

DEGENERATIVE SPINE

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WHY THIS MATTER

- MC spinal pathology in daily practice
- Major cause of back pain, radiculopathy and/or myelopathy
- Imaging drives
 - Surgical vs conservative management
 - Level localization
 - Severity grading

OVERVIEW

- Understanding of relevant imaging anatomy
- Use standardized terminology
- Pattern recognition

OUTLINE

- Spine anatomy
- General principles
- Degenerative terminology
- Cases

OUTLINE

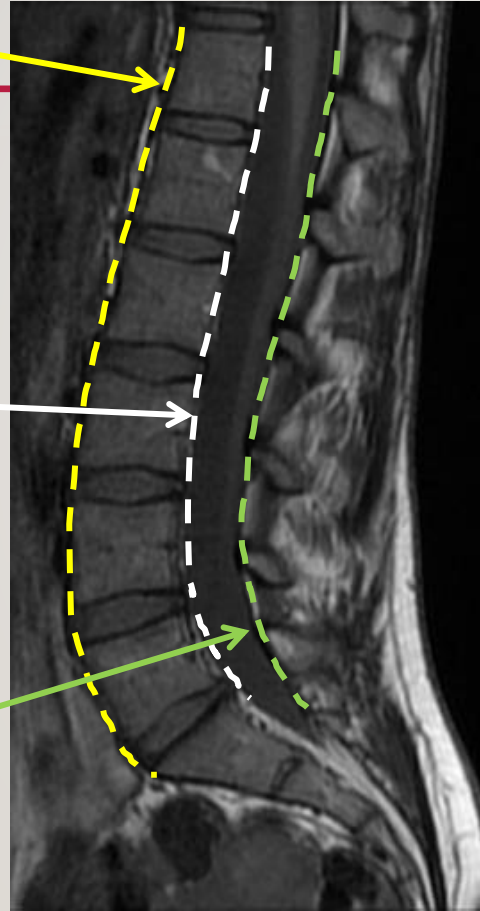
- Spine anatomy
- General principles
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- Cases

LUMBAR SPINE SAGITTAL

anterior
longitudinal
ligament (ALL)

posterior
longitudinal
ligament (PLL)

