Lumbar Spine Imaging for Low Back Pain

고려대학교 안암병원 영상의학과
강창호

Degenerative disease of the spine

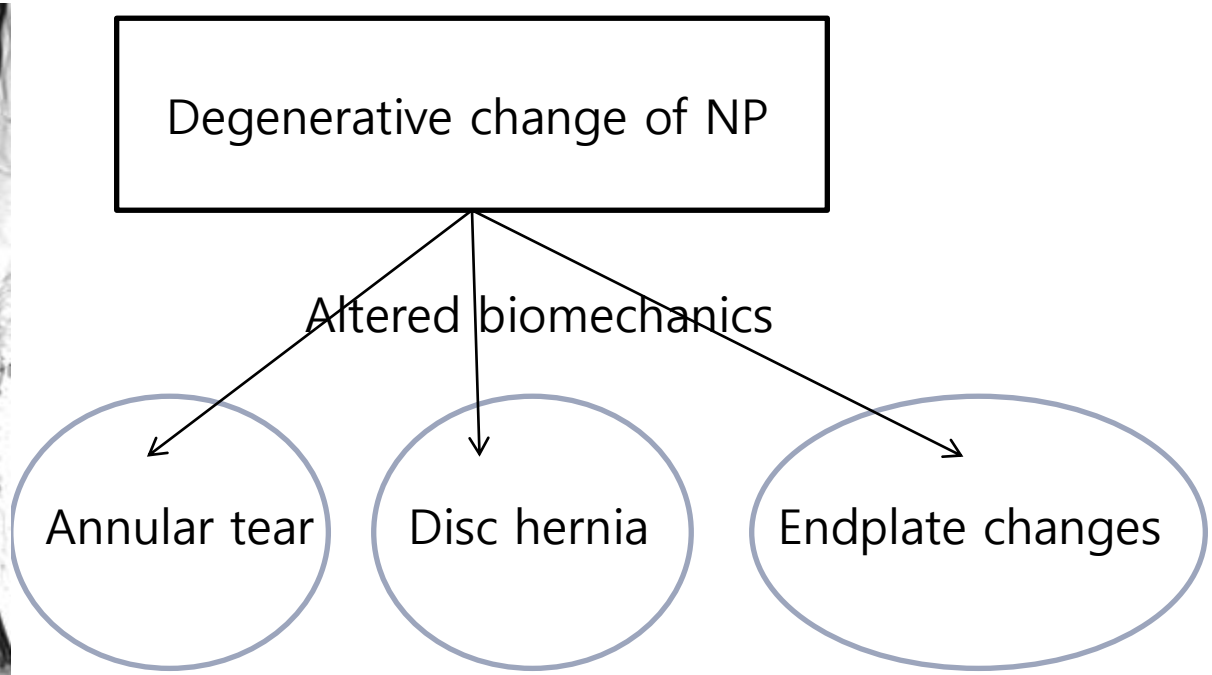
- Disc & endplate (discovertebral joint)
- Facet joints
- Fibrous joints and entheses
- Alignment abnormalities
- Spinal stenosis
- Indications and limitations of imaging

Discovertebral joint

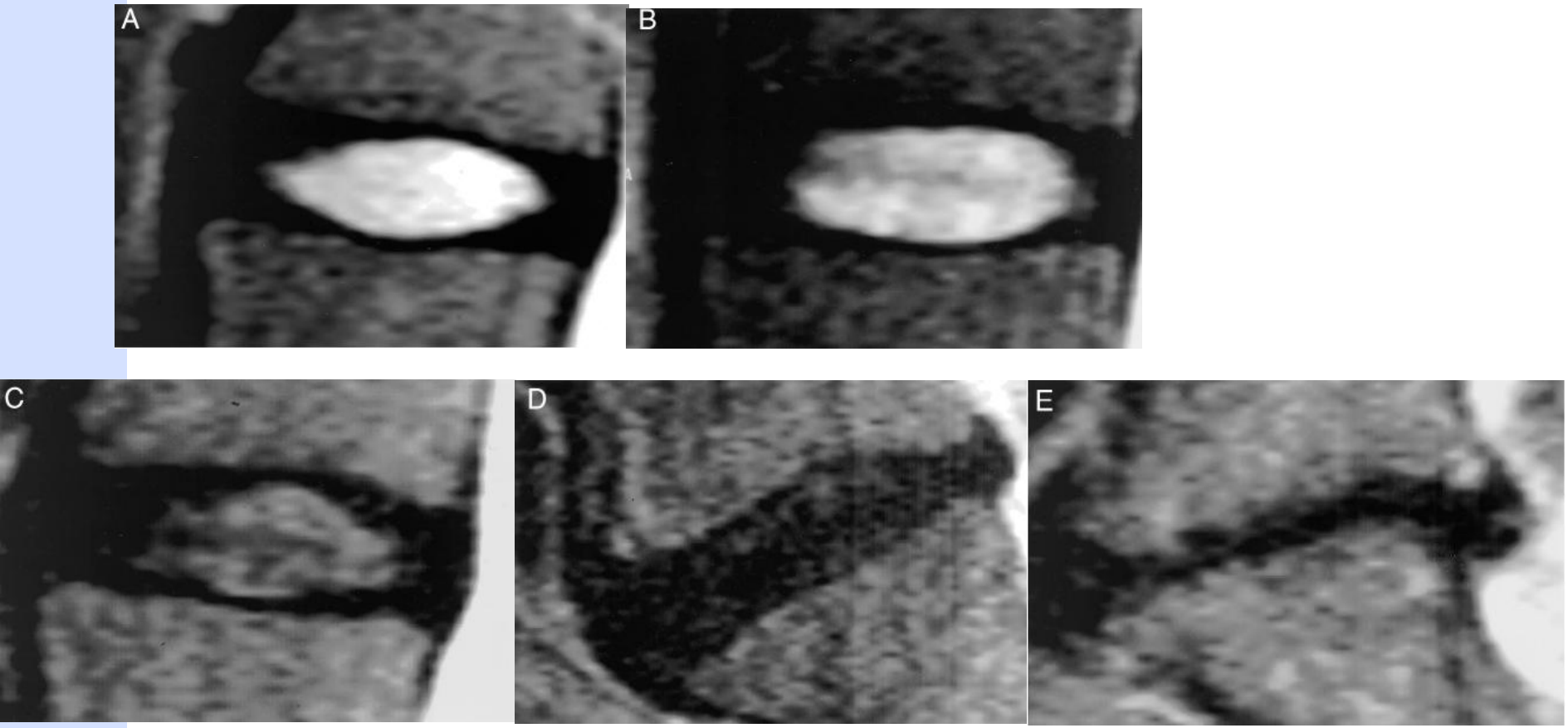
- Intervertebral osteochondrosis
- Spondylosis deformans
- Disc hernia
- Modic endplate abnormalities

Intervertebral osteochondrosis

- Degenerative process of the spine involving the vertebral body end-plates, the nucleus pulposus, and the anulus fibrosus, which is characterized by disc space narrowing, vacuum phenomenon, and vertebral body reactive changes. Syn: deteriorated disc, chronic discopathy, osteochondrosis.



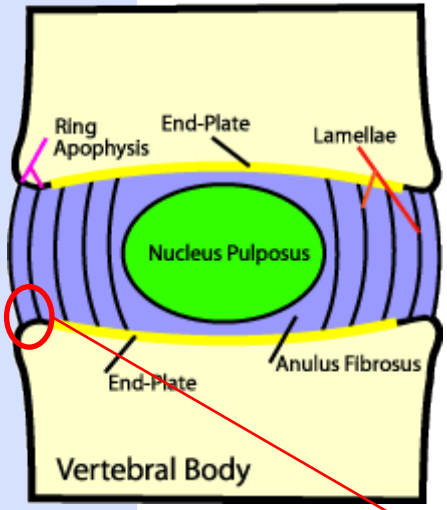
Classification of disc degeneration



Spine 2001;26:1873-8

Spondylosis deformans

- Degenerative process of the spine involving essentially the anulus fibrosus and characterized by anterior and lateral marginal osteophytes arising from the vertebral body apophyses, while the intervertebral disc height is normal or only slightly decreased.



Osteophytes

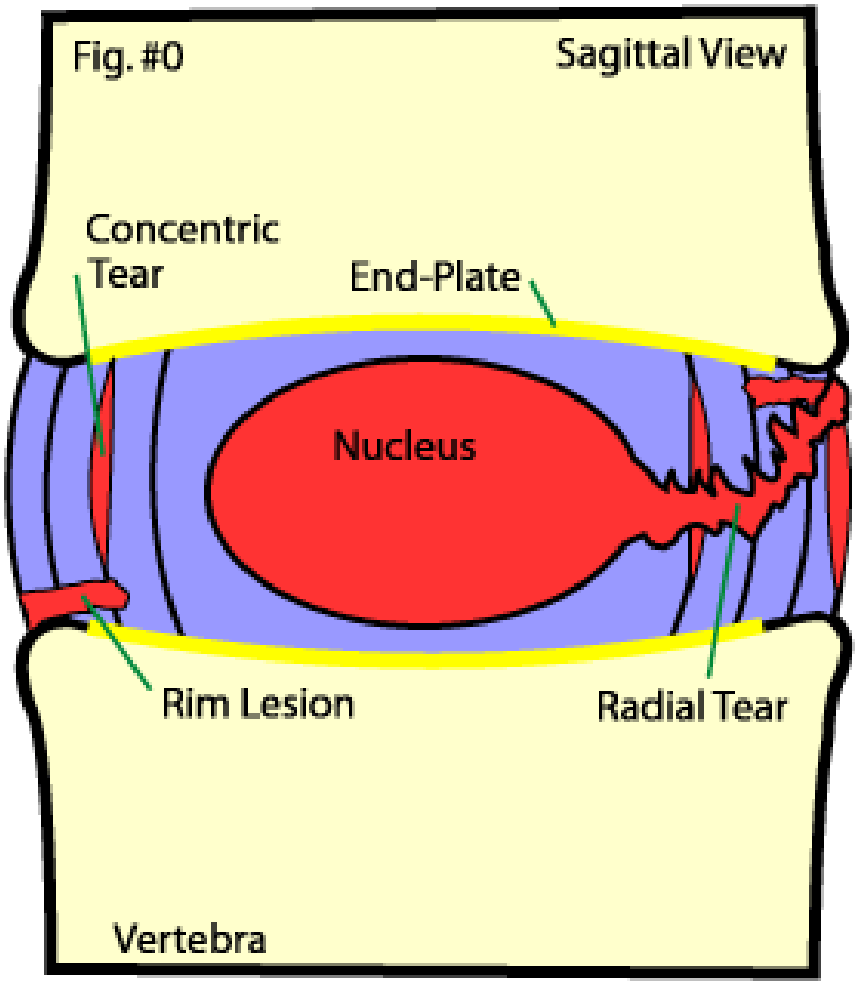
Chronic traction stress

Spondylosis

- Spondylosis deformans, for which spondylosis is a shortened form.
- (Non-Standard) Any degenerative changes of the spine that include osteophytic enlargement of apophyseal bone.
- Spondylosis deformans has specific characteristics that distinguish it from intervertebral osteochondrosis.
- The term "spondylosis" is often used in general as synonymous with "degeneration" which would include both processes, but such usage is confusing, so it is best that "degeneration" be the general term and "spondylosis deformans" a specifically defined sub-classification of degeneration.

Annular tear/fissure

- Concentric tear, vertical tear, delamination:
- secondary to laminar shear forces
- occur between the concentric fibers of the annulus fibrosis
- Transverse tear, peripheral rim tear:
- occur at the attachment of the outer fibers of the annulus fibrosis to the vertebral periosteum
- Radial tear, "full thickness":
- affecting the entire inner-to outer dimension of the annulus
- precursor to disc herniation and a potential cause for axial back pain



J Bone Joint Surg. [Br] 1992; 74-B:678-82

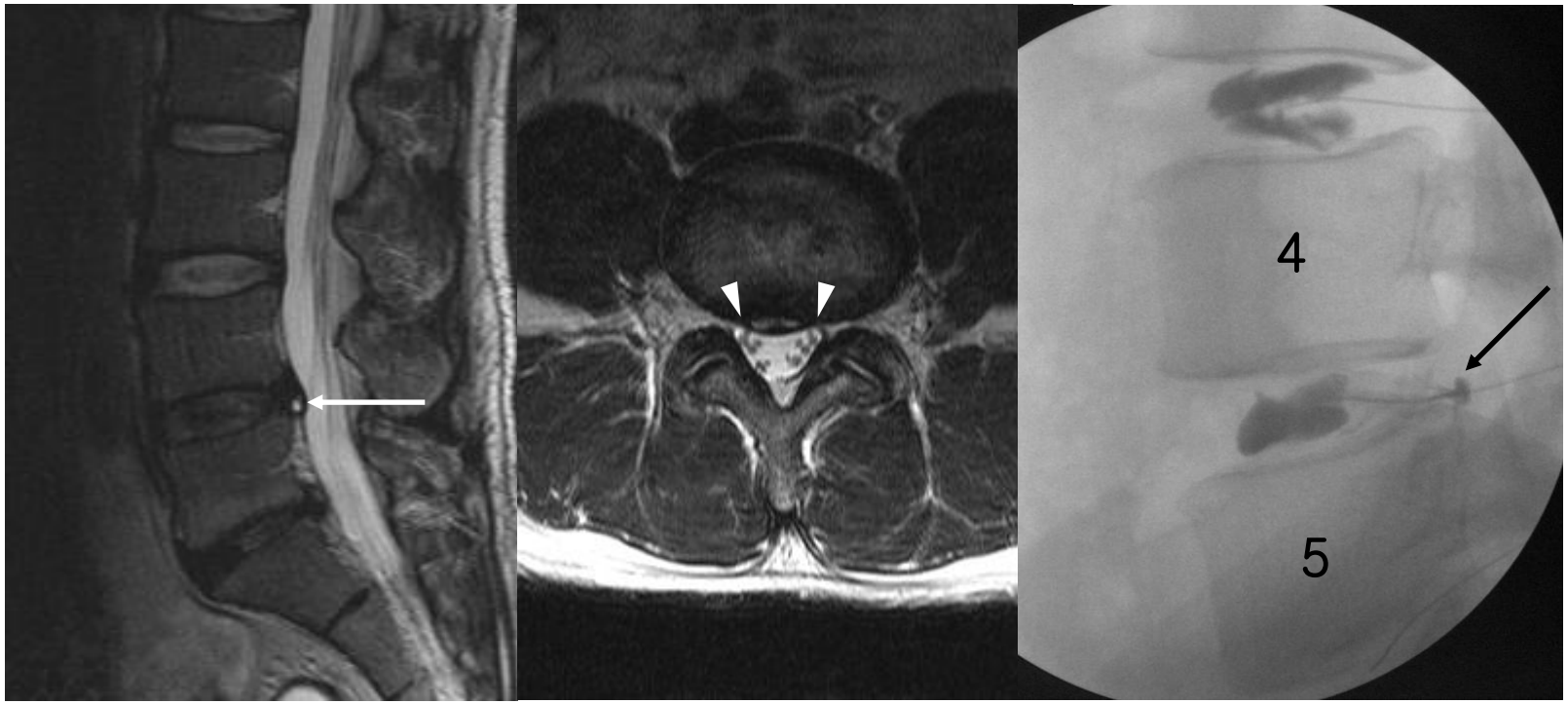
Radial tear

- May be potential cause for axial back pain

22-yo male, LBP, 4 years, Intradiscal steroid & ozone injection

High intensity zone

- Can HIZ represent an area of painful inflammation?



