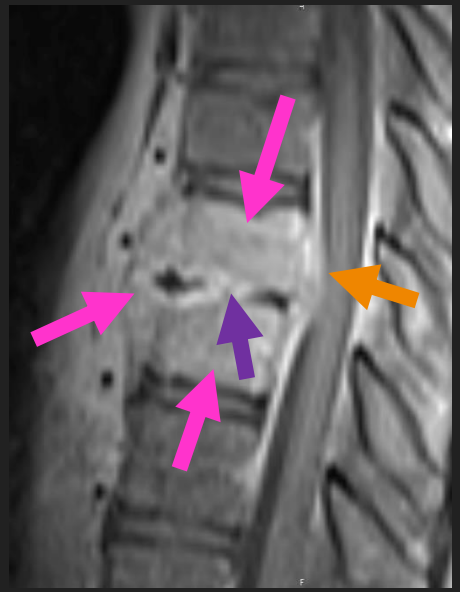
Uncomplicated Discitis/Osteomyelitis

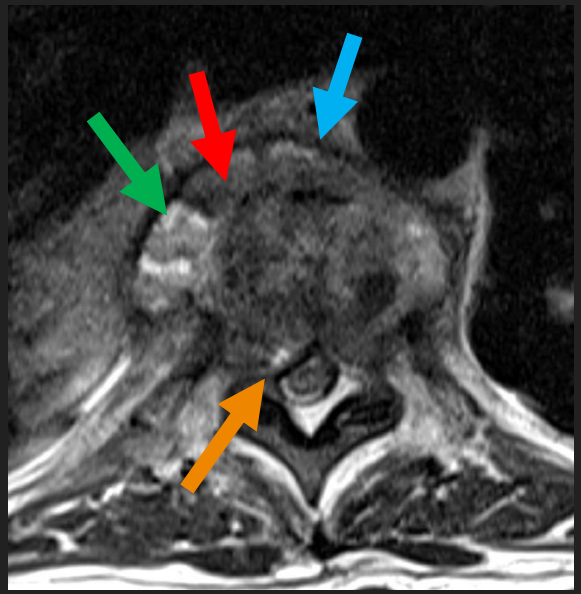


Sagittal & coronal CT images in the same patient as on prior slide, early in the clinical course, show narrowing of the L4-L5 disc space, subtle cortical erosions, and focal endplate destruction. Axial image demonstrates paravertebral soft tissue thickening at this level.

Discitis/Osteomyelitis with Phlegmon

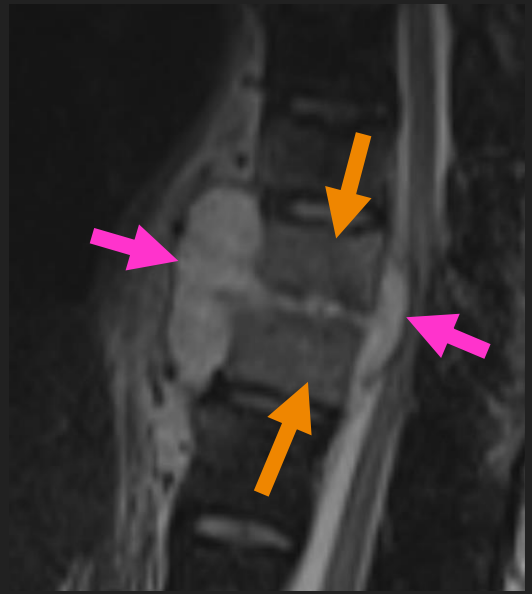


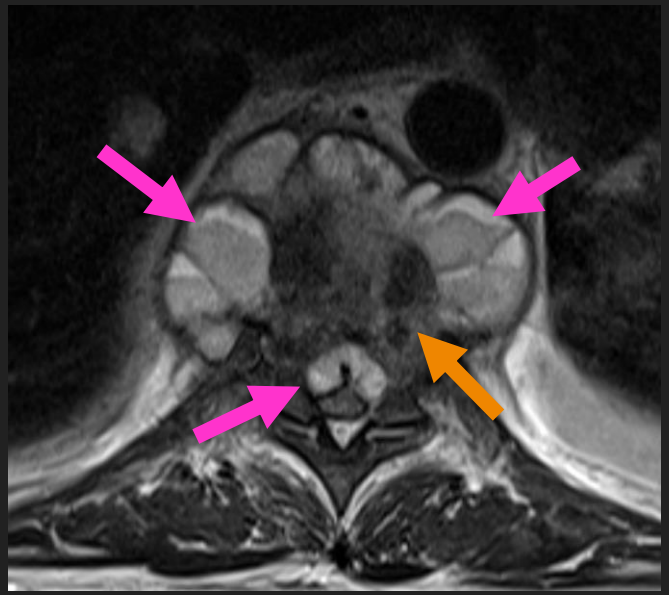




In a different patient, sagittal STIR and axial T2 images show more pronounced phlegmonous change in the anterior paravertebral soft tissues, distending the anterior longitudinal ligament with early abscess formation and extension of the phlegmon into the spinal canal. Also, note the enhancement within the disc, soft tissues, and marrow of the adjacent vertebral bodies.