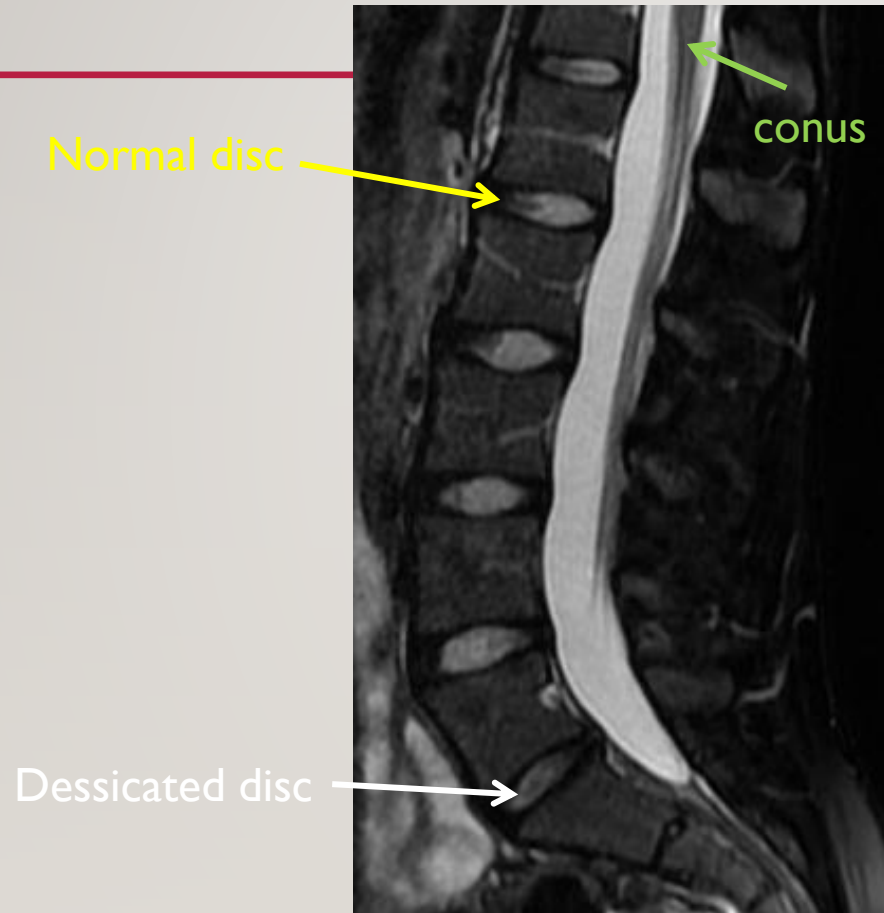
ligamentum
flavum



Pearl #1: Sagittal imaging is the
workhorse of spine MRI

Pearl #2: On T1, marrow should be
at least as bright as the disc

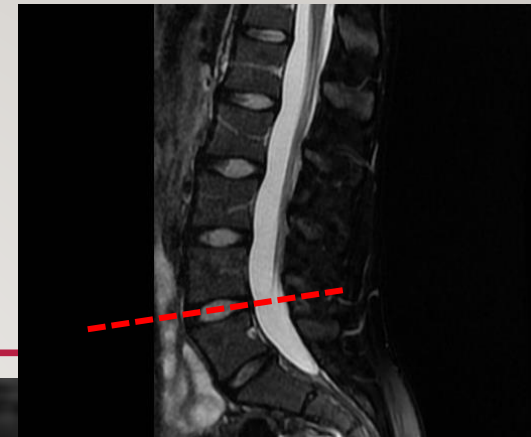
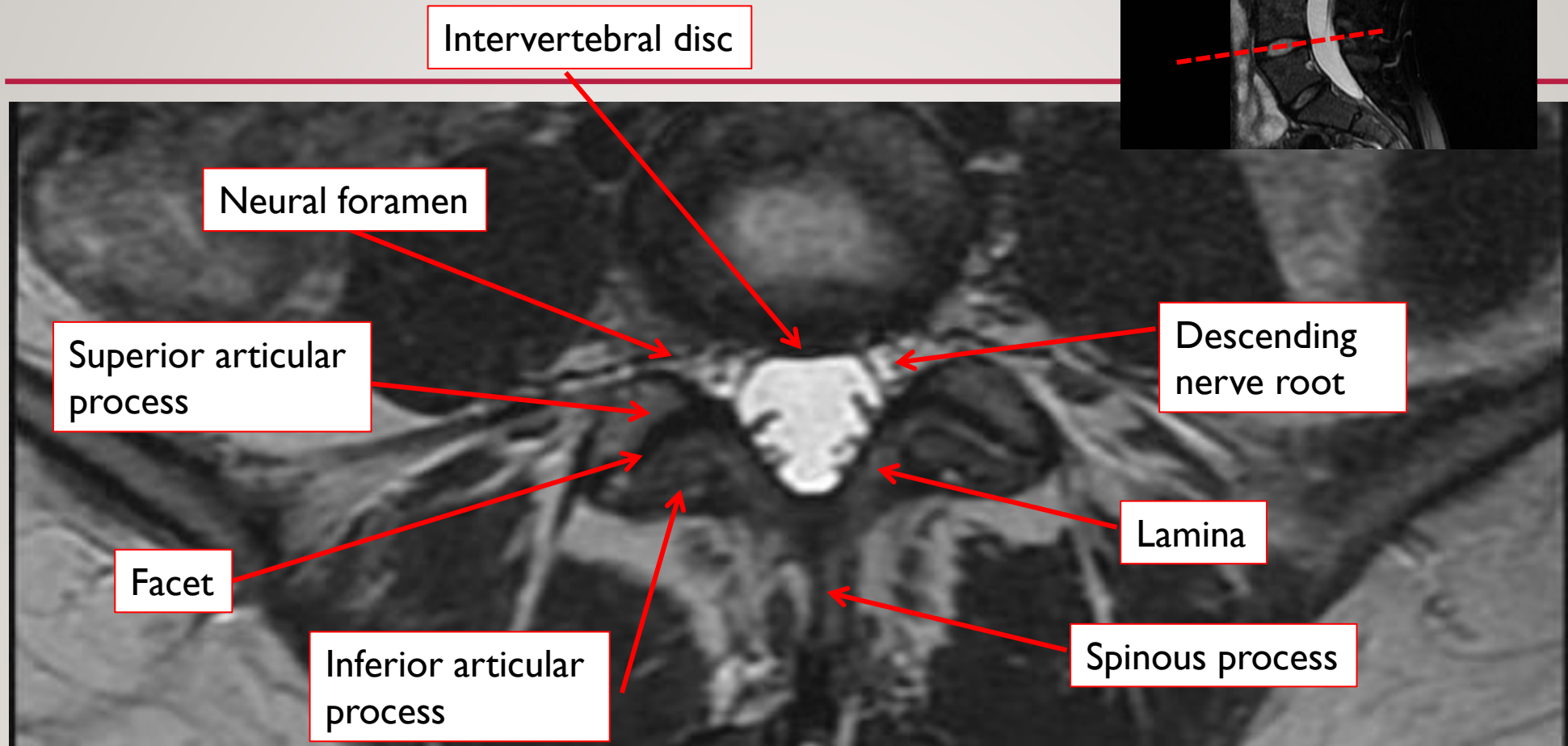
LUMBAR SPINE SAGITTAL