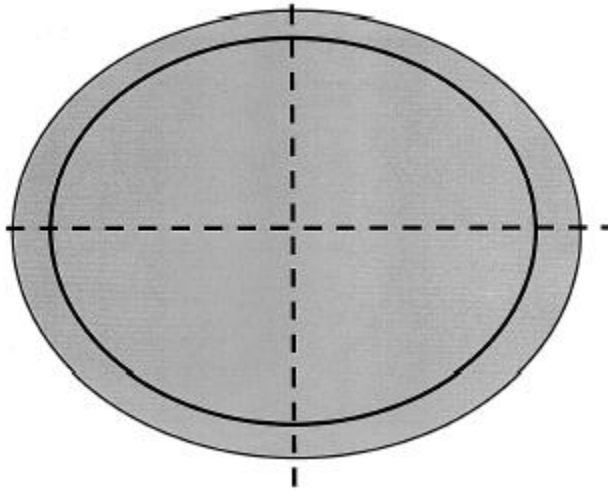
Skeletal Radiol. 2009 Sep;38(9):877-85

Annular tear/fissure

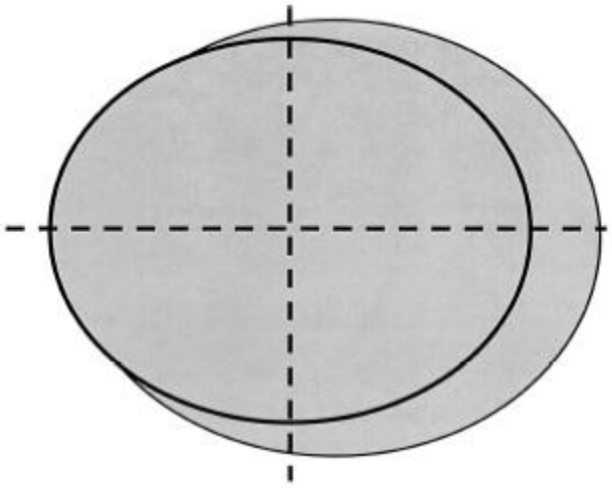
- Annular tears are of uncertain clinical significance.
- Tears are noted frequently in asymptomatic patients and in nearly all severely degenerated discs.

Bulging disc

- Generalized extension beyond the edge of the disc space
- Bulging is an observation of the contour of the outer disc and is not a specific diagnosis.



Symmetric bulging disc

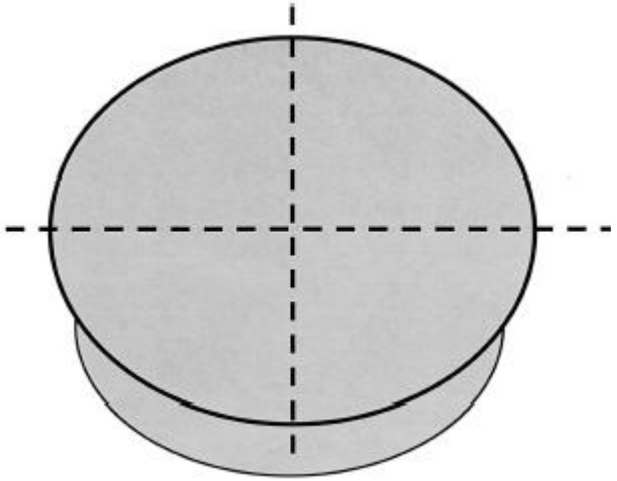


Asymmetric bulging disc

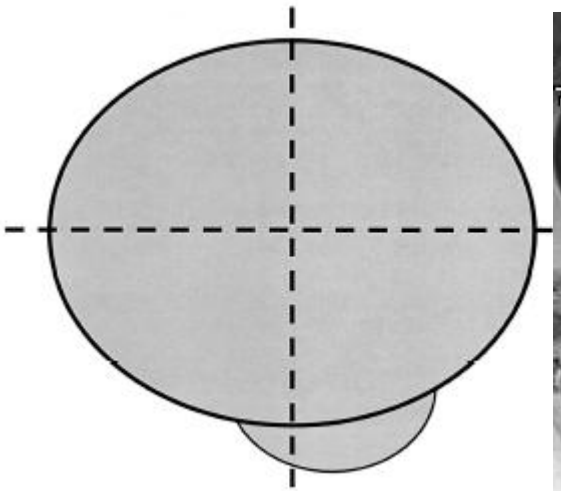
Disc hernia

- Combined Task Forces: NASS, ASSR, ASN, …
- “localized displacement of nucleus, cartilage, fragmented apophyseal bone, or fragmented annular tissue beyond the intervertebral disc space”