Discitis/Osteomyelitis with Abscess



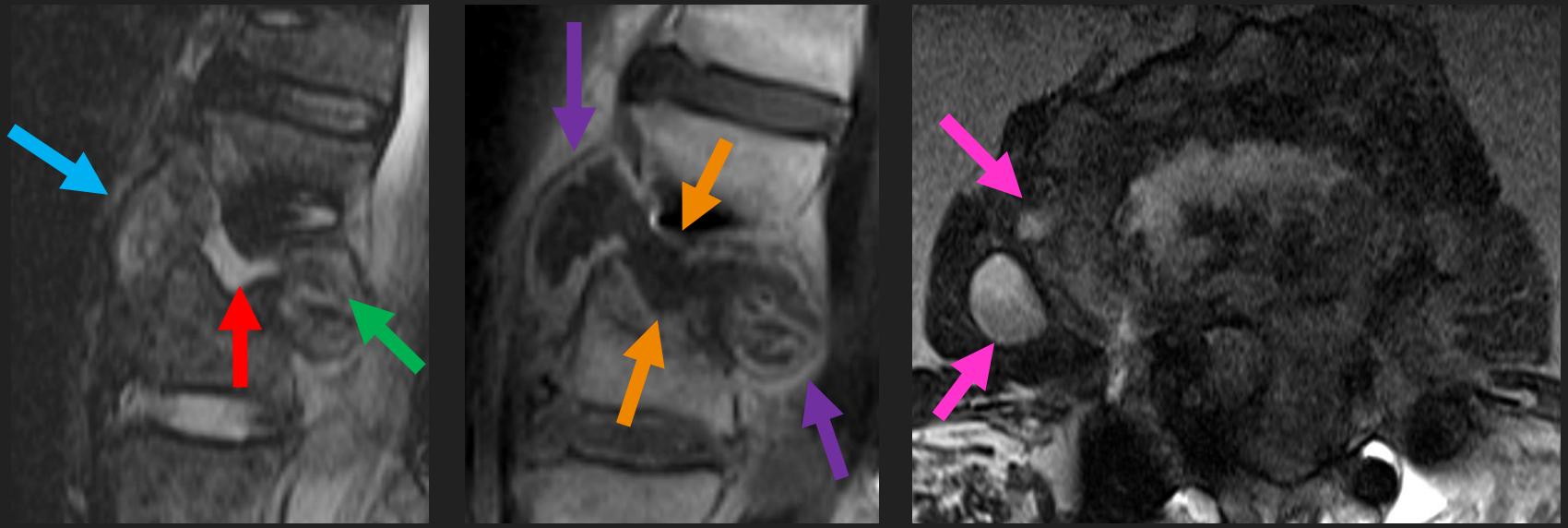


Sagittal T1+Gd image reveals enhancement in a narrowed disc space extending into the epidural & prevertebral spaces with associated bone marrow edema & multi-loculated fluid collections in the paravertebral & epidural spaces on the sagittal STIR & axial T2 images. These are classic MR findings of DO complicated by epidural & paravertebral abscesses.

Tuberculous Discitis/Osteomyelitis

- Clinical features:
  - Insidious onset of back pain and low grade fever
- General features:
  - Equal predilection for thoracic & lumbar spine[2]
  - Subligamentous spread with multilevel involvement
- Imaging features:
  - Similar early manifestations & late complications as pyogenic DO
  - Abscess wall is typically thin & smooth rather than thick & irregular
  - Vertebral body destruction may lead to gibbus deformity