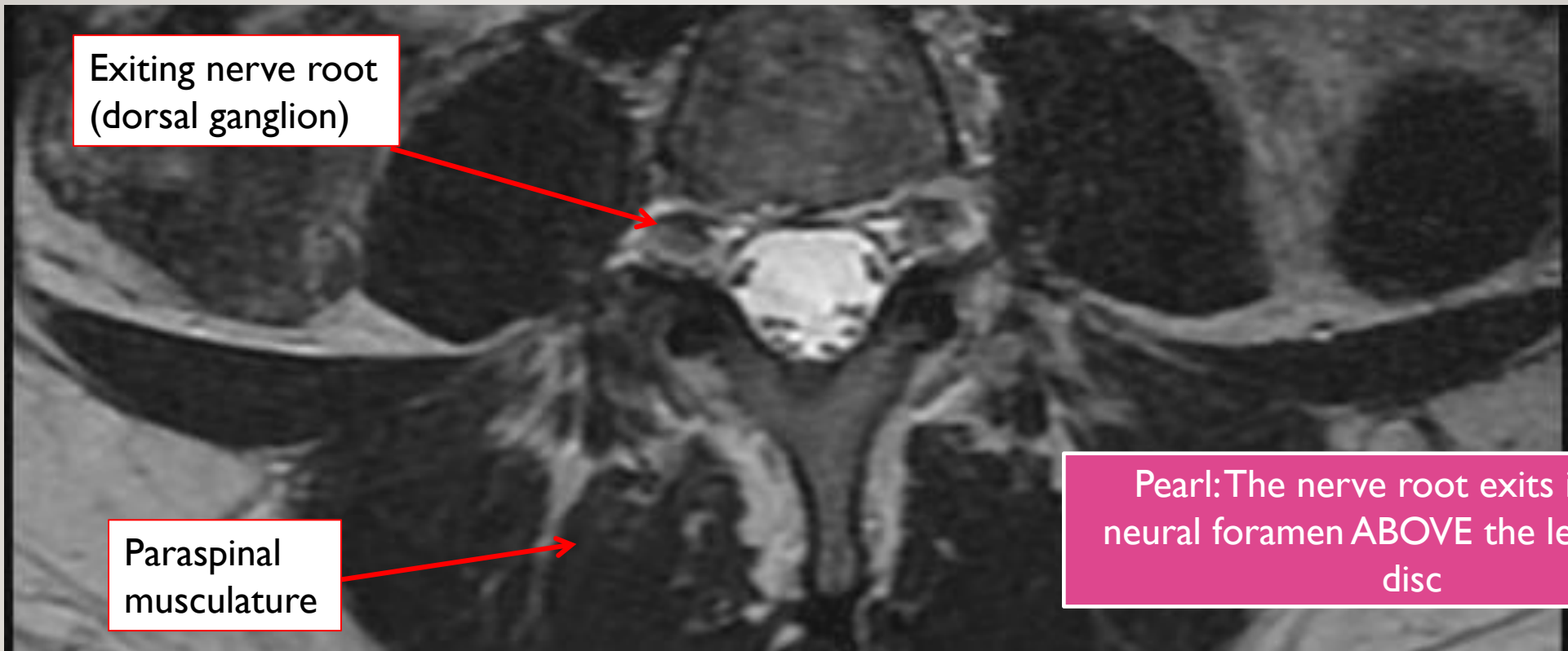
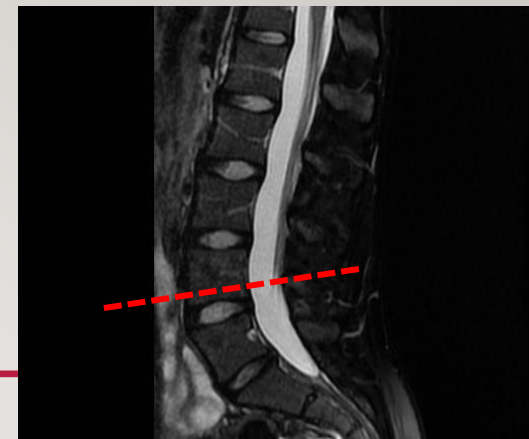
Pearl #1: T2 imaging is excellent for seeing height and water content of discs

Pearl #2: Fat saturation makes it easier to see edema within the vertebral bodies

LUMBAR SPINE AXIAL (DISC LEVEL)



LUMBAR SPINE AXIAL (JUST ABOVE DISC)

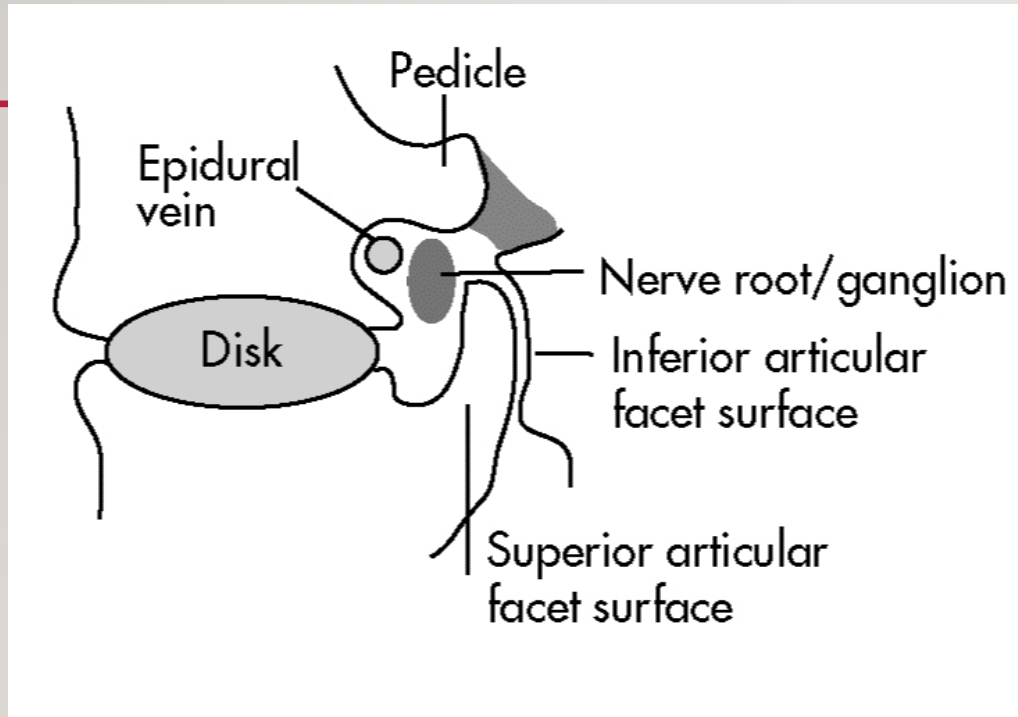


Exiting nerve root
(dorsal ganglion)

Paraspinal
musculature

Pearl: The nerve root exits into the neural foramen ABOVE the level of the disc

NEURAL FORAMEN (SAGITTAL)