Herniation

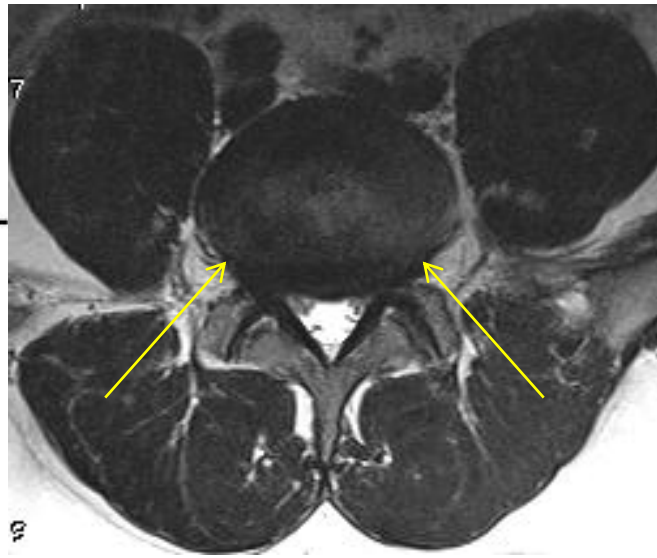


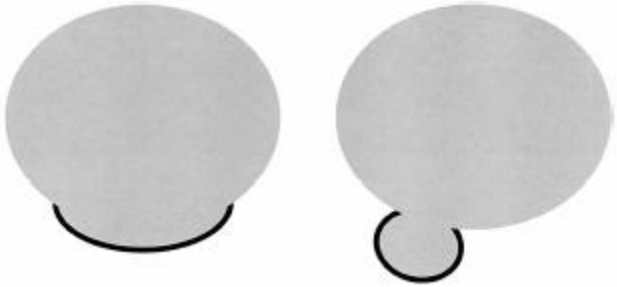
Broad-based herniation



Focal herniation

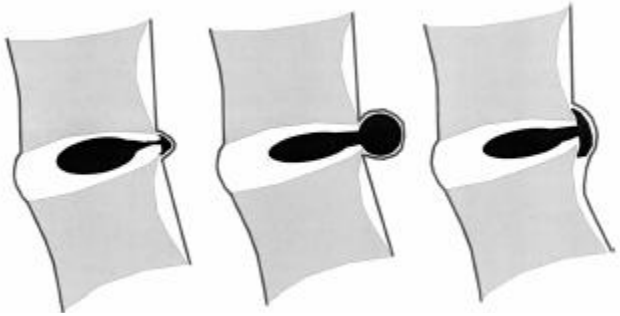
Dx: Broad-based hernia





Protrusion

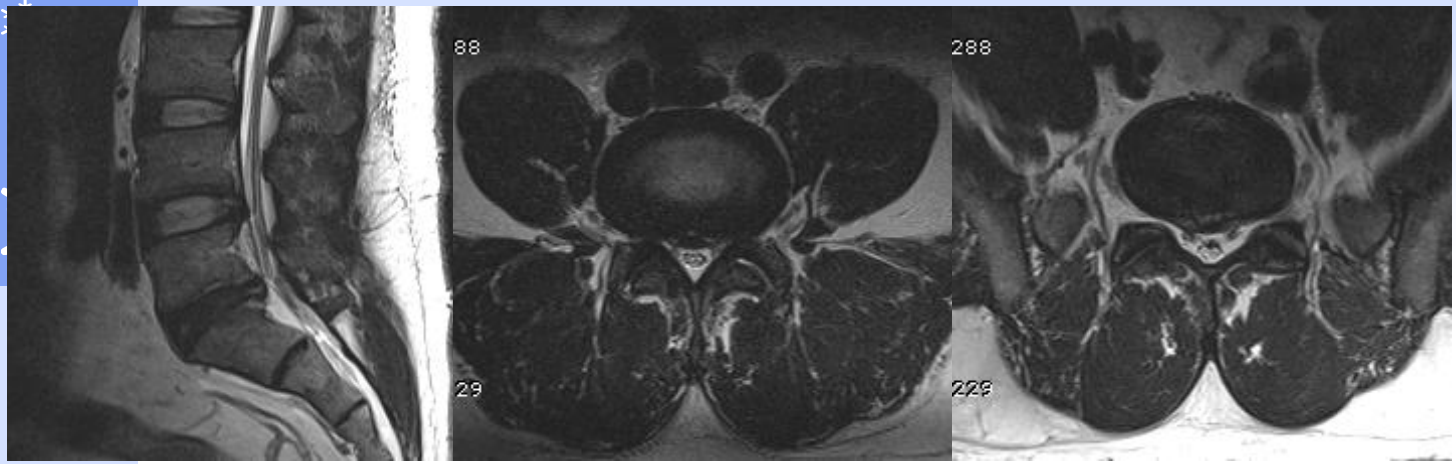
Extrusion



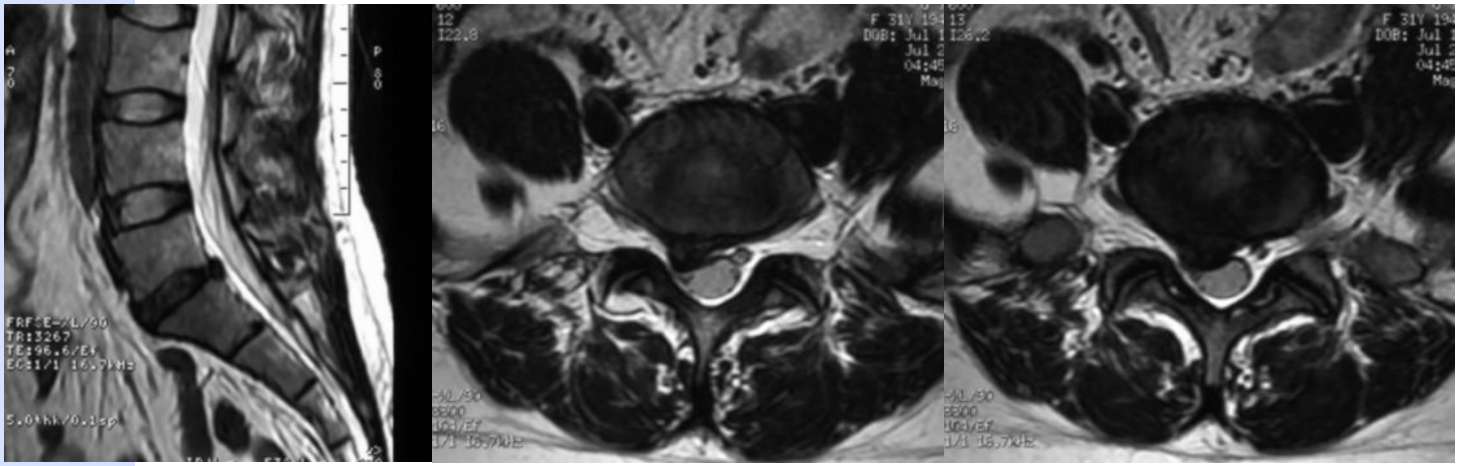
Protrusion

Extrusion

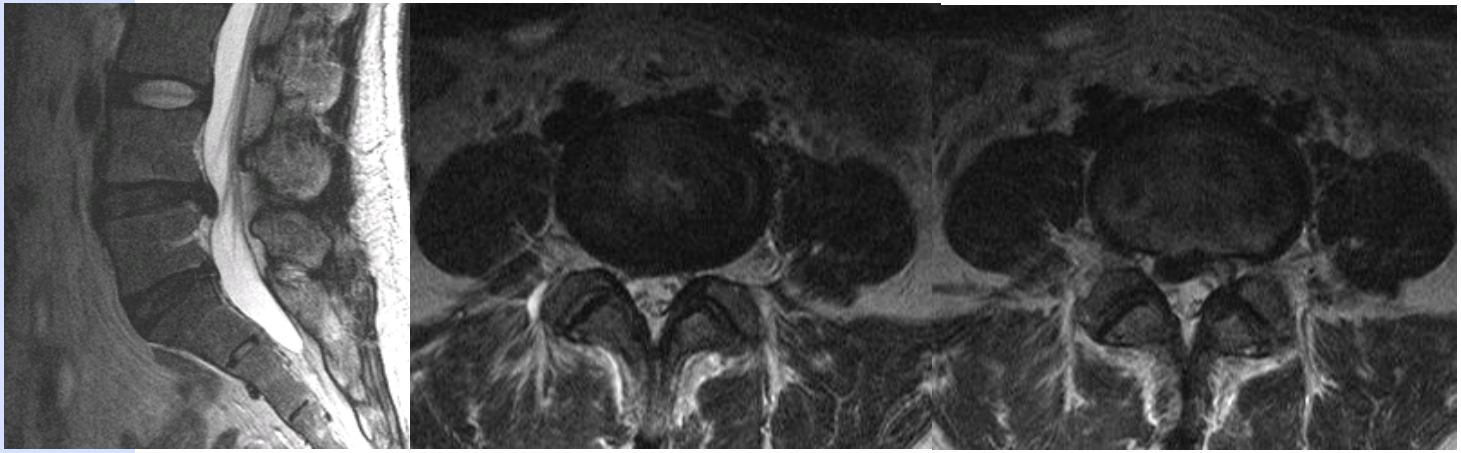
Sequestration



Dx: Protrusion

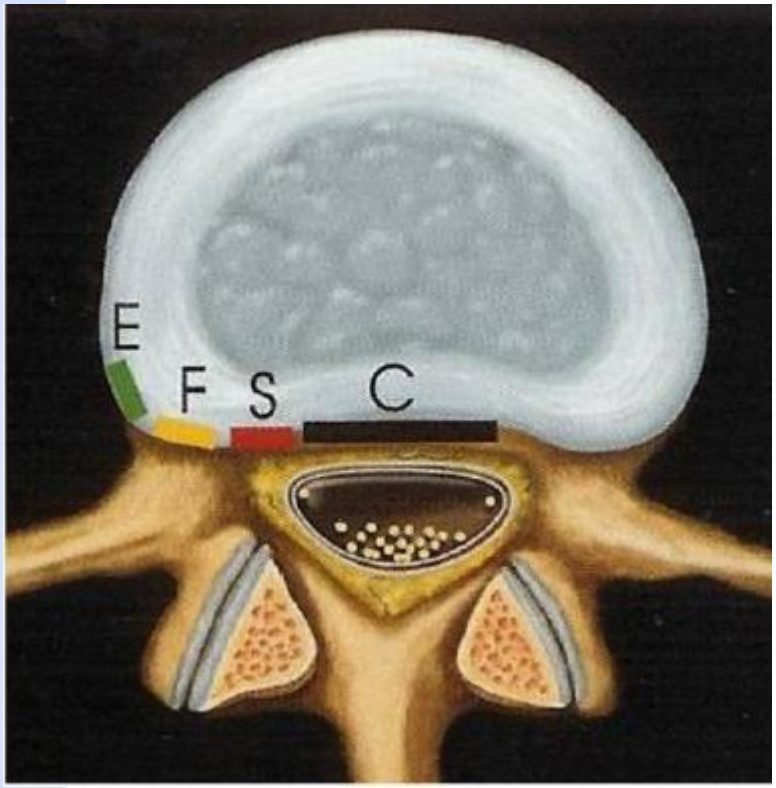


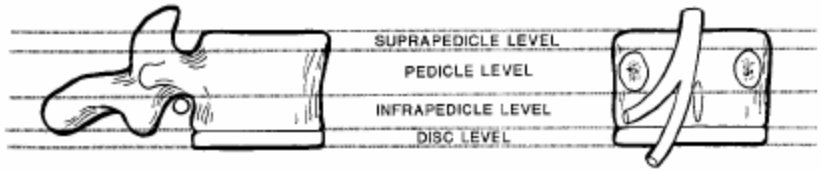
Dx: Extrusion

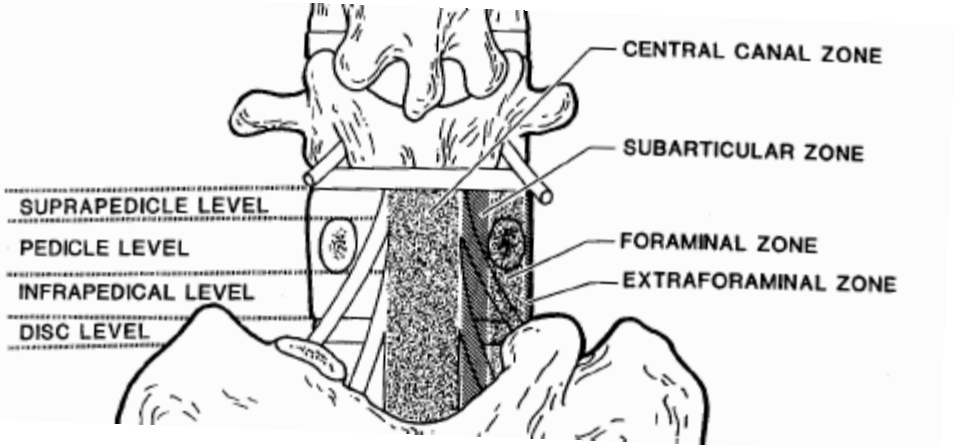


Dx: Extrusion

Location & level of disc herniation

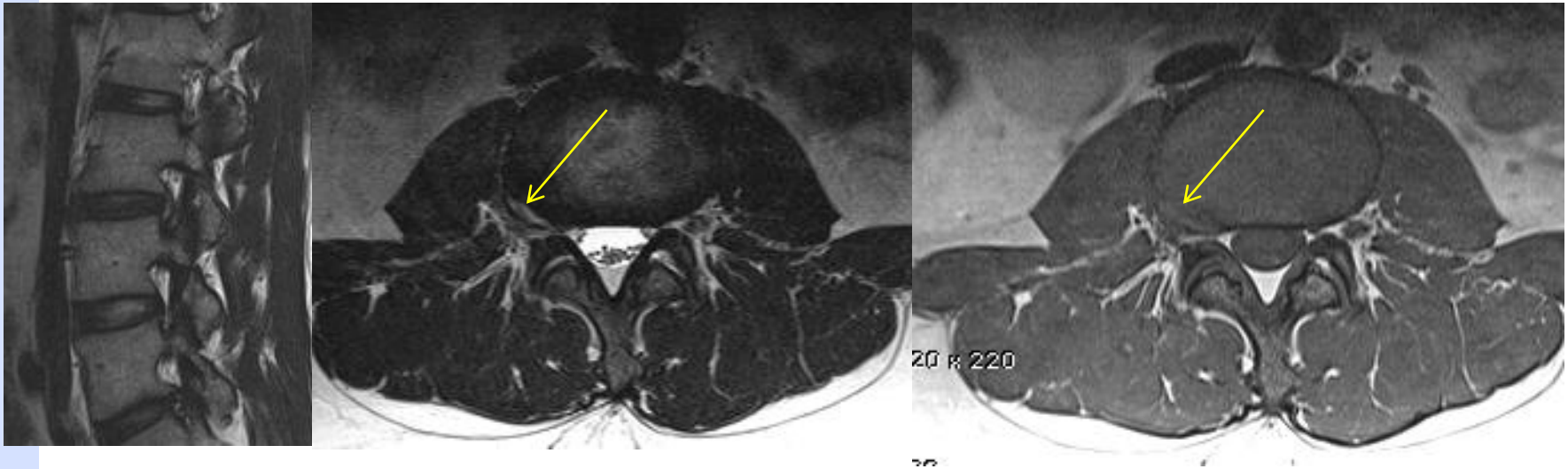






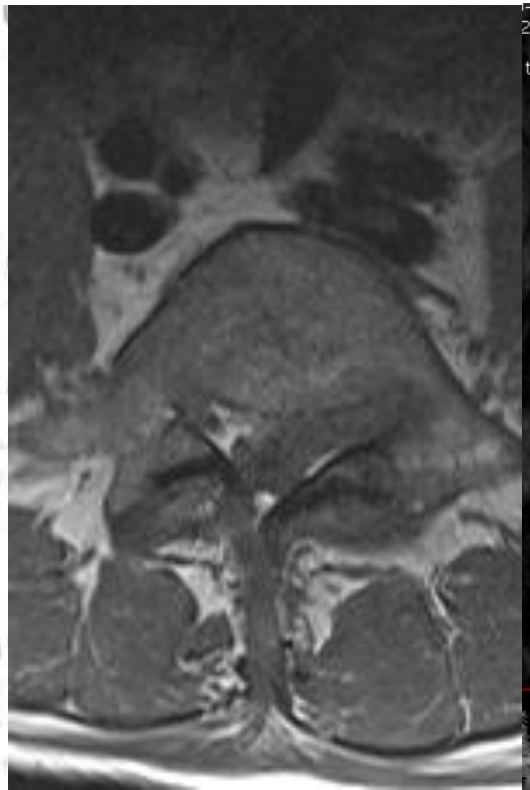
Foraminal & extraforaminal disc hernia

- The incidence of lateral disc hernia varies from 1 to 11.7 %
- Posterior hernias have predilection the lower lumbar levels but for lateral hernias are seen in the L3-4 level with more often higher frequency.

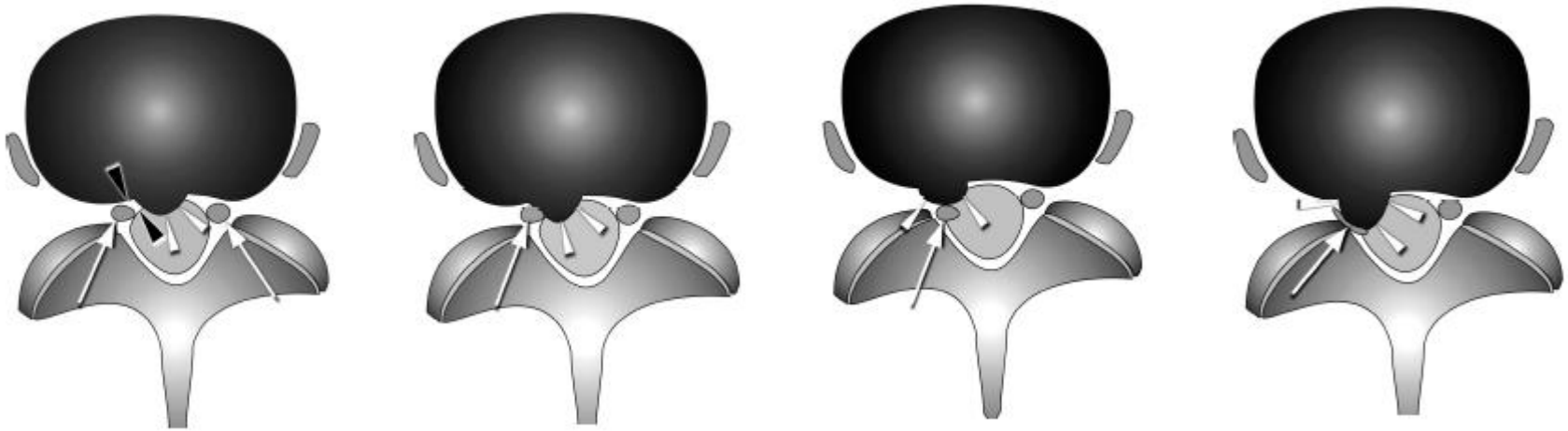


Containment

- Designation of a disc as contained, or uncontained, should define the integrity of the anulus enclosing the disc, though such distinction may not be possible with currently available imaging modalities.