Tuberculous Discitis Osteomyelitis

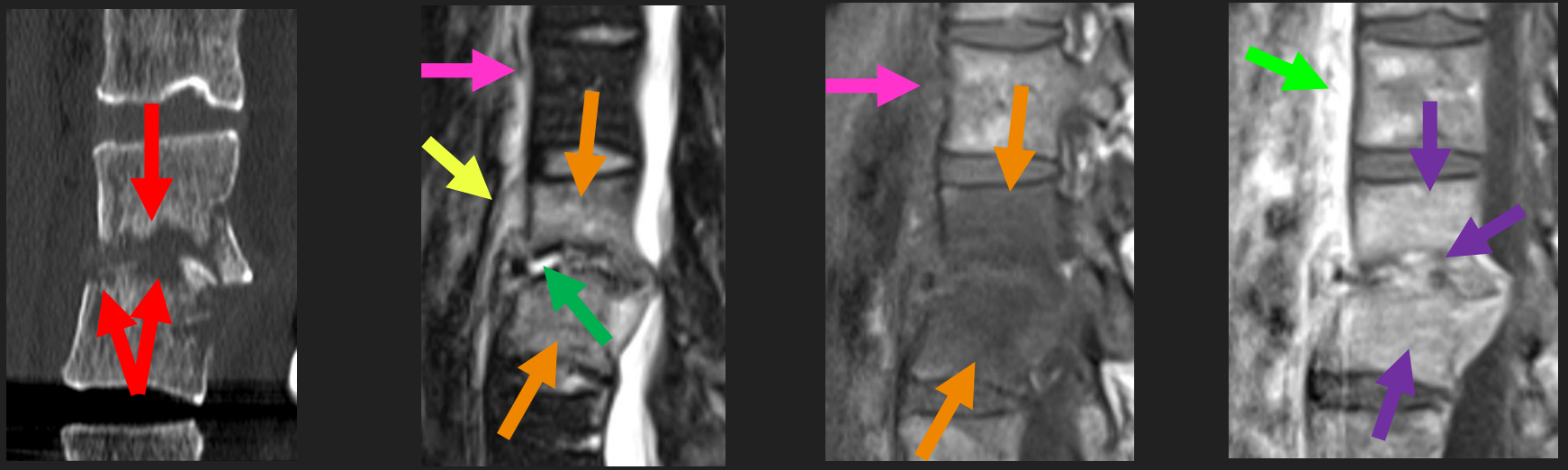


Sagittal STIR image shows fluid in the intervertebral disc extending into the prevertebral & epidural spaces with destructive endplate changes and rim enhancement on the sagittal T1+Gd image indicating profound DO complicated by epidural & prevertebral abscesses. Additional abscesses are seen in the right psoas muscle on the axial T2 image.

Fungal Discitis/Osteomyelitis

- Clinical features:
  - Typically manifests in immunocompromised patients
- General features:
  - Rare cause of DO
  - Can affect multiple segments, mimicking tuberculous DO
- Imaging features:
  - Often low T1 & T2 signal due to intrinsic paramagnetic & ferromagnetic elements within fungi[3]
  - Similar early manifestations & late complications as pyogenic DO with thick & irregular abscess walls with Aspergillus infection[4]

Fungal Discitis/Osteomyelitis (Candida sp.)

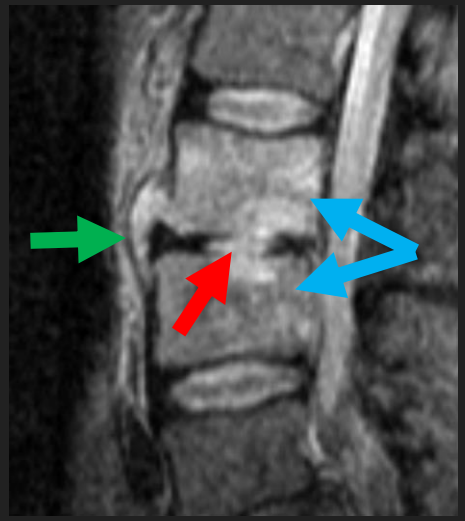


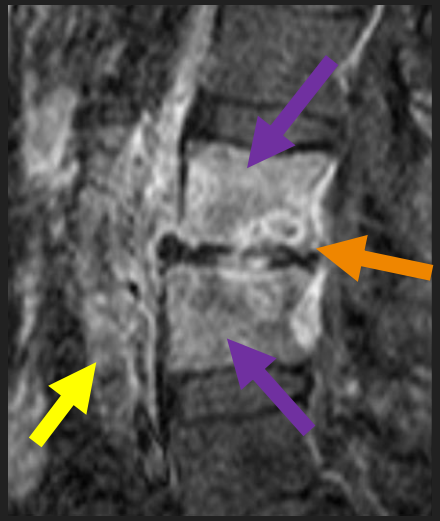
Sagittal CT in bone window shows destructive endplate changes. Sagittal STIR image also reveals fluid in the affected disc and bone marrow edema with associated enhancement on the T1+Gd image consistent with DO. Note the tracking of fluid and enhancement across multiple vertebral bodies deep to the anterior longitudinal ligament indicating spread of the infection beyond the affected vertebral bodies levels.