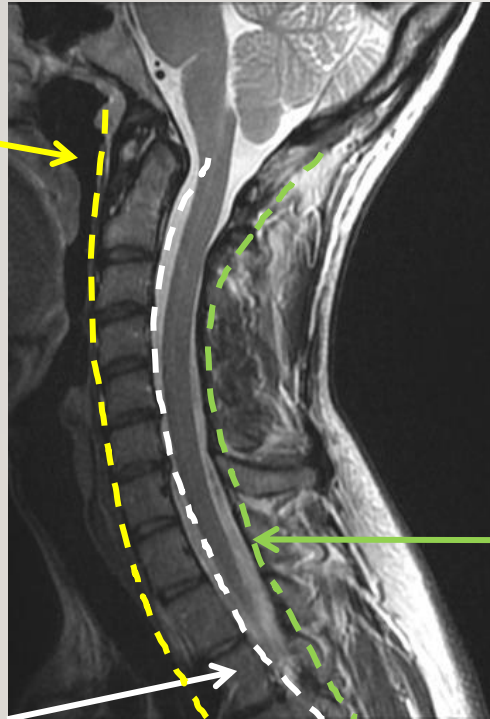
Weissleder, Primer

Pearl: T1 sagittal is the best view of lumbar neural foramina

CERVICAL SPINE ANATOMY

anterior
longitudinal
ligament (ALL)

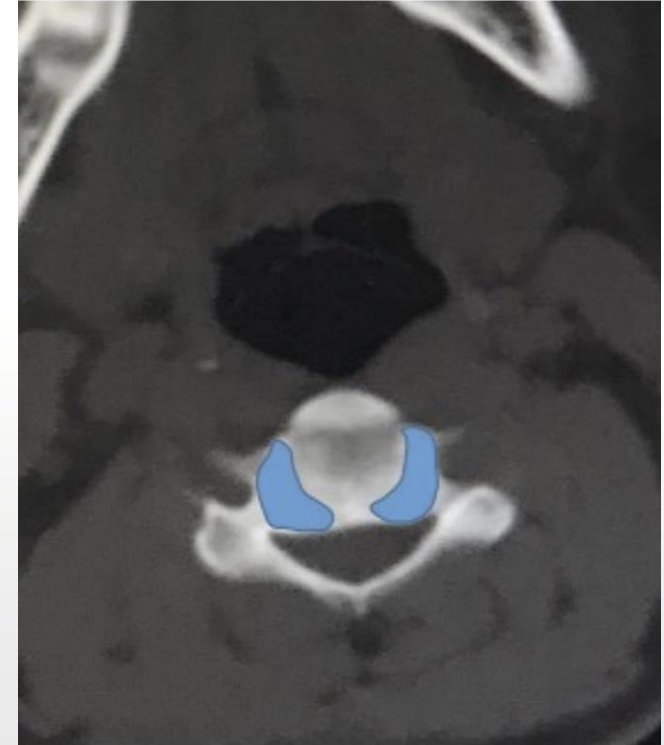
posterior
longitudinal
ligament (PLL)



ligamentu
m
flavum

UNCOVERTEBRAL JOINT

THE CERVICAL SPINE HAS
SMALL SYNOVIAL JOINTS
LATERALLY JUST ANTERIOR TO
THE NEURAL FORAMEN.



CERVICAL VS. LUMBAR

CERVICAL SPINE

- 7 vertebral bodies
- 8 nerve roots (numbered by pedicle above + 1)
- Uncovertebral joints
- No lateral recess

LUMBAR SPINE

- 5 vertebral bodies
- 5 nerve roots (numbered by the pedicle above)
- No uncovertebral joints
- Nerve root for level below is in a lateral recess

WHAT ABOUT THORACIC SPINE?

- Anatomy
 - 12 vertebral bodies
 - 12 nerve roots
 - Numbered like lumbar spine
- Transverse processes articulate with ribs (uncovertebral equivalent)
 - Articulates with the numbered vertebral body

OUTLINE

- Spine anatomy
- General principles
- Degenerative terminology
- Cases

-
- Concept of functional spinal unit: Adjacent Vertebrae + IV disc + posterior elements + ligaments

ROLE OF DIFFERENT IMAGING TECHNIQUES

- Radiographs
 - Useful for instability
- CT – the screening test
 - Bony anatomy
 - Alignment
 - Trauma
 - Hardware evaluation
- MR – the workhorse of spine
 - Soft tissue anatomy
 - Degenerative disease
 - Spinal canal and spinal cord
- Myelography
 - When MR contraindicated
 - CSF leak evaluation

ROLE OF INTRAVENOUS CONTRAST

Indication	Contrast needed
Degenerative disease	no
Trauma	no
Hardware evaluation	sometimes fracture or malpositioning – no other complication - yes
Postoperative evaluation	sometimes remote surgery (> 6 months) – probably not recent surgery (< 6-12 months) – maybe
Inflammation/demyelination	yes
Tumor	yes
Infection	yes
Metastases	yes

Pearl: For degenerative disease, no contrast unless surgery in last 6 months

*If for some reason you can't give contrast (allergy, renal failure), most of the time 90% of the information is available on non-contrast MR

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Review Article

Lumbar disc nomenclature: version 2.0
Recommendations of the combined task forces of the North American
Spine Society, the American Society of Spine Radiology
and the American Society of Neuroradiology