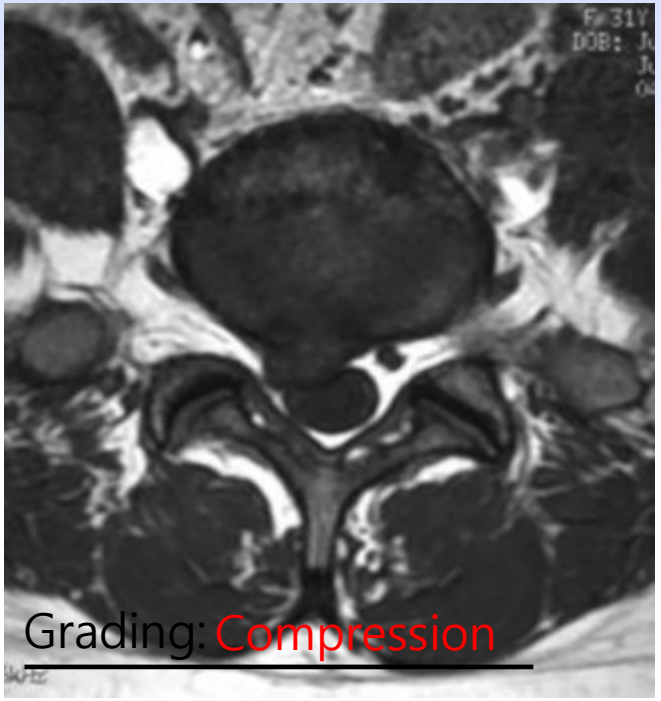
Grading of nerve root compromise



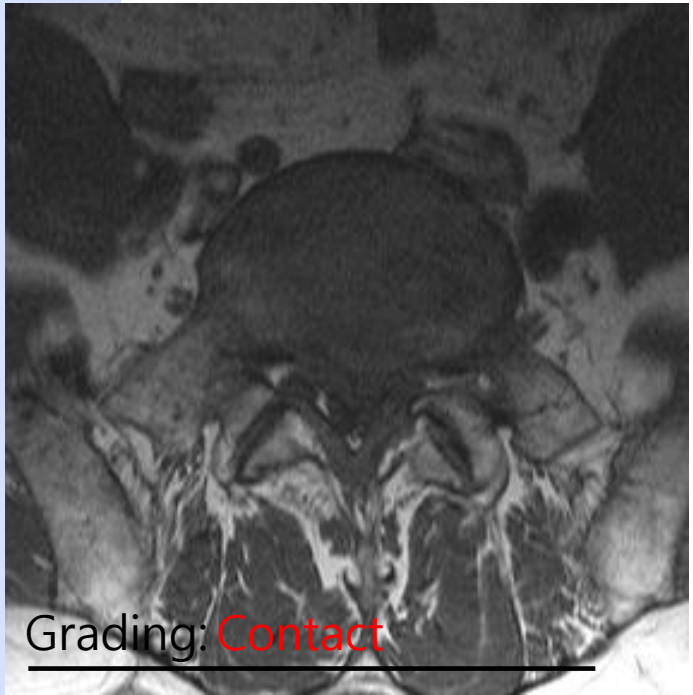
No compromise Contact Deviation Compression

Radiology. 2004 Feb;230(2):583-8

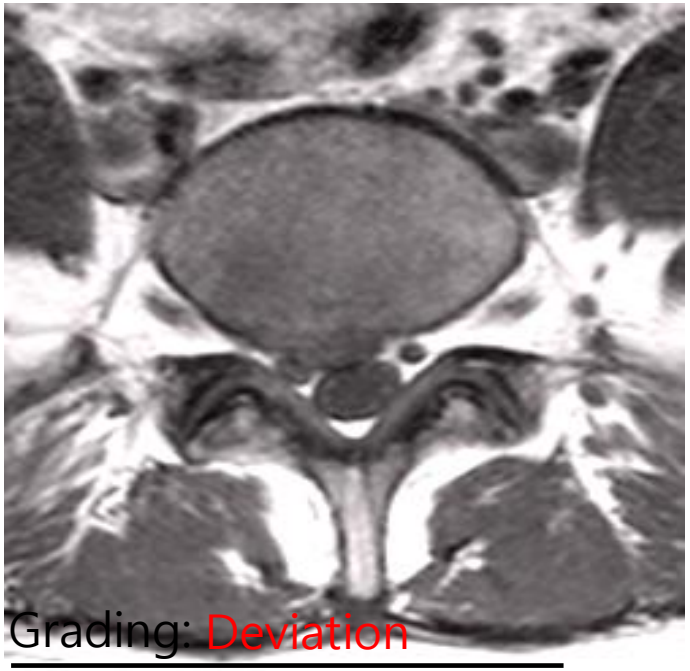
Grading: No compromise



Grading: Compression



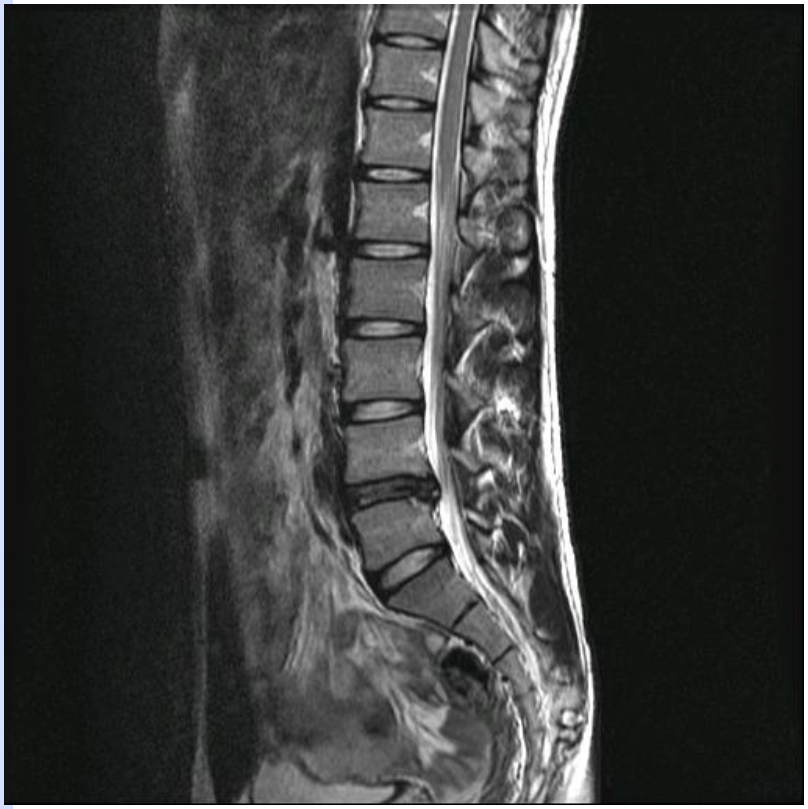
Grading: Contact



Grading: Deviation

Disc hernia in adolescents

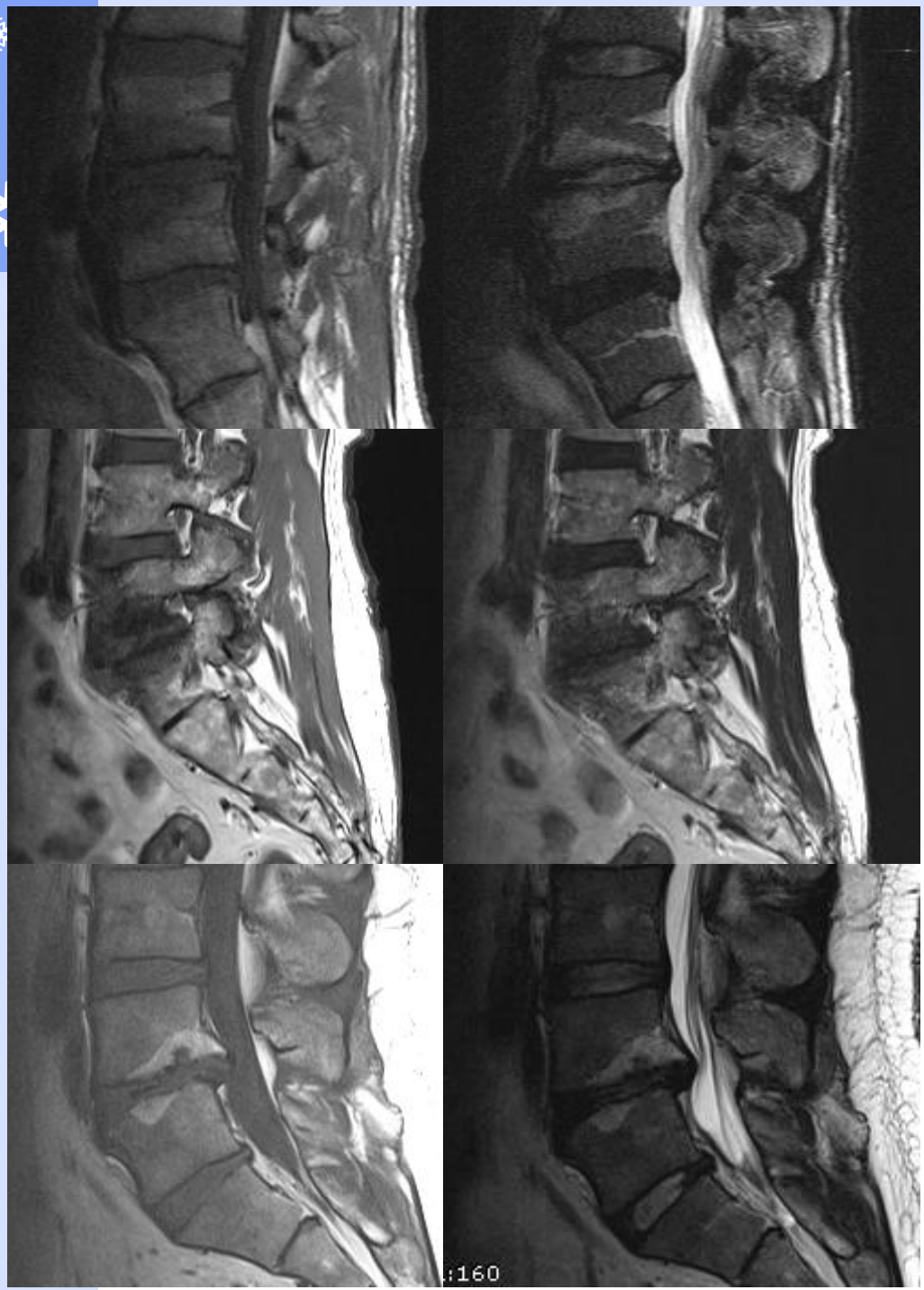
- Disc hernia + concomitant posterior limbus vertebrae
- Traumatically induced ?



M/24, low back pain, 2-3 years ago

Endplate abnormality

- Classification by **Modic** et al.
- Type 1: replacement with fibrovascular marrow, fissuring of the cartilaginous endplates
- Type 2: replacement by fatty marrow, sequela of chronic marrow ischemia
- Type 3: replacement by bony sclerosis with little residual marrow
- Relationship of type I endplate changes to low back pain (discogenic pain): controversial
- Most authors agree that, among Modic changes, type 1 changes are the ones most strongly associated with LBP.