Brucellar Discitis/Osteomyelitis

- Clinical features:
  - Affects patients handling contaminated animal products or consuming unpasteurized milk
- General features:
  - Most commonly affects lower lumbar spine
  - Intact vertebral architecture despite diffuse involvement of vertebra
  - May involve facet joint(s)
- Imaging features:
  - Similar to tuberculous DO but with smaller abscesses & rare gibbus deformity

Brucellar Discitis/Osteomyelitis





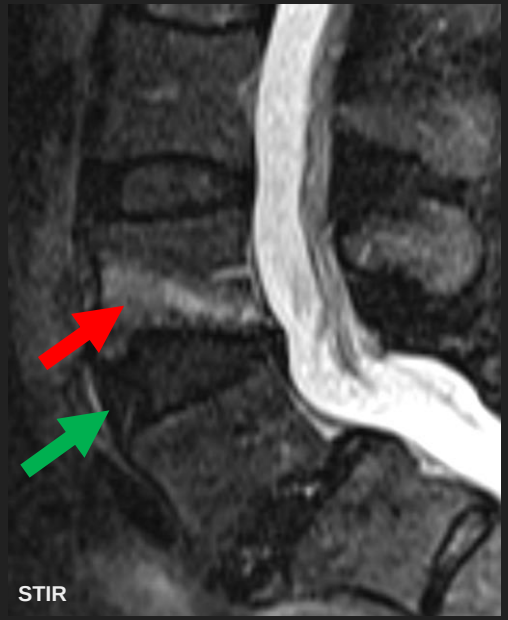
Sagittal STIR image reveals intervertebral fluid & marrow edema in adjacent vertebral bodies with fluid tracking deep to anterior longitudinal ligament. Note the associated disc space narrowing and enhancement of the prevertebral soft tissues, intervertebral disc, and adjacent vertebral bodies on the sagittal T1+Gd image consistent with DO and adjacent abscesses on axial T1+Gd. Notice the vertebral body architecture remains intact.

Mimics of Discitis/Osteomyelitis: Clinical Features and Imaging Findings

Modic Type I Endplate Changes

- Clinical features:
  - Non-specific back pain or afebrile radicular pain
- General features:
  - Marrow edema and enhancement
  - Difficult to distinguish from infectious spondylitis with imaging alone
- Distinguishing imaging features:
  - Vacuum disc phenomenon with lack of T2 hyperintense signal
  - Lack of abnormal signal and enhancement in adjacent soft tissues

Modic Type I Endplate Changes



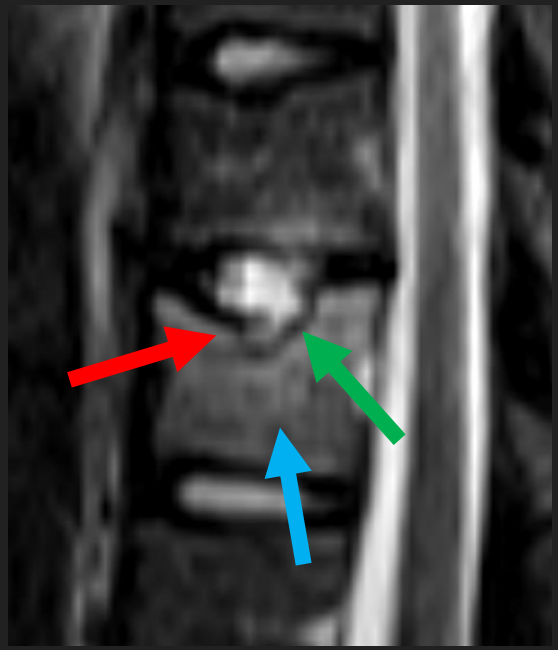
Sagittal STIR image shows marrow edema isolated to the inferior L4 vertebral body with enhancement in same location on the sagittal T1+Gd image.

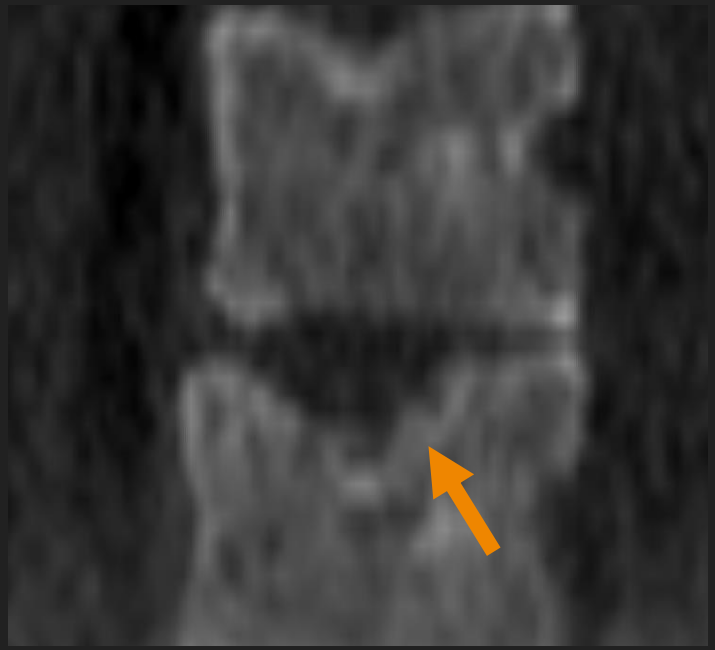
The lack of disc space narrowing & T2 hyperintensity within the disc should trigger other differential diagnostic considerations such as acute Modic type I endplate changes as in this patient.