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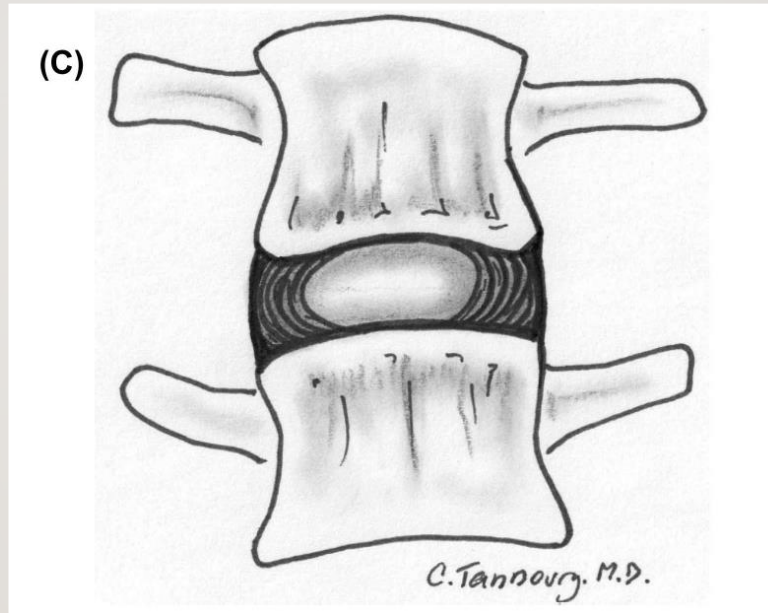
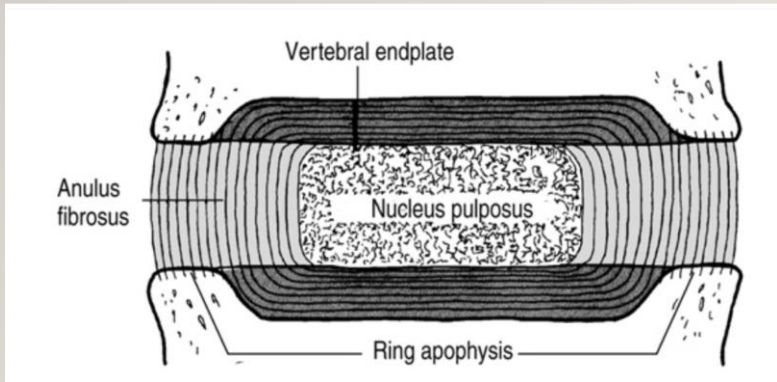
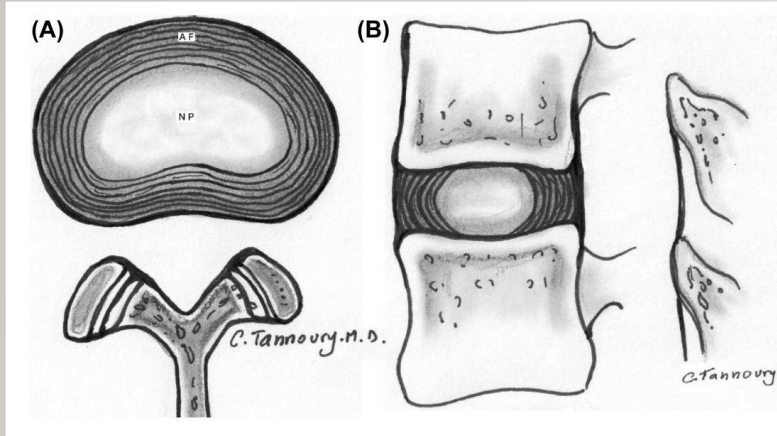
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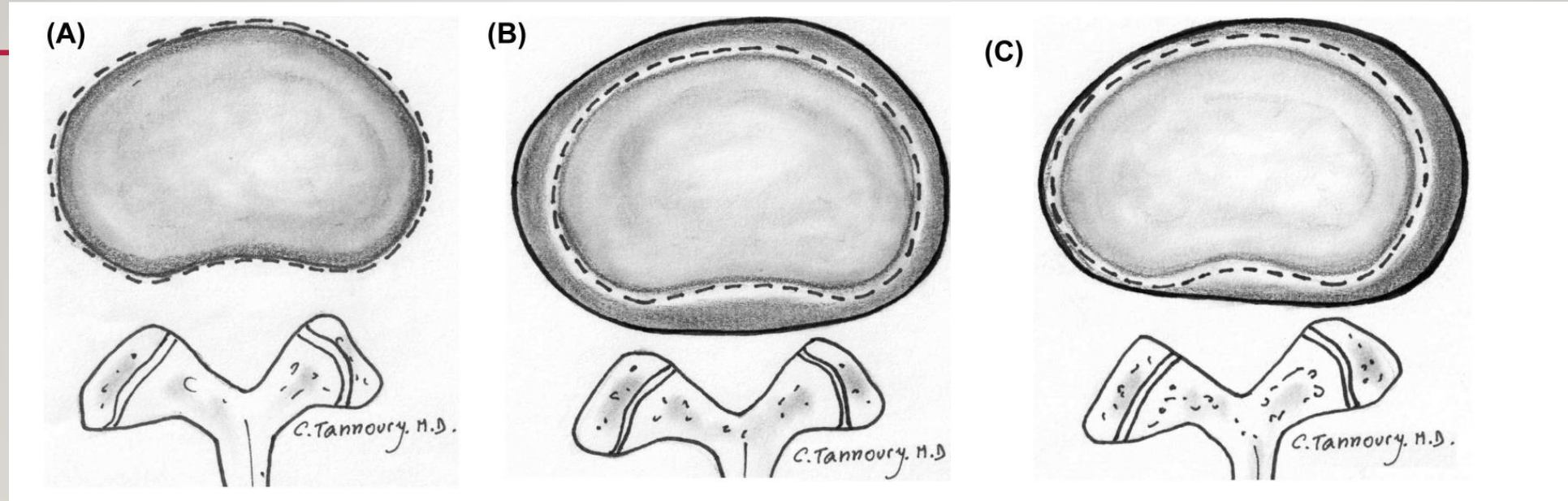
NORMAL DISC