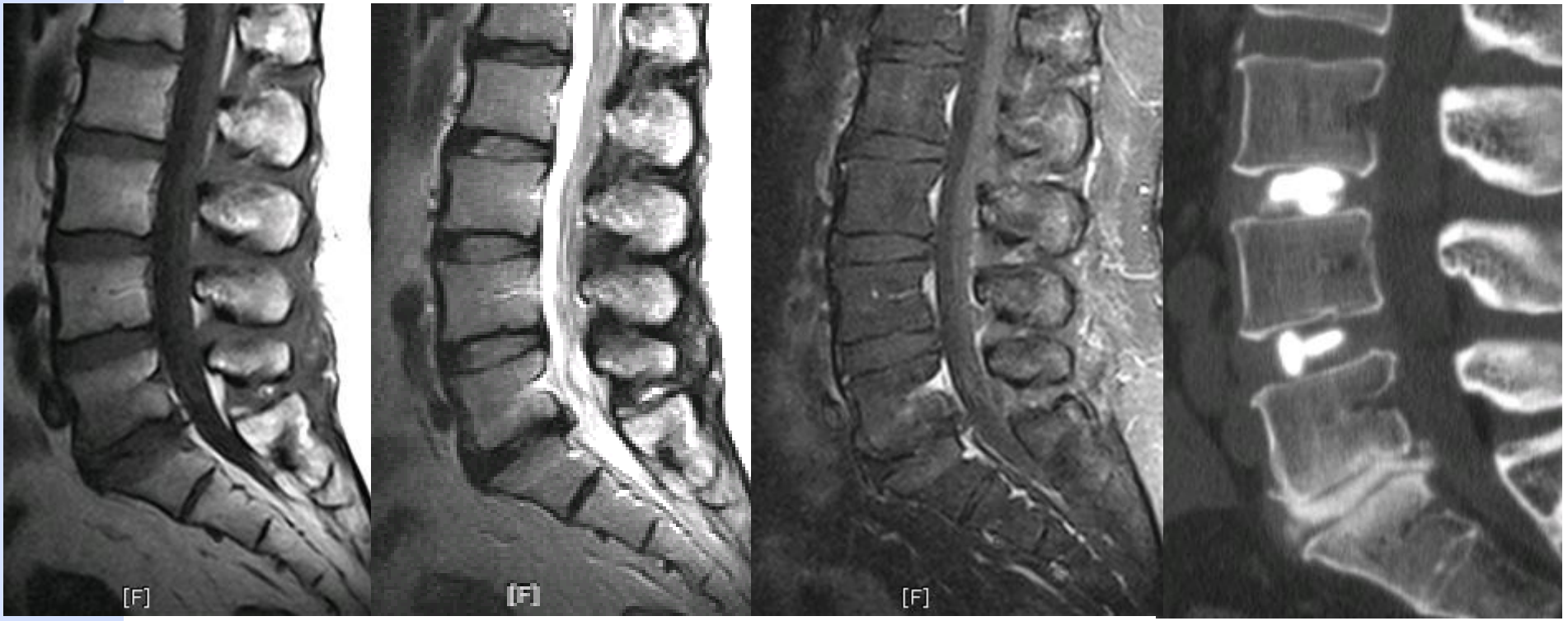


Modic: 1

Modic: 3

Modic: 2

Endplate abnormality



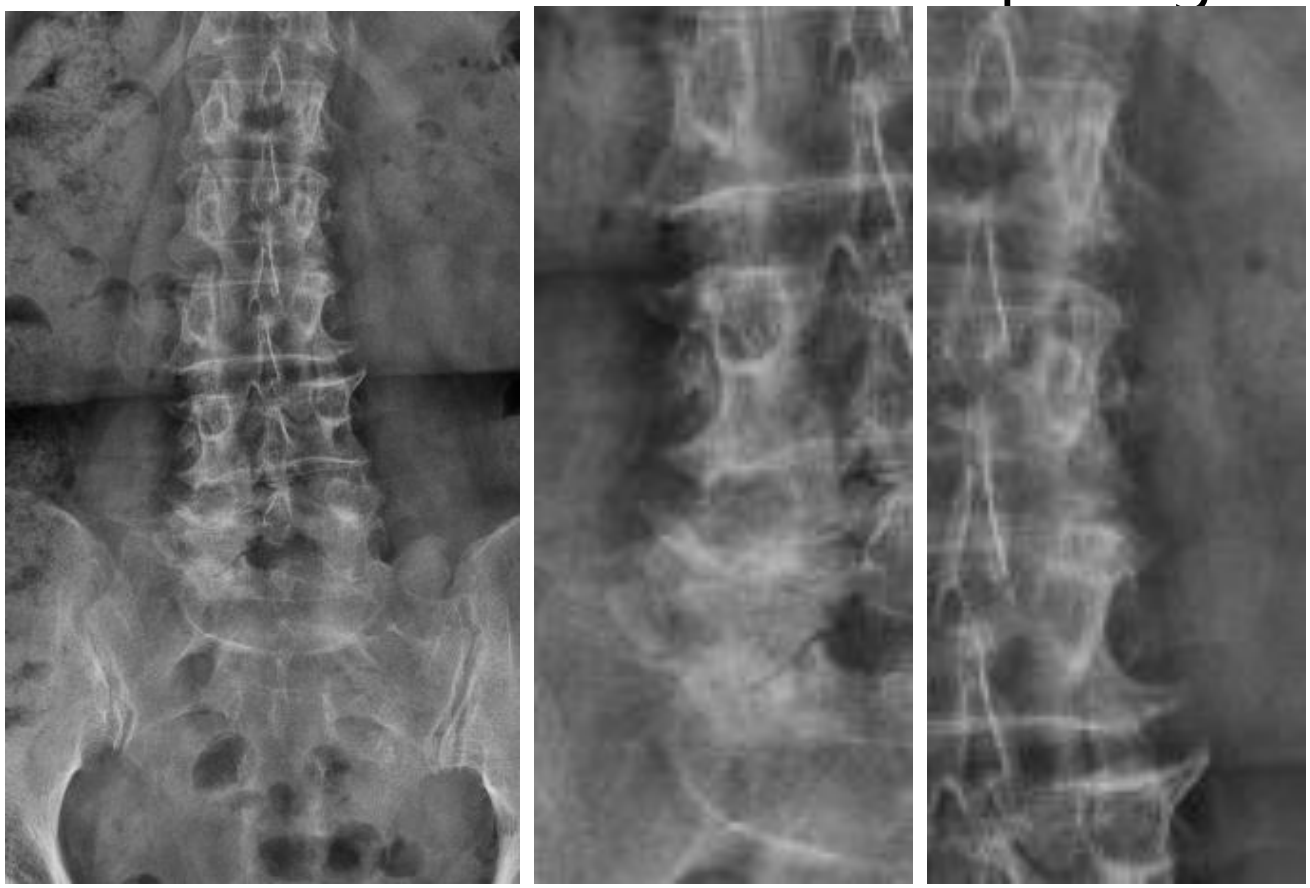
47-yo woman, Dx: low pressure sensitive disc on discography

Facet joints

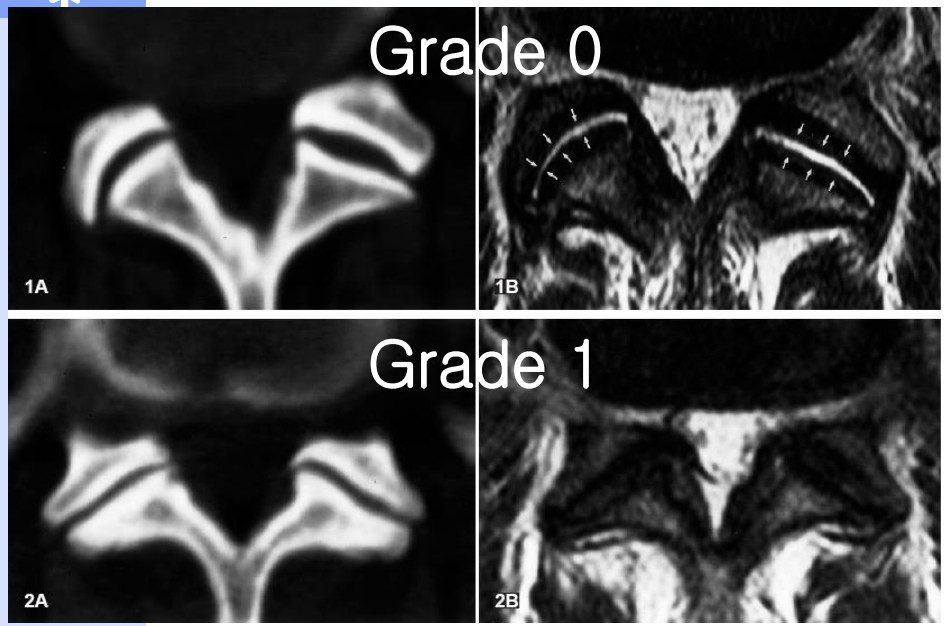
- Osteoarthritis
- Facet cyst
- Facet joint edema