Acute Schmorl’s Node

- Clinical features:
  - Acute onset of localized back pain
- General features:
  - Causes inflammation and vascularization within the vertebral body
- Distinguishing imaging features:
  - Focal depression of one endplate only in contrast to two endplates in DO
  - Enhancement of affected vertebral body only
  - Vertebral body edema with preserved cortex around the herniated disc in contrast to eroded endplate(s) in DO

Acute Schmorl’s Node



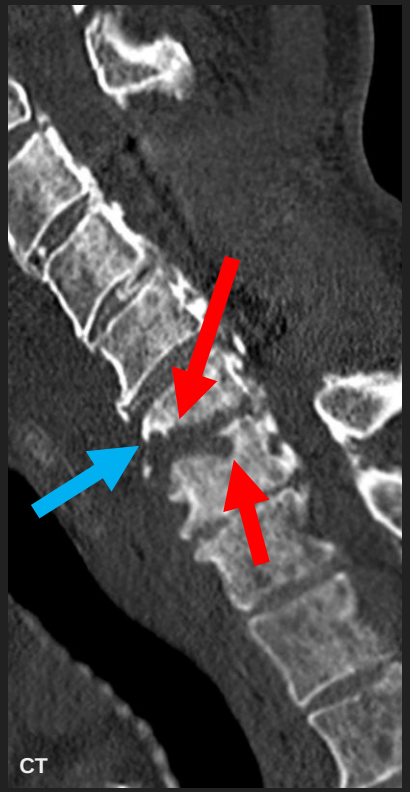


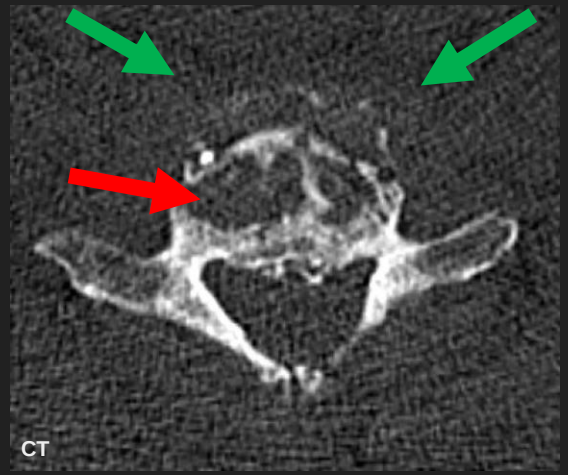
Sagittal STIR image shows focal depression of the superior endplate with marked adjacent edema which might be mistaken for DO. However, close observation reveals a dark band consistent with preserved cortex which is confirmed on the sagittal CT in bone window. The imaging findings are typical for an acute Schmorl’s node.

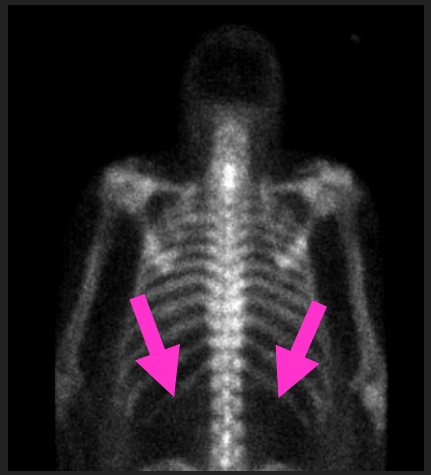
Dialysis Related Spondyloarthropathy

- Clinical features:
  - Non-specific neck or back pain in renal dialysis patients
- General features:
  - Destructive spondyloarthropathy with disc space narrowing and subchondral erosions & resorption with or without cystic changes[6]
- Distinguishing imaging features:
  - Absent uptake in the kidneys & affected vertebral levels on Gallium & MDP bone scan
  - Low T1 & T2 bone marrow signal at affected vertebral levels
  - Lack of paravertebral or epidural phlegmon/abscess