SPINE 2014;39:E1448–E1465

DISC DEGENERATION

- Broadly defined as a localized or focal displacement of disc material beyond the limits of the intervertebral disc space.
- Disc dessication
- Hight loss
- Annular fissures
- **Avoid vague term “disc herniation without subtype”.**

DISC BULGE



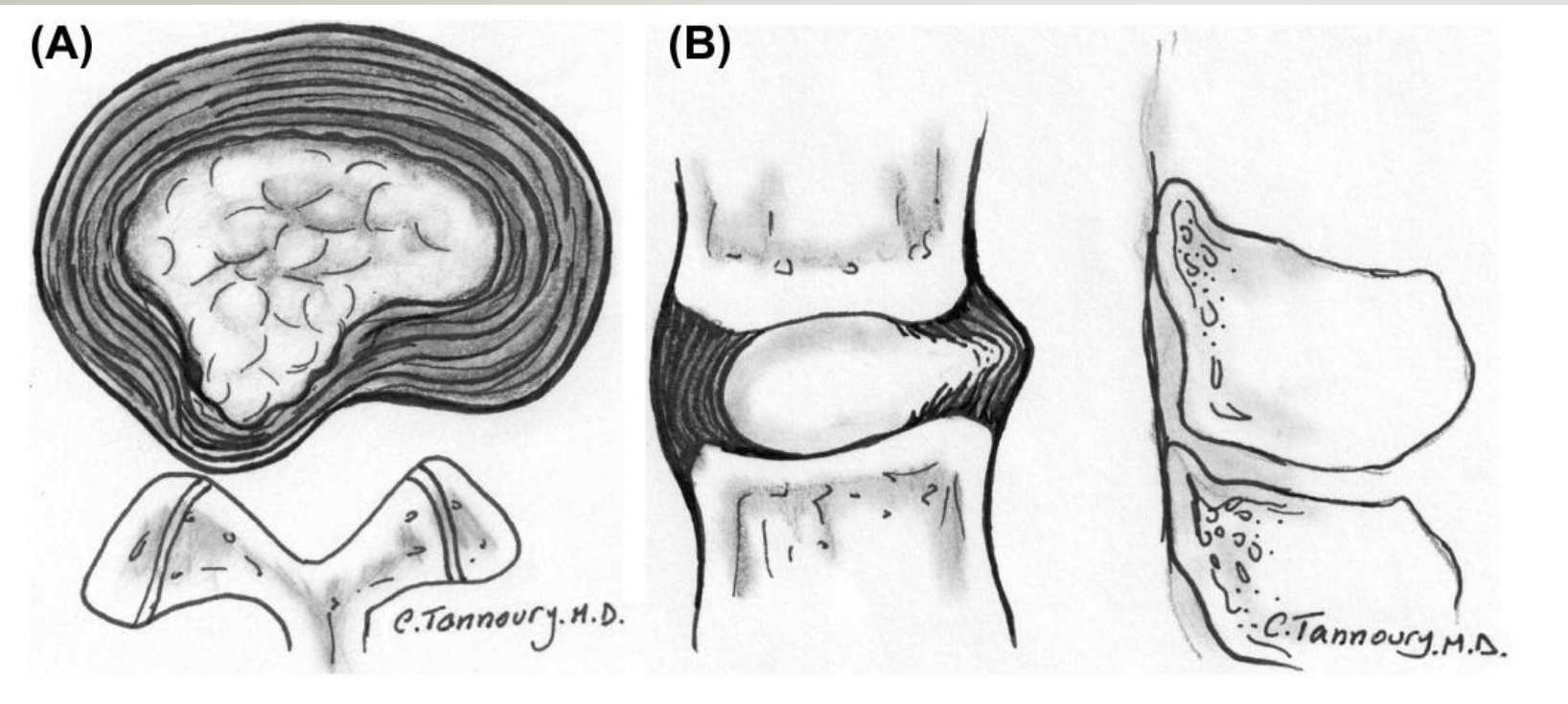
Normal

Symmetric bulge
(entire margin of disc)

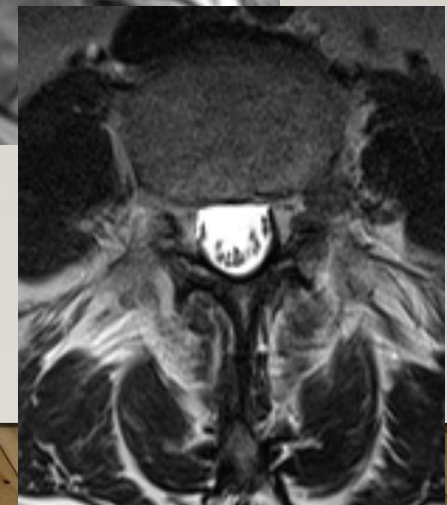
Asymmetric bulge
(**> 25%** of circumference)