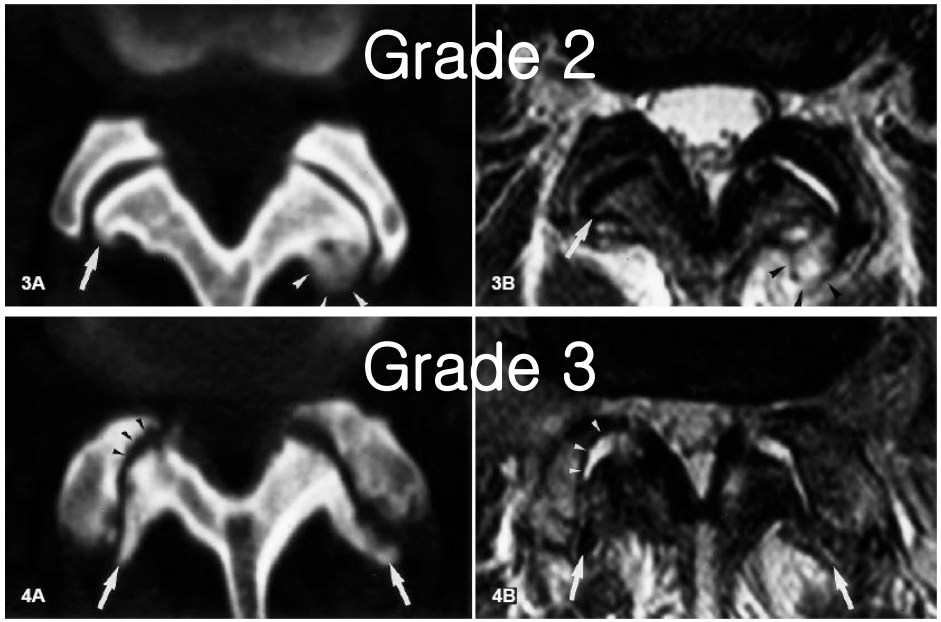
Facet joint osteoarthritis

- Leading to the spinal stenosis
- Common but controversial pain generator



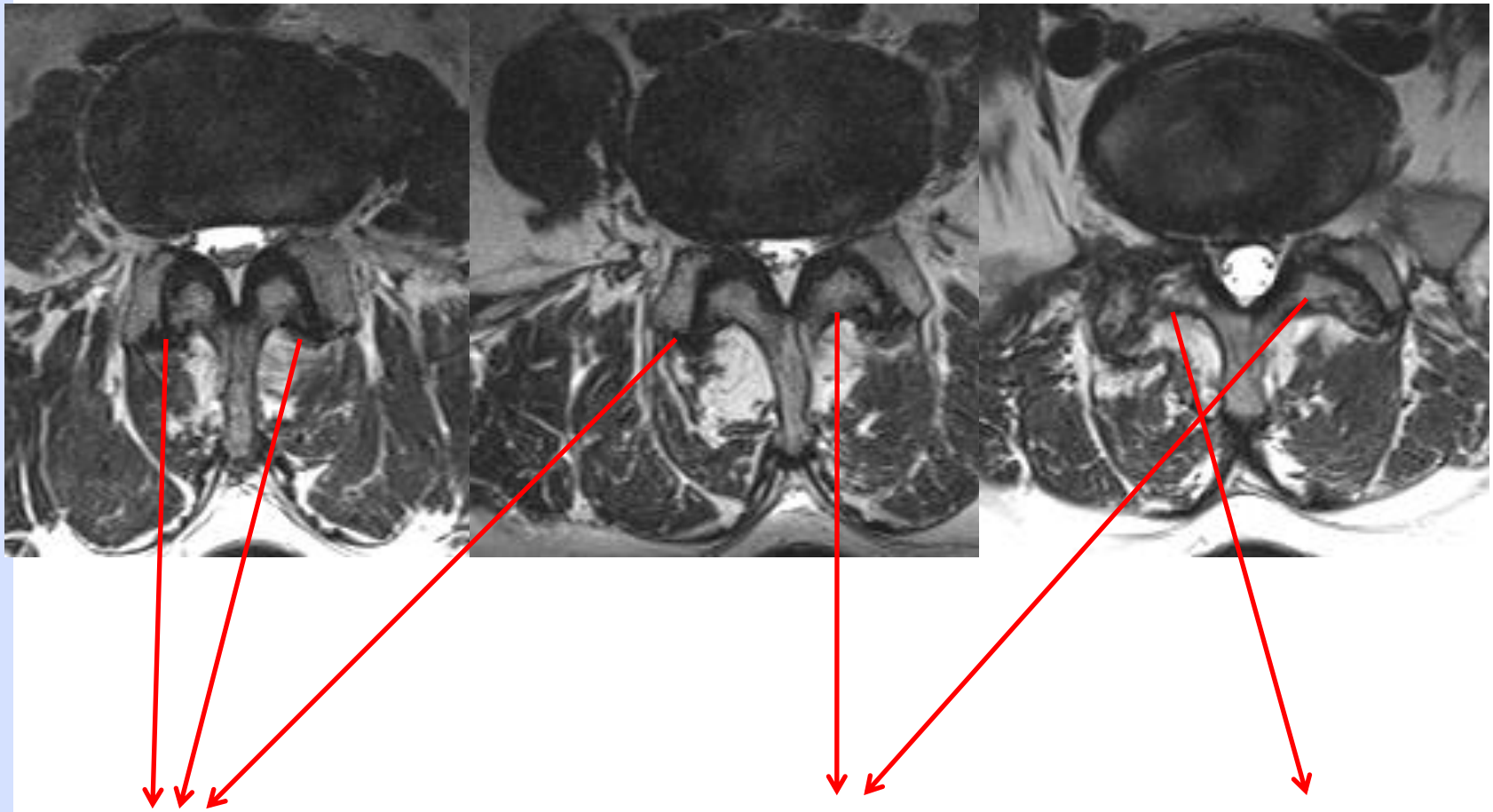
Facet joint osteoarthritis





Skeletal Radiol (1999) 28:215±219

Facet joint osteoarthritis



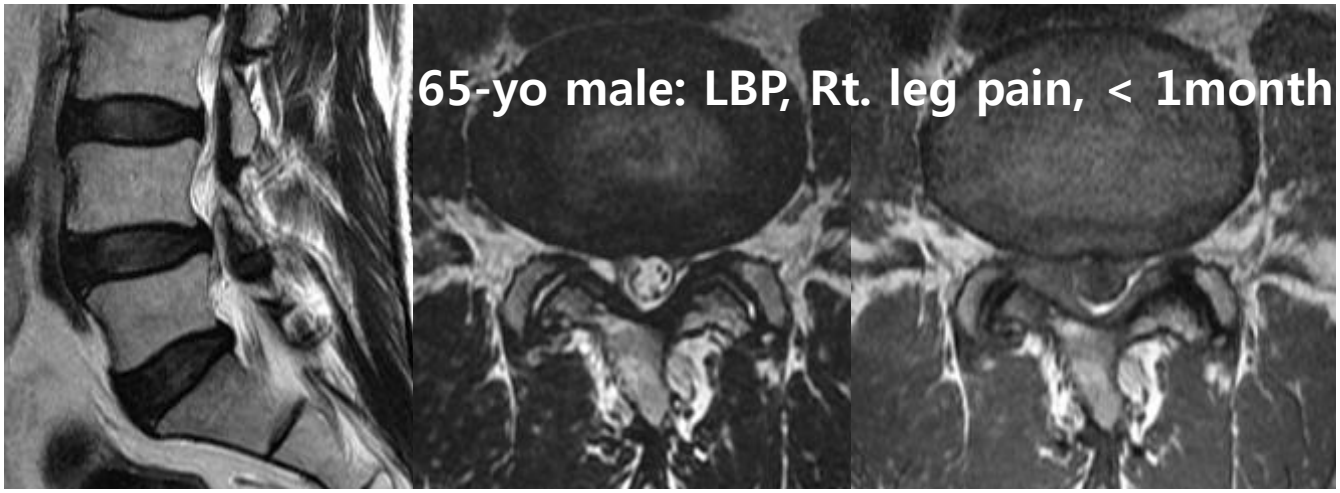
Grade: 1

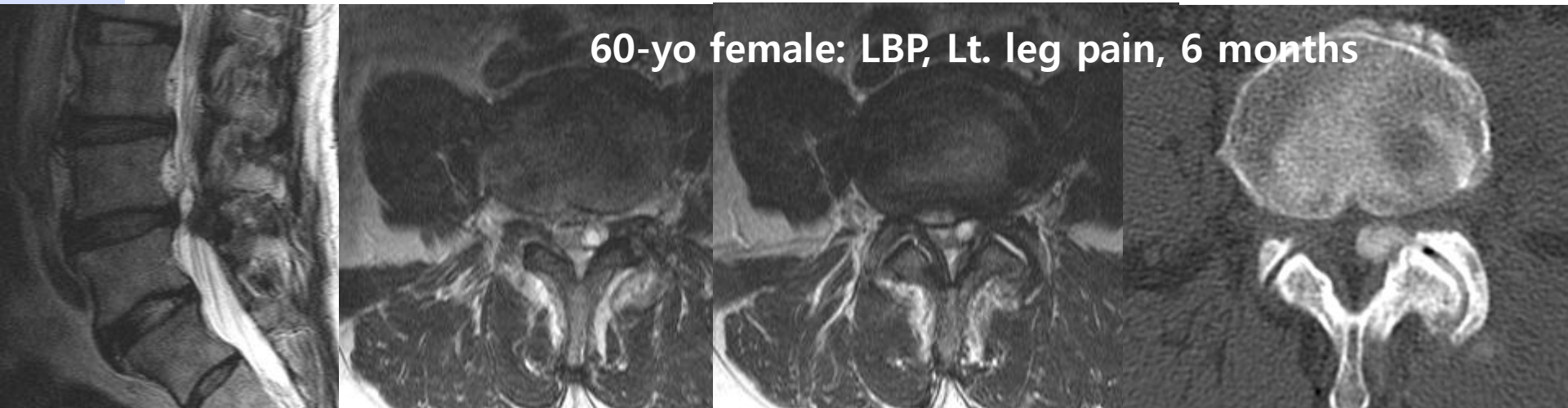
Grade: 2

Grade: 3

Facet cyst

- Synovial cyst, ganglion, juxta-articular cyst





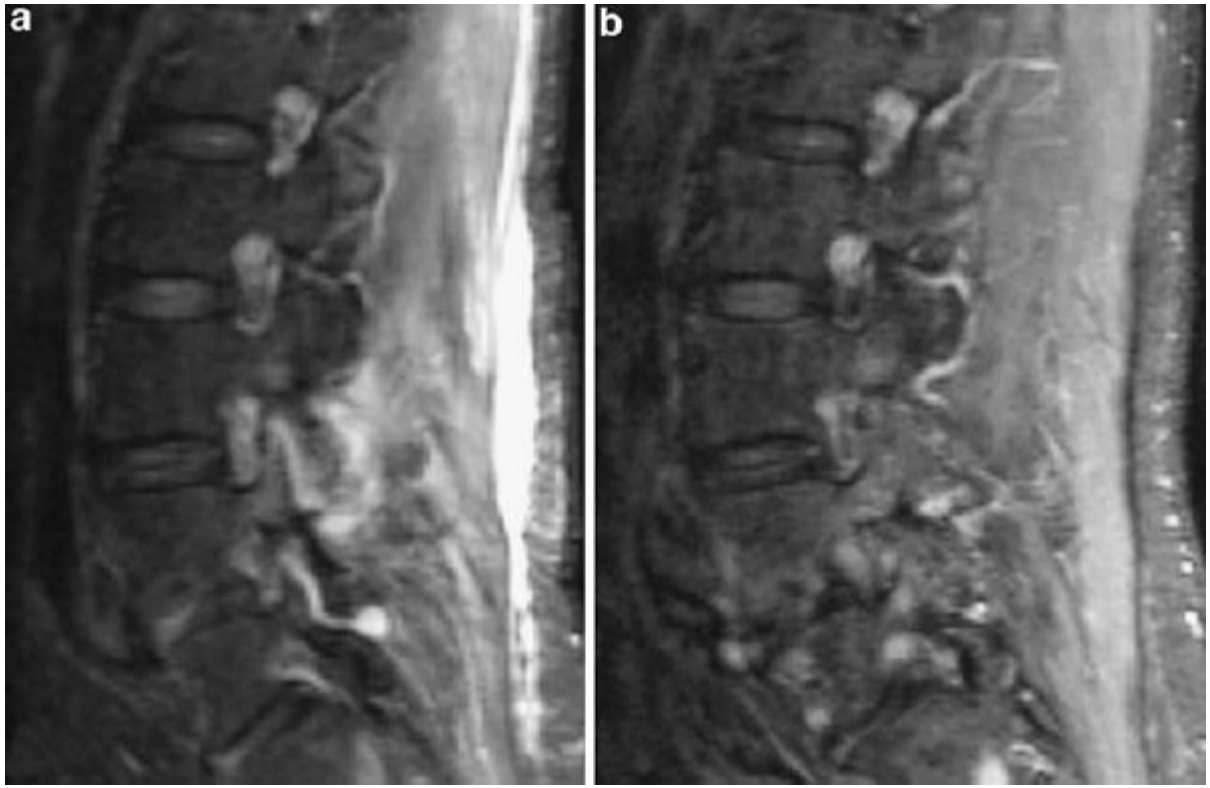
Facet joint edema

- Significant pain generator?

Facet joint edema

- In 21 of the 145 patients (14%) edema was found at the facet joints. The agreement between the change in pain score and intensity of edema within the follow-up group was “almost perfect” (kappa=0.81).

Skeletal Radiol (2007) 36:755–760

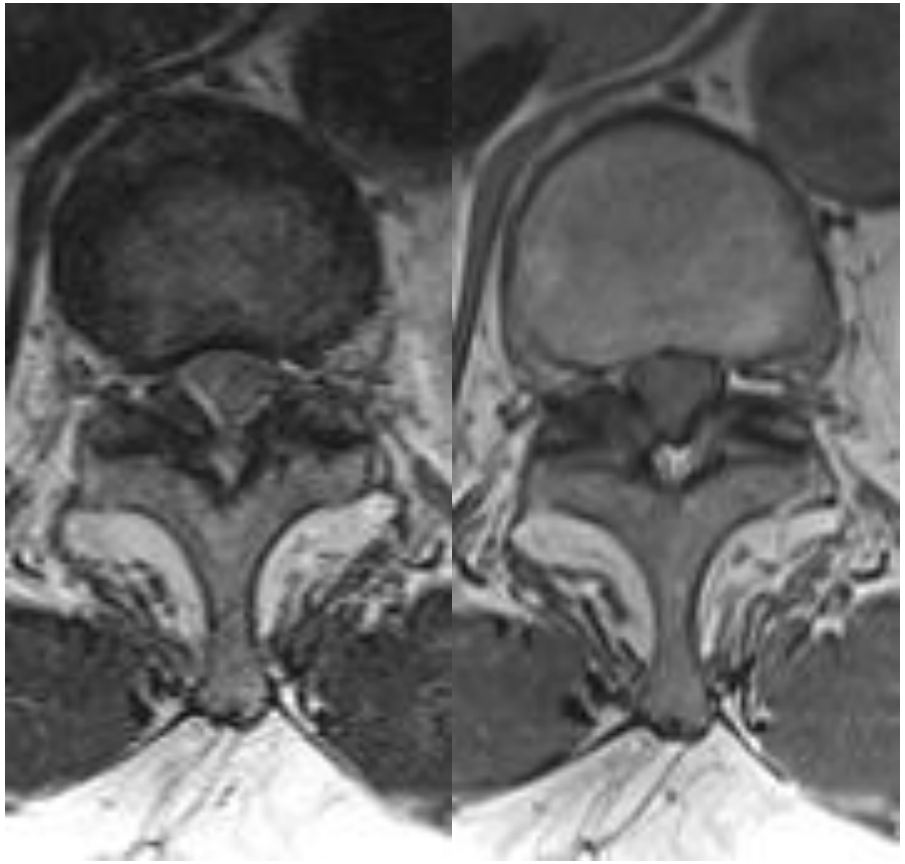


Fibrous joints and entheses

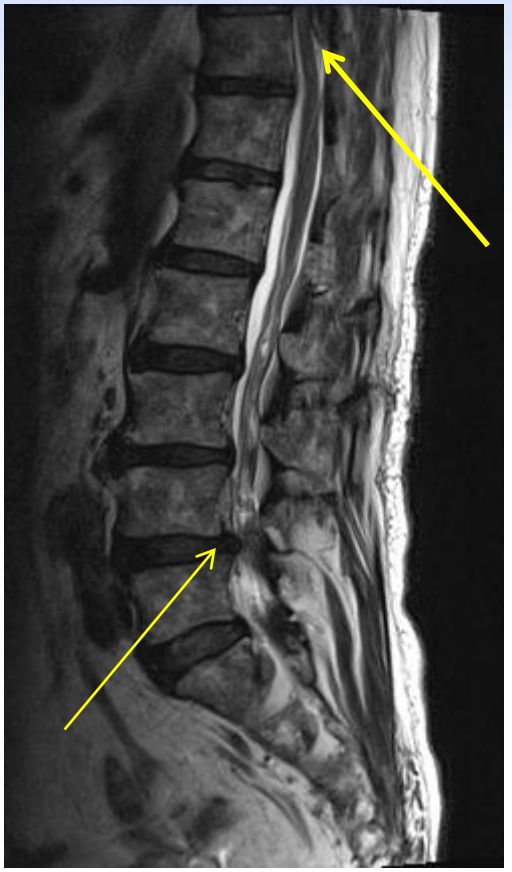
- DISH
- OPLL
- OYL
- Baastrup's phenomenon

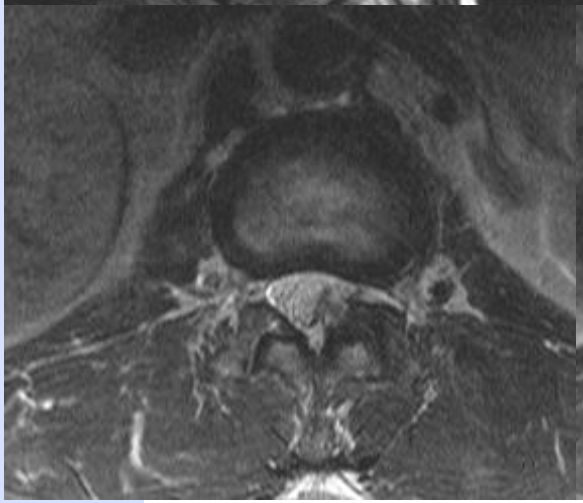
Ossification of ligamentum flavum

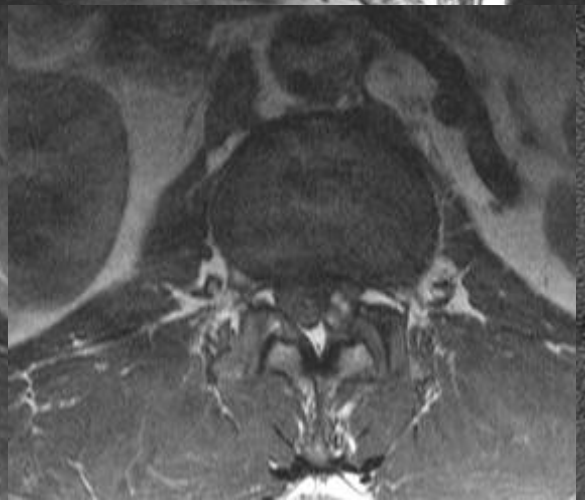
- Common in thoracolumbar junction

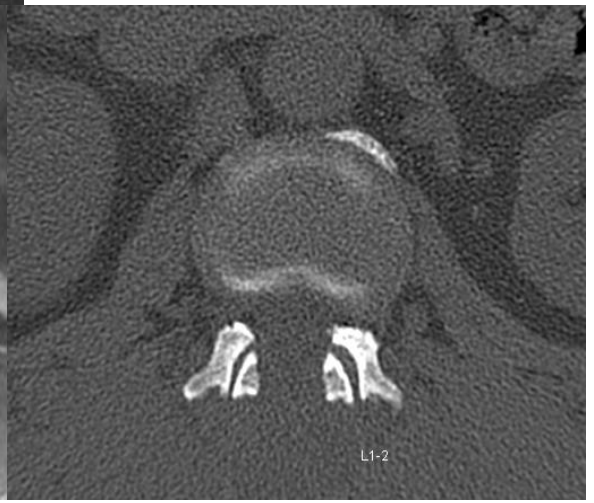


OYL







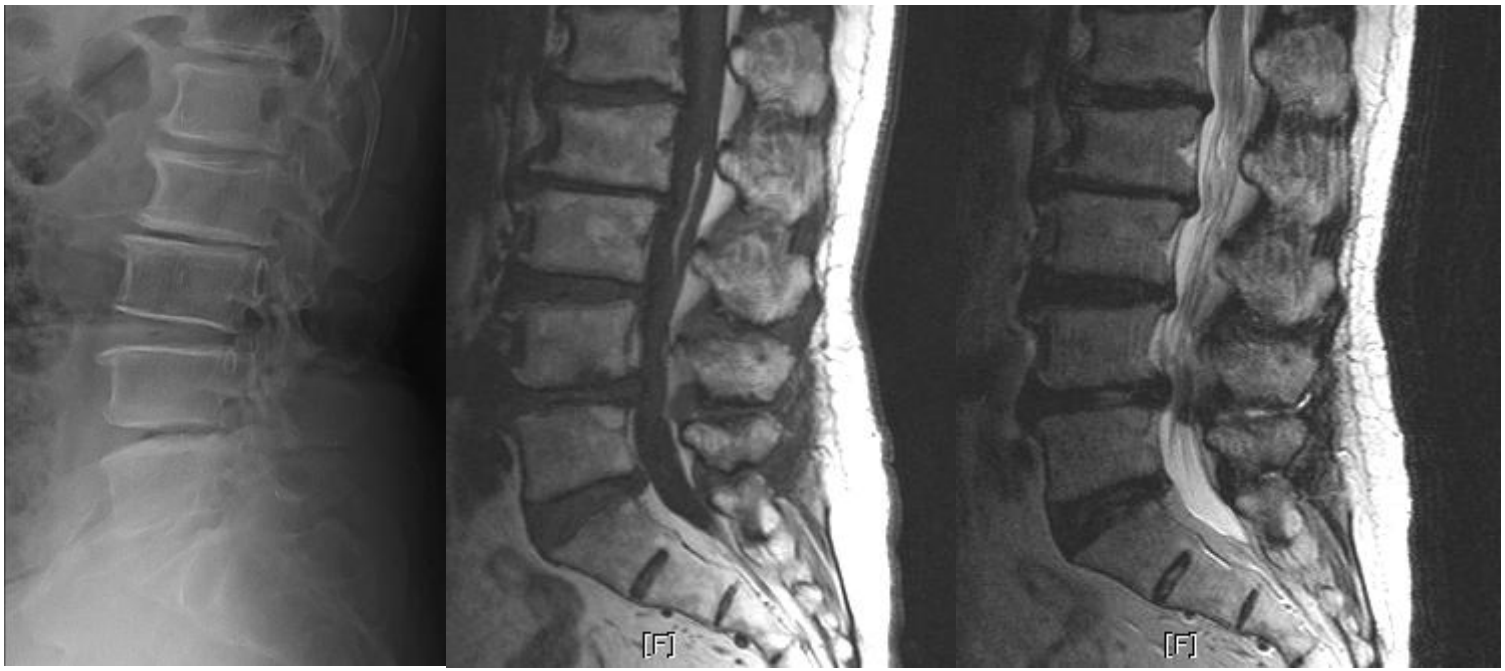


Interspinous ligament degeneration

- Narrowing of the intervertebral disc & instability
- Abnormal contact between the spinous processes
- Degeneration of the interspinous lig and spinous processes
- The clinical significance of these changes is unknown.