Dialysis Related Spondyloarthropathy





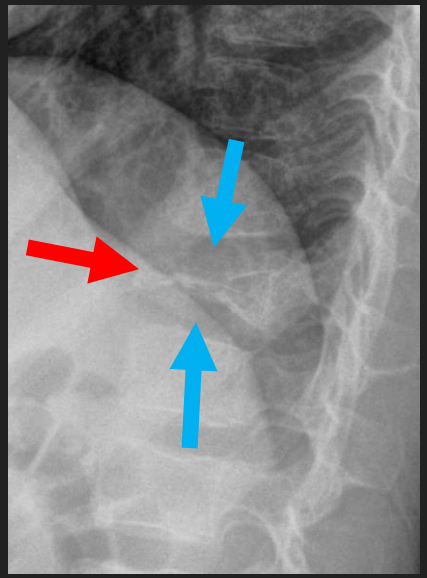


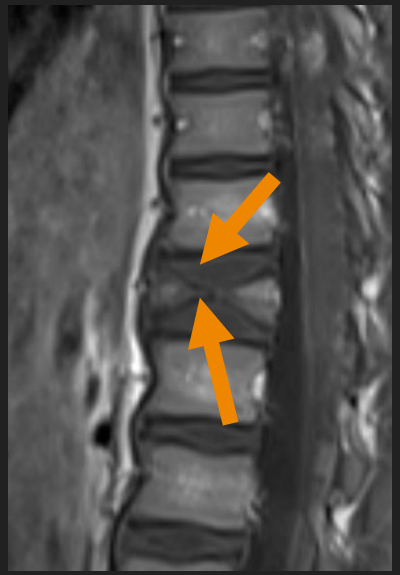
Sagittal & axial CT in bone window show endplate erosions with vertebral height loss & prevertebral fullness. Such findings could indicate DO. However, history of hemodialysis with lack of clinical & laboratory signs of infection should lead to the correct diagnosis of dialysis related spondyloarthropathy, which is confirmed by lack of uptake in the cervical spine on Gallium and lack of uptake in the kidneys on bone scan.

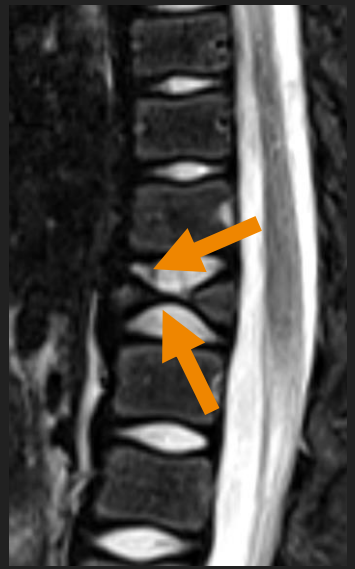
Eosinophilic Granuloma (EG)

- Clinical features:
  - Predominantly affects children
  - Localized or diffuse back pain with progressive kyphotic deformity
- General features:
  - Proliferation of Langerhans cells in the vertebra leads to increased prostaglandin release and medullary bone resorption
- Distinguishing imaging features:
  - Vertebra plana with intact endplate cortex & preserved intervertebral disc
  - May see paraspinal mass or extradural defect due to edema & hemorrhage related to vertebral collapse or extension of EG
  - MDP bone scan findings variable depend on chronicity of vertebral collapse

Eosinophilic Granuloma (EG)