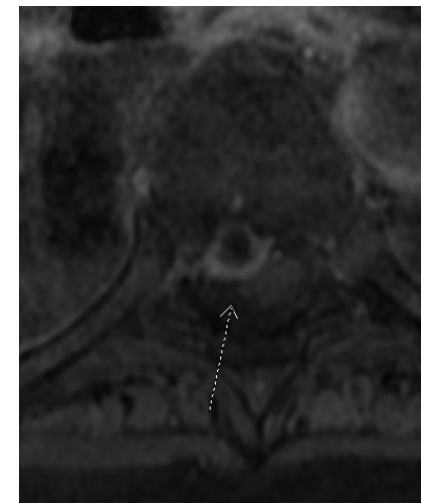
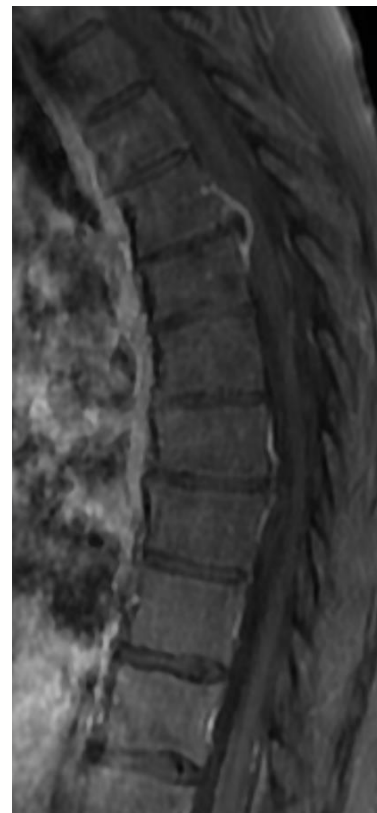
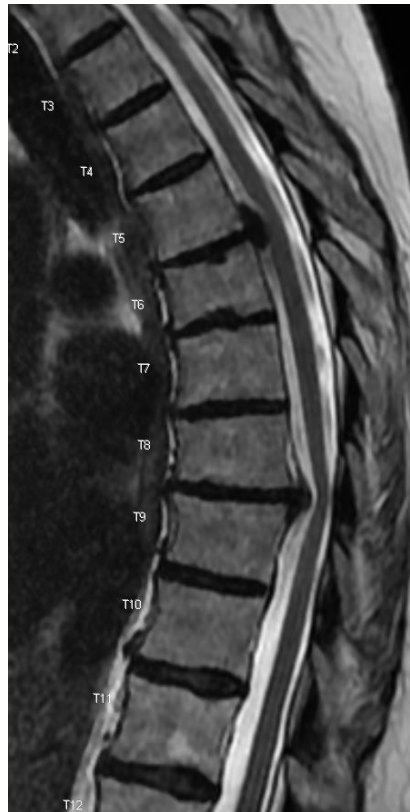
DISC PROTRUSION



- Displaced disc material extending beyond $< 25\%$ of the disc space
- Wider at the base than at the dome



-
- Post contrast enhancement



ANNULAR FISSURE



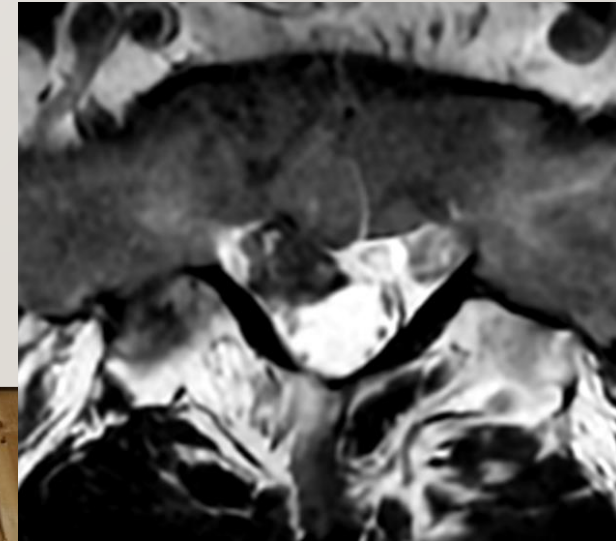
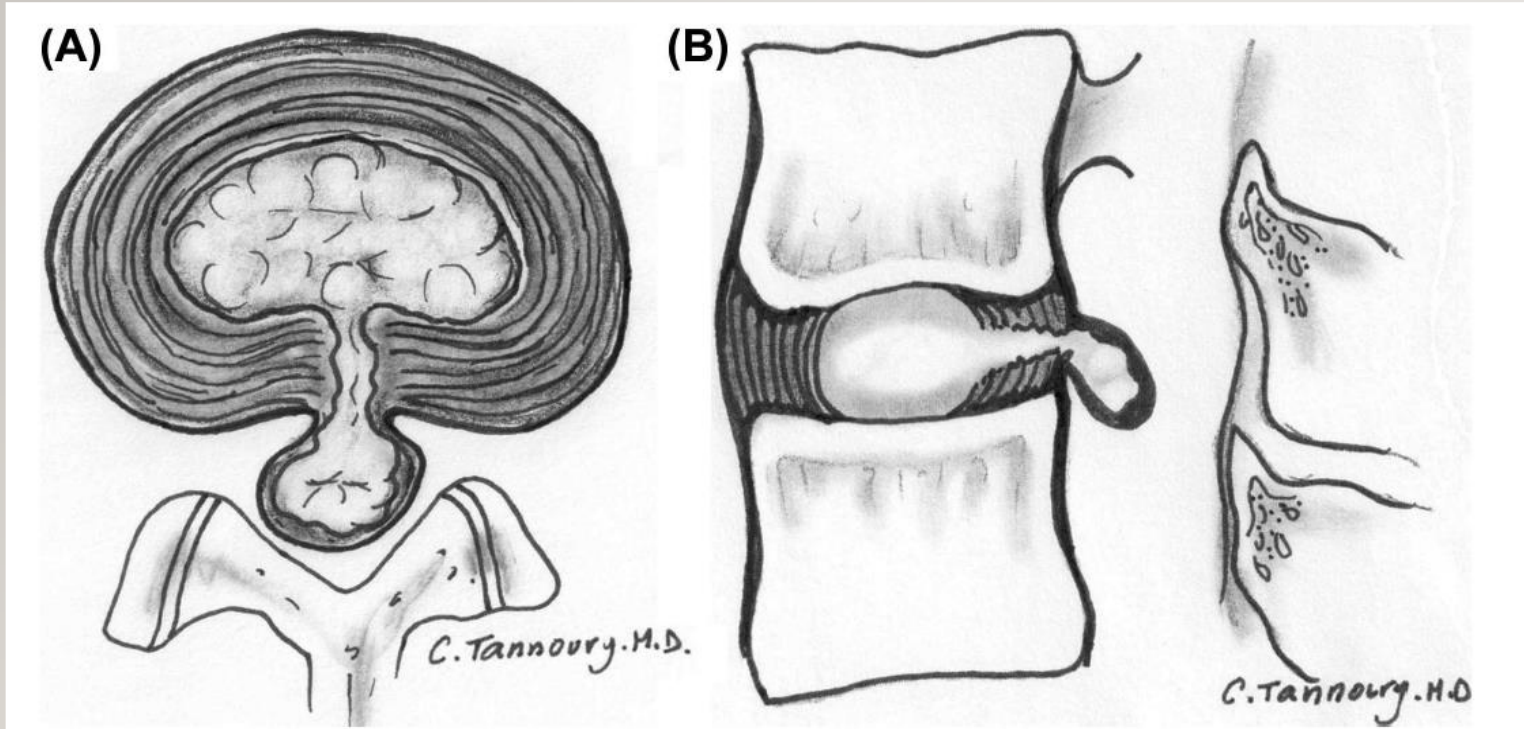
separations between the annular fibers or separations of annular fibers from their attachments to the vertebral bone

TERMINOLOGY MATTERS: "FISSURE" VS. "TEAR"

- Fissure: correct and preferred term
 - Most accurate description and avoids misunderstanding
- "Tear" can be misleading
 - Implies injury or trauma
 - Carries inappropriate connotations in this context
- **Avoid term "tear" in your dictations**

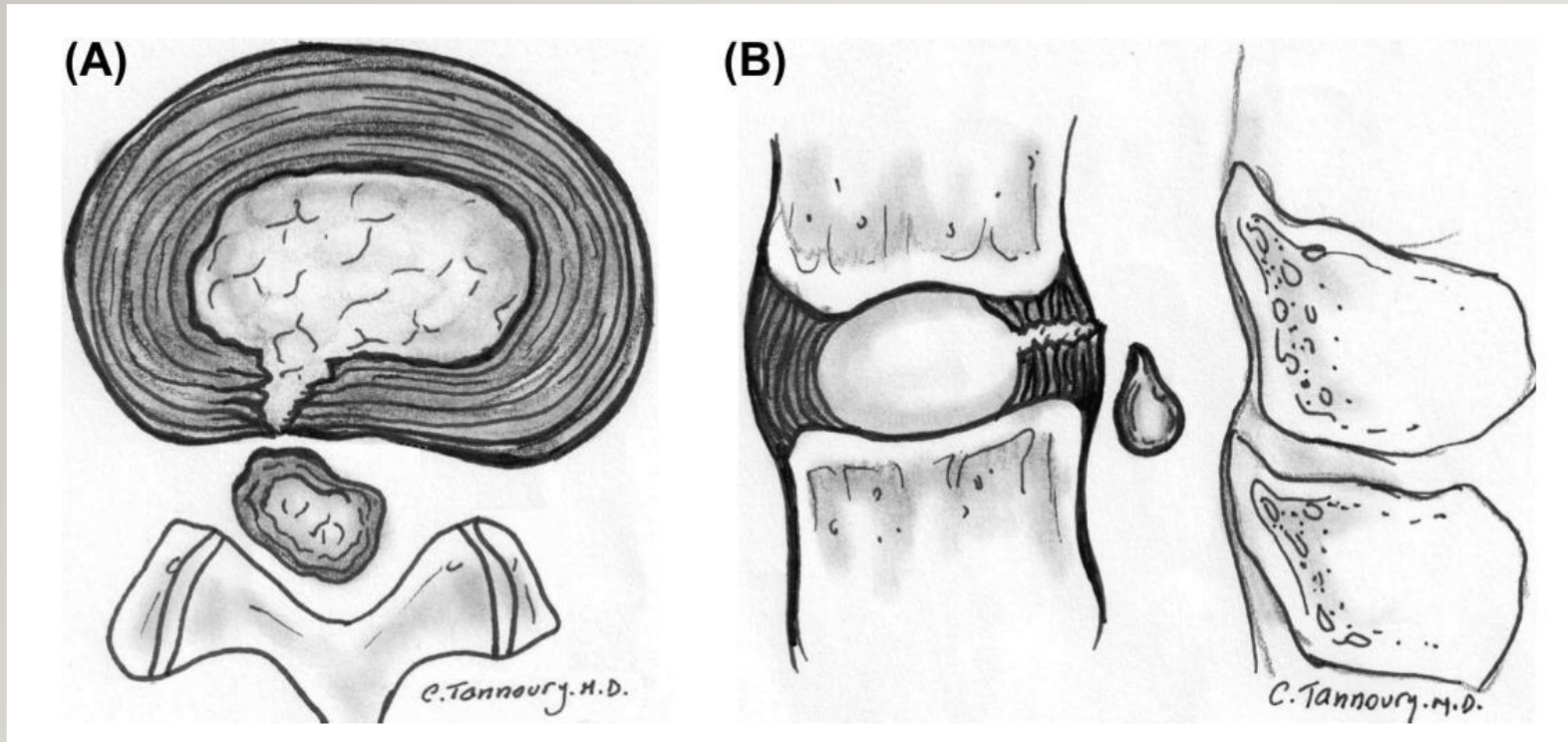


DISC EXTRUSION