Baastrup's phenomenon (disease)

- Interspinous pseudarthrosis formation and cyst formation
- Clinically localized tenderness
- Exacerbated with extension and relieved with flexion



Alignment abnormalities

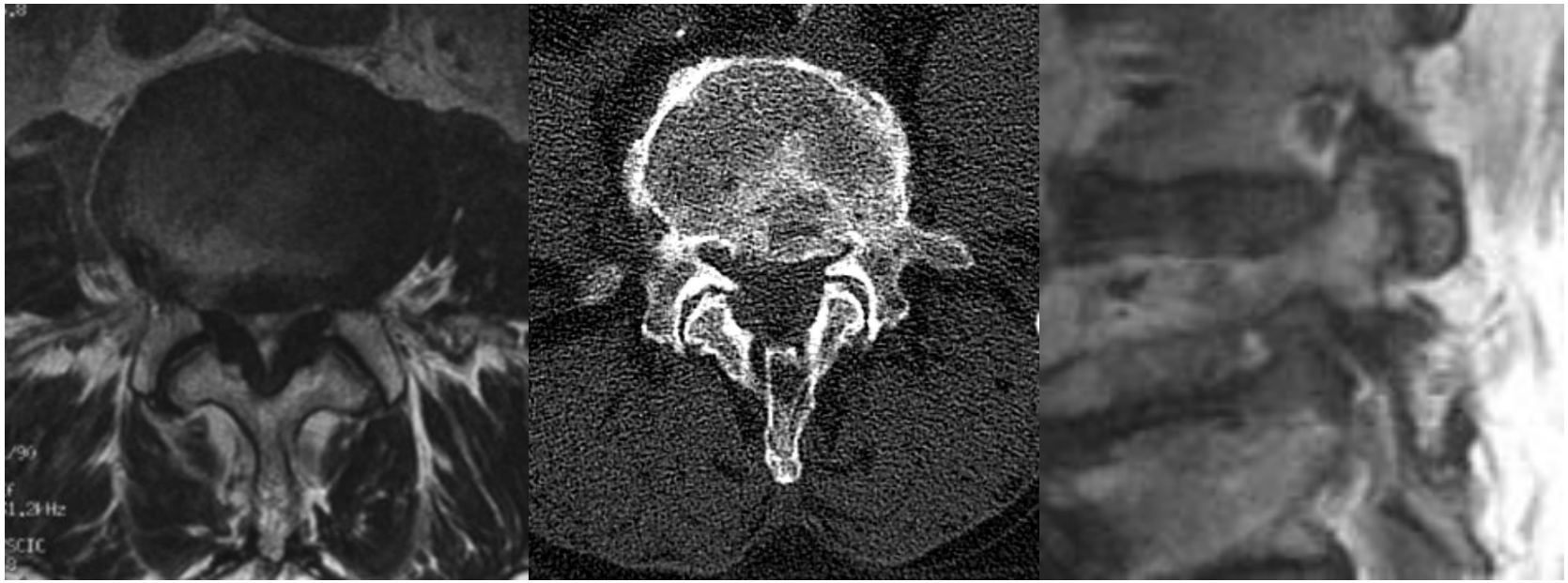
- Segmental instability
- Degenerative anterior spondylolithesis
- Degenerative retrolithesis
- Degenerative lumbar scoliosis
- Degenerative lumbar kyphosis

Instability

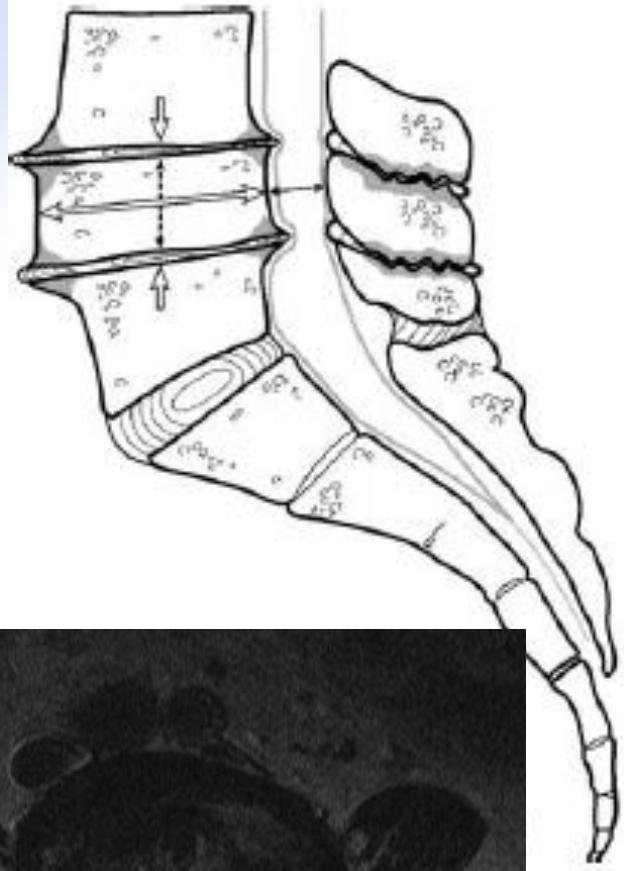
- Loosely applied to the demonstration of increased movement or loss of stiffness between two vertebral segments
- Poorly understood and imprecisely defined
- Dynamic slip > 3mm
- Angulation > 10-15
- Traction osteophytes
- Vacuum phenomenon

Spinal stenosis

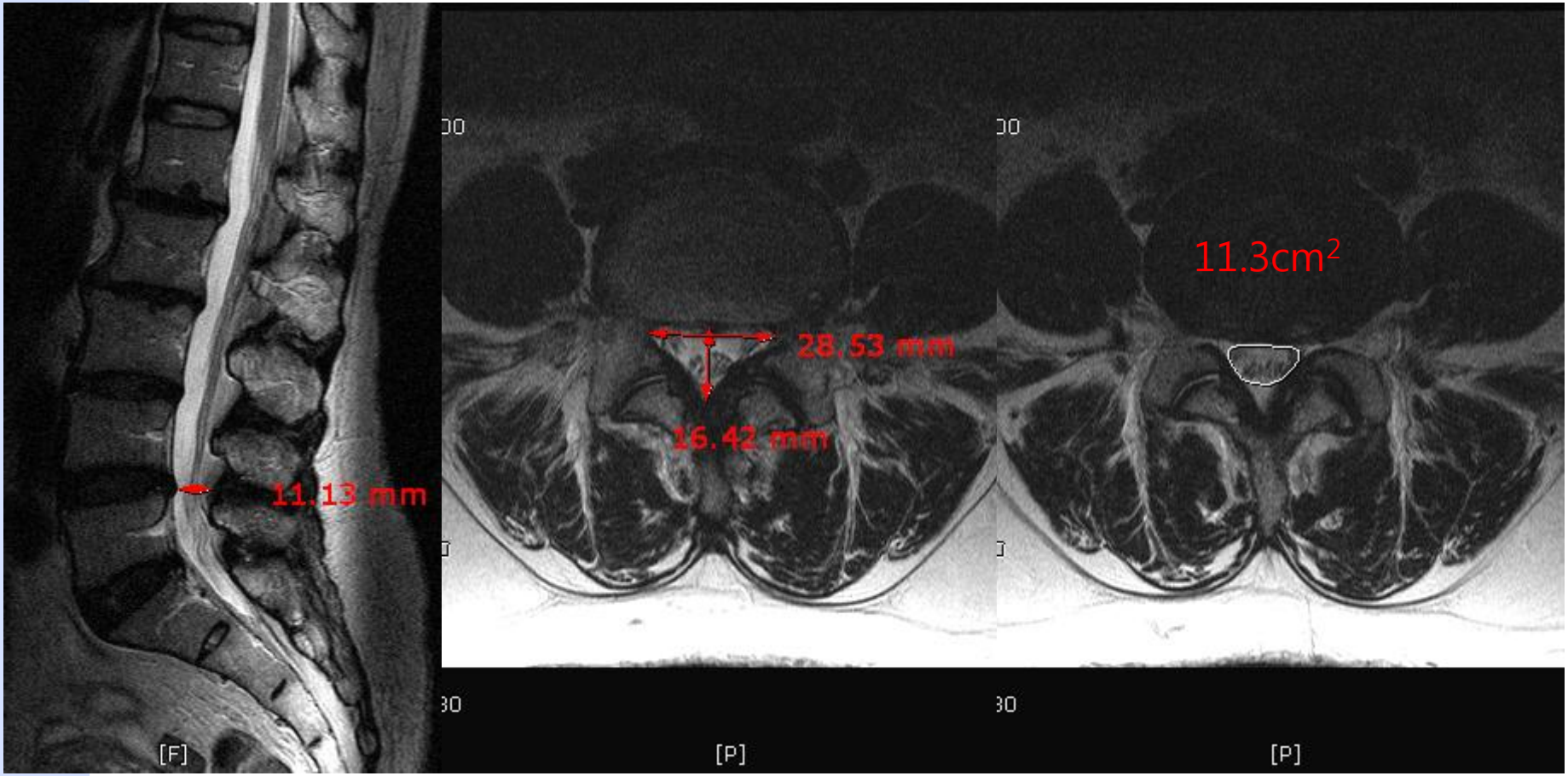
- Multifactorial degenerative changes
- Multi-levels
- Central canal stenosis
- Lateral recess stenosis
- Neural foraminal stenosis