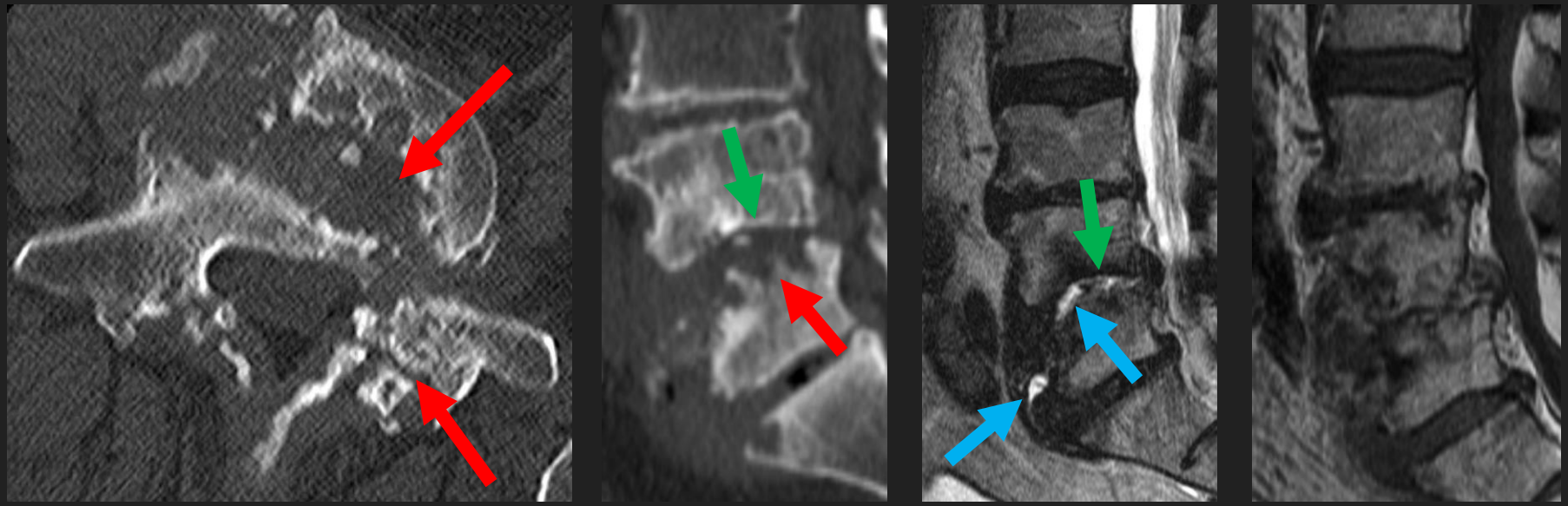


Lateral spine x-ray shows vertebra plana at the thoracolumbar junction. Preservation of the adjacent disc spaces & lack of soft tissue swelling contradicts the diagnosis of DO. In addition, MRI reveals intact vertebral body cortex, lack of enhancement on the sagittal T1+Gd and bone marrow edema on T2 images. The negative MDP bone scan negates active disease. The imaging findings are therefore consistent with EG.

Neuropathic Spine

- Clinical features:
  - Related to diminished nociceptive protection most often in diabetes mellitus or in association with other neuropathic disorders
- General features:
  - Repeated trauma leads to destructive changes
- Distinguishing imaging features:
  - Severe degenerative changes with discogenic sclerosis, vacuum phenomenon, large osteophytes & disc space narrowing
  - Low T2 signal & lack of enhancement in disc & surrounding tissues
  - Facet joints may be affected

Neuropathic Spine

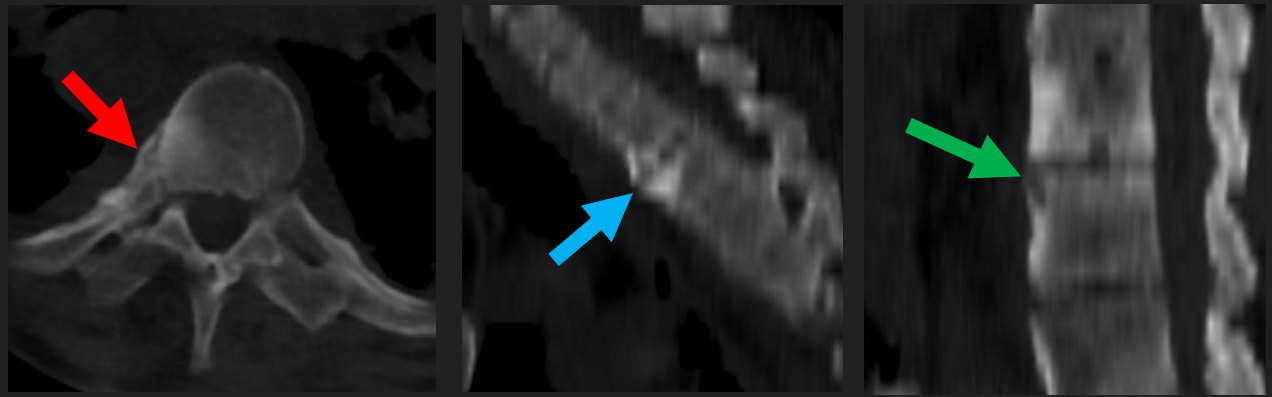


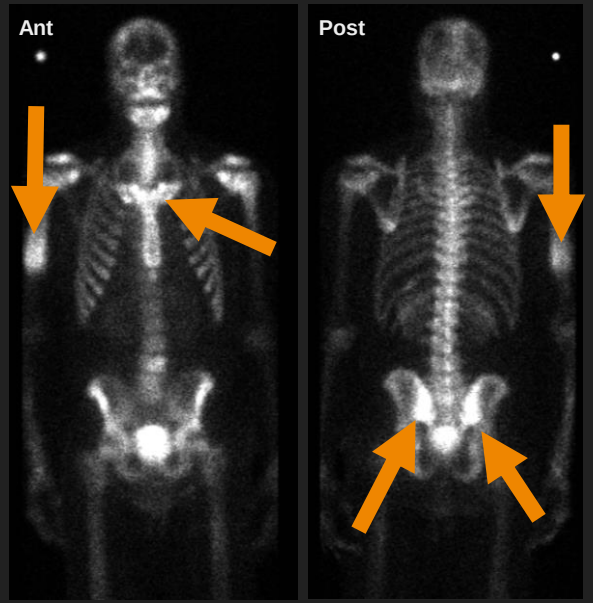
Axial & sagittal CT images in bone window reveal destruction of the superior L5 endplate and facet joints with fluid in the disc space & prevertebral subligamentous space on the sagittal T2 image mimicking DO. Preservation of the cortex of L4 inferior endplate & lack of enhancement on sagittal T1+Gd image is however inconsistent with such a diagnosis. These changes are classic for neuropathic spine.