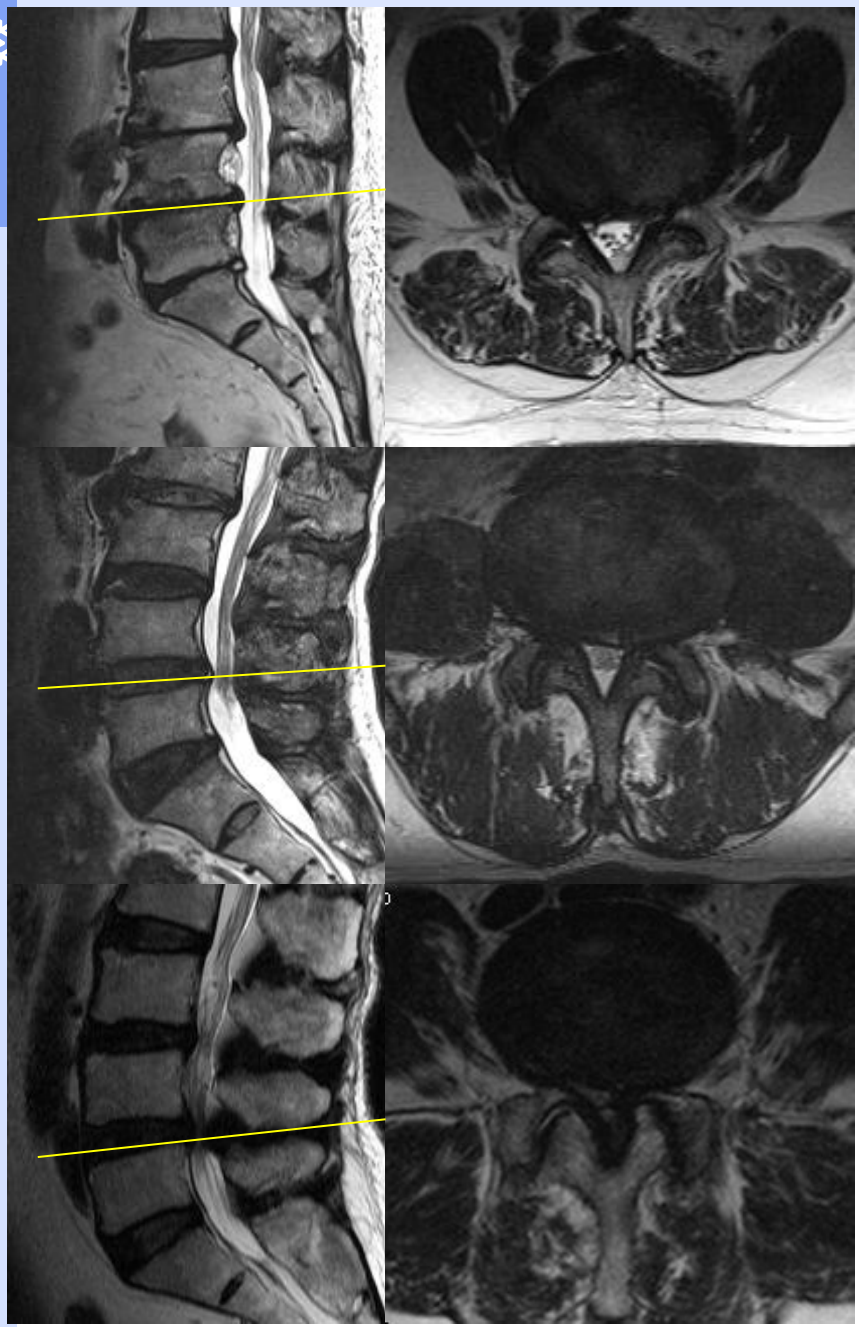


Central canal stenosis



Spinal stenosis





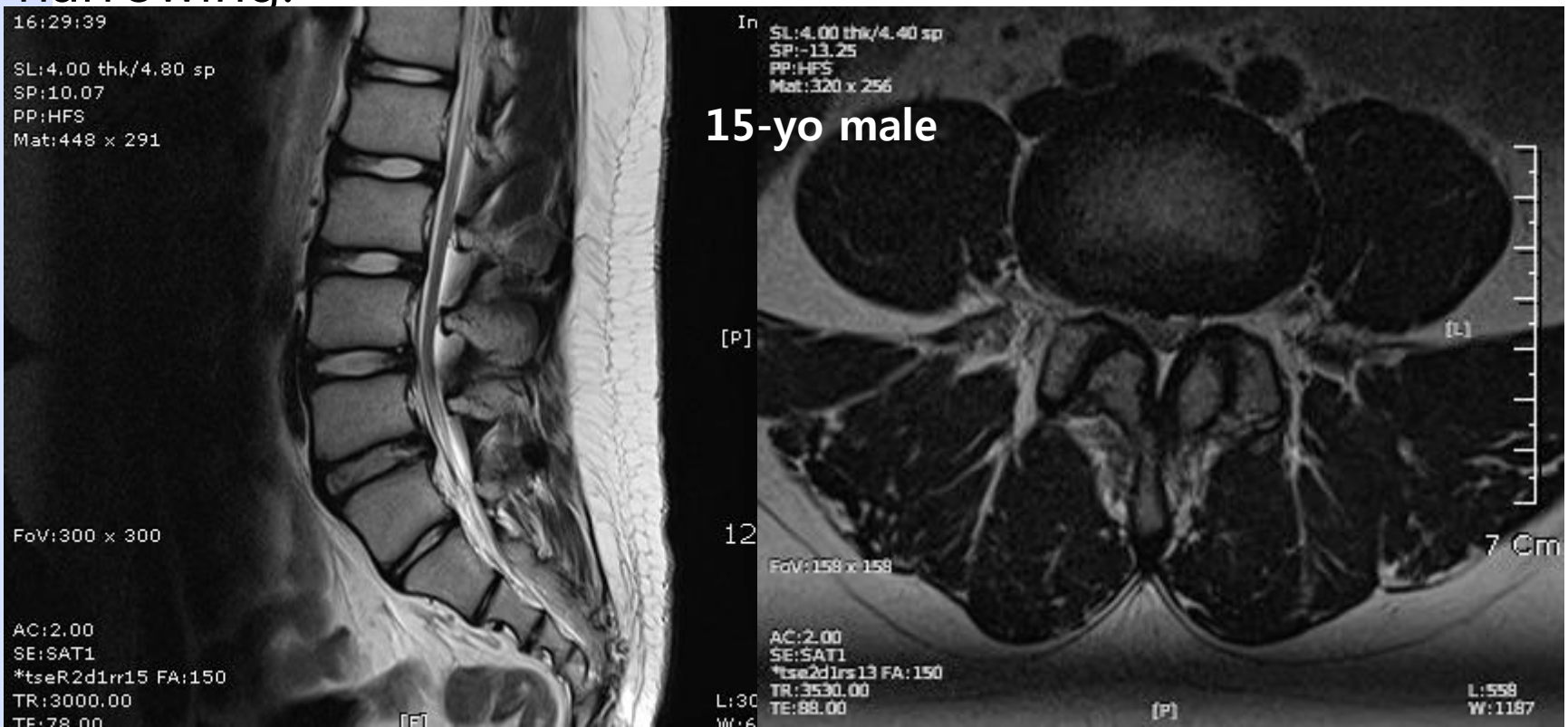
(Mild) central spinal stenosis

(Moderate) central spinal stenosis

(Severe) central spinal stenosis

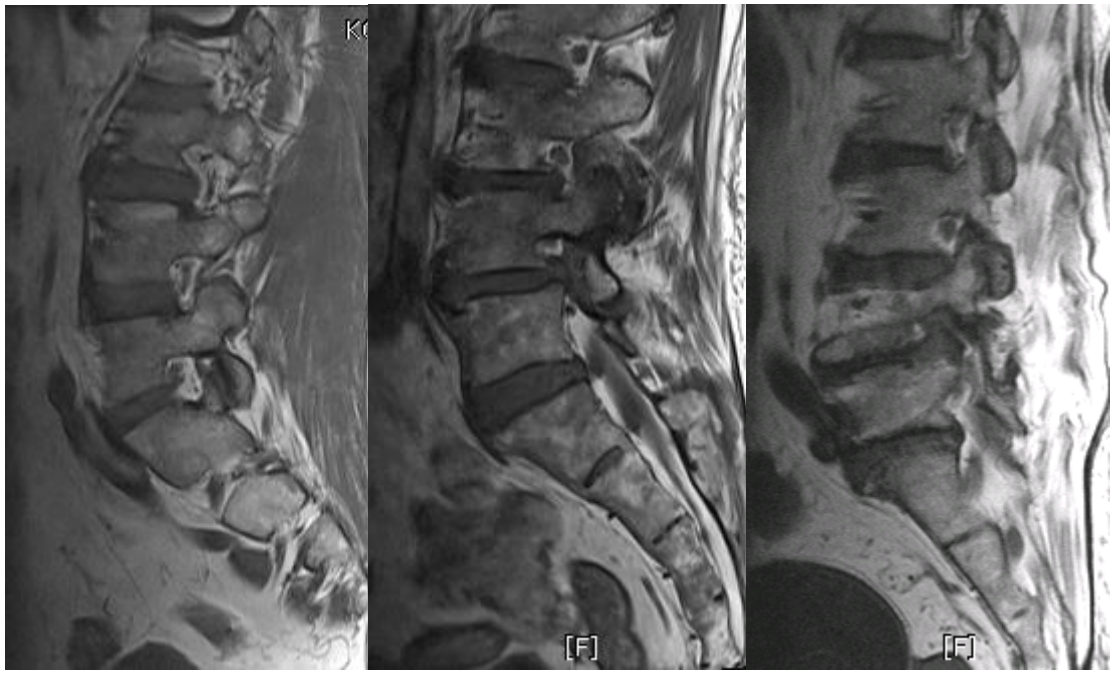
Congenitally narrowed spinal canal

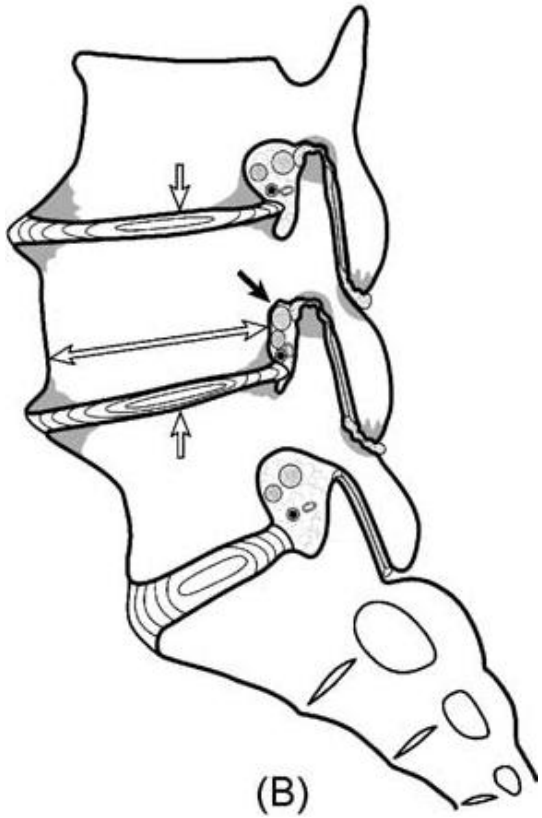
- Patients with symptomatic spinal stenosis who present at a young age, often present with degenerative changes superimposed on some degree of congenital osseous canal narrowing.



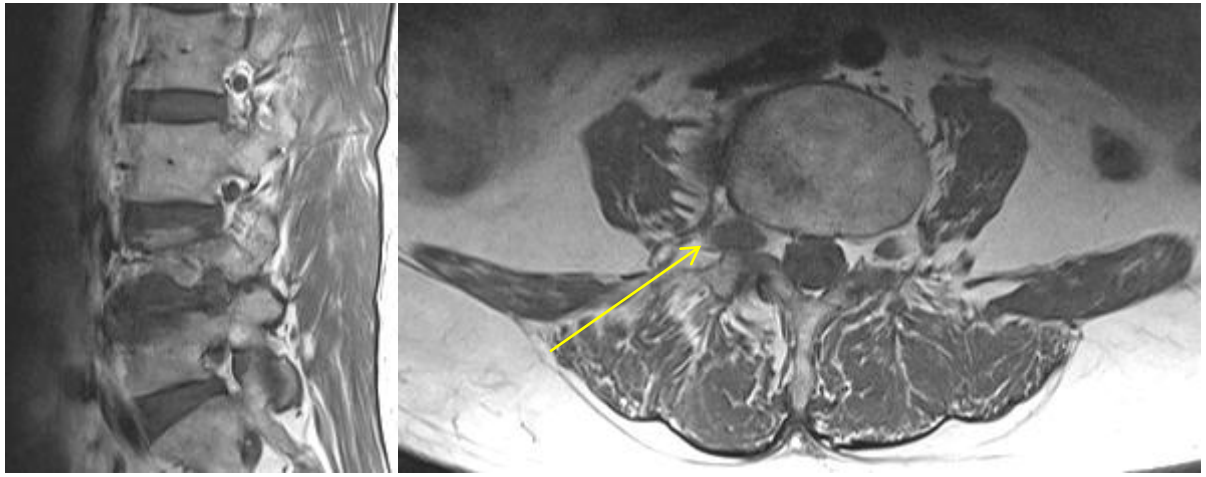
Foraminal stenosis

- Nerve root impingement is a common finding and is often asymptomatic.
- Correlation with symptoms of radiculopathy is essential.

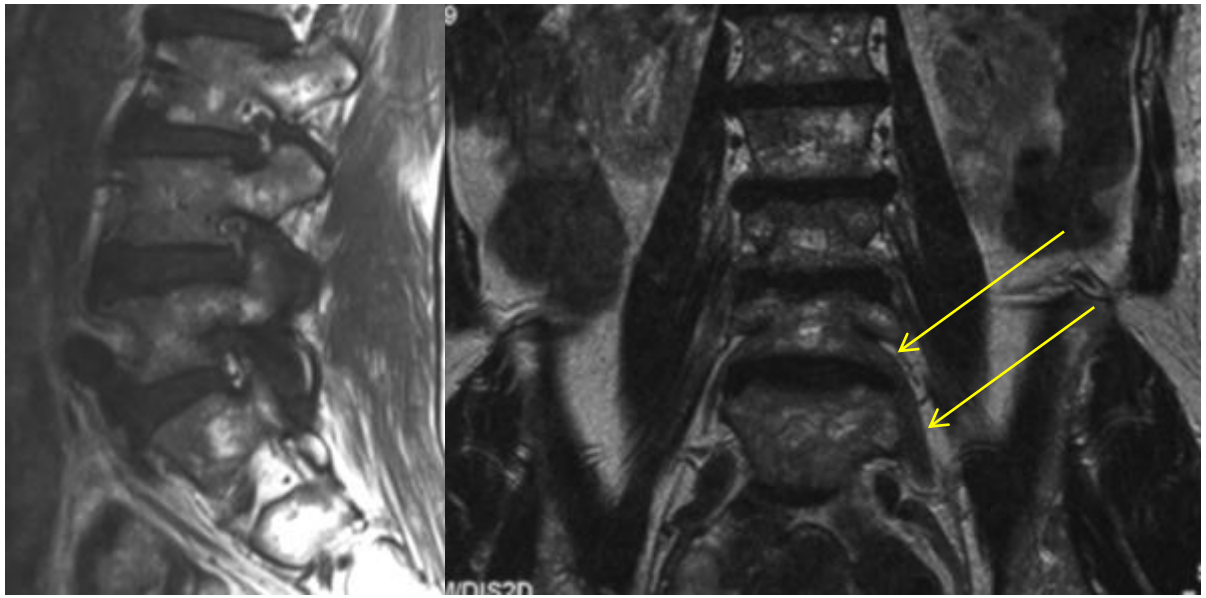




Foraminal stenosis



62-yo female
LBP with right sciatica



71-yo female
LBP with left sciatica

Indications and limitations of imaging

- There is a high incidence of “false positive” scans” (abnormal findings in patients without symptoms).
- More than 1/4 of asymptomatic individuals had disc protrusion, and 50% had disc bulges in one study [1] [2].
- The condition is self limited in most, with 80% of people improving within a few weeks, regardless of the appearance of the spine [3].

1. New England Journal of Medicine 1994; 331:69-73.

2. Journal of Bone and Joint Surgery 1998; 80-B:19-24.

3. Journal of Bone and Joint Surgery 2004; 86-A:1810-1818.

Indications and limitations of imaging

- Spine imaging should not used to follow patients with disc disease or spinal stenosis, since changes in scan appearance do not reliably predict patient symptoms or disability.
- MRI and CT certainly help with diagnostic confidence, but play little role in determining the treatment plan [4].
- It has been shown that patients in whom the clinical and imaging features correlate have a better prognosis after surgery. [5]

4. Radiology 2001; 220:393-399.

5. Radiology 1997; 203:815-822.

Indications and limitations of imaging

- For patients with disc disease or spinal stenosis, MRI may play an important role in surgical planning, but it should not be part of the initial decision concerning whether a patient is a surgical candidate.
- In choosing an imaging procedure, MRI is preferred to CT.

Issues of imaging

- The rationale for advanced imaging is frequently to identify rare but high-consequence conditions, such as metastases or infection.
- Cost-effectiveness
- Higher utilization of advanced imaging is associated with improvements in patient outcome?
- Patients with persistent low back pain and signs or symptoms of radiculopathy or spinal stenosis should undergo MRI or CT only if positive results would potentially lead to surgery or epidural steroid injection for suspected radiculopathy (ACP, APS).

Thank you for listening.