SAPHO Syndrome

- Clinical features:
  - Symptoms of synovitis, acne, pustulosis, hyperostosis, & osteitis[5]
- General features:
  - Anterior chest wall & spine most commonly affected
- Distinguishing imaging features:
  - Marrow edema & enhancement without intervertebral disc involvement
  - Anterior endplate corner erosions, which may enhance
  - May cause prevertebral soft tissue thickening & enhancement with multilevel involvement without associated paravertebral or epidural abscess

SAPHO Syndrome





Axial CT & sagittal CT reformations in bone window show

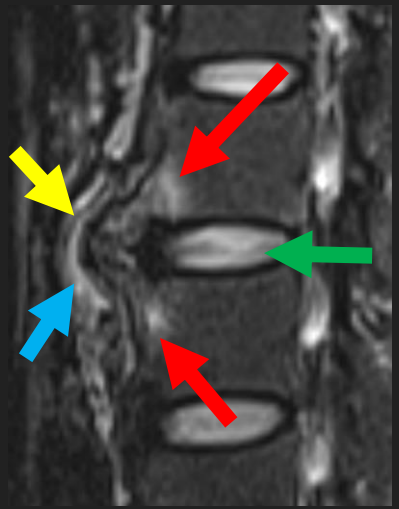
- Ankylosis & reactive bone formation of the costovertebral joint
- Reactive bone formation in cervical anterior vertebral body
- Erosion of an anterior thoracic vertebral body corner.

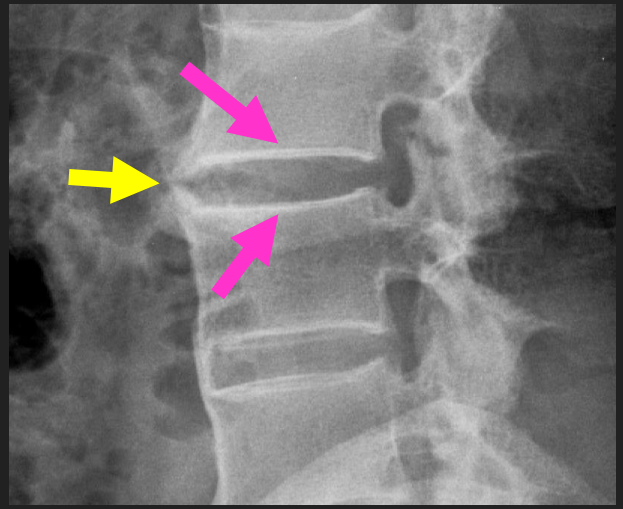
These findings might be mistaken for chronic DO. The multiplicity & localized involvement of anterior disc space should trigger other diagnostic considerations such as SAPHO syndrome that often also affects other body parts such as sacroiliac joints, right humerus, sternum, ankles & femurs (not shown) as in this patient.

Seronegative Spondyloarthropathy

- Clinical features:
  - Non-specific back and sacral pain
- General features:
  - Bridging syndesmophytes fuse spinal segments often complicated by fracture typically extending through all three columns
- Distinguishing imaging features:
  - Ascending spinal ankylosis beginning with the sacroiliac joints
  - Possible pseudarthrosis of stress factures extending to posterior column and causing endplate erosions & subchondral sclerosis
  - Focal marrow edema & enhancement in acute fractures

Seronegative Spondyloarthropathy





Sagittal STIR image shows marrow edema along the anterior endplates of adjacent vertebral bodies & small amount of prevertebral fluid. This might be mistaken for DO. The localized edema, lack of disc space narrowing, fusion of the SI joints on axial T1 image & the disrupted appearing syndesmophyte with intact endplate cortex should lead to the correct diagnosis of fractured syndesmophyte in a patient with seronegative spondyloarthropathy that was confirmed on the lateral radiograph.

Conclusion

- Identification of key imaging findings of DO requires attention in resident education
- This exhibits focuses on improving diagnostic competence in diagnosing DO through
  - Review of clinical presentations and of the broad spectrum of imaging findings of DO on various imaging modalities
  - Discussing mimics of DO and their distinguishing clinical and imaging features

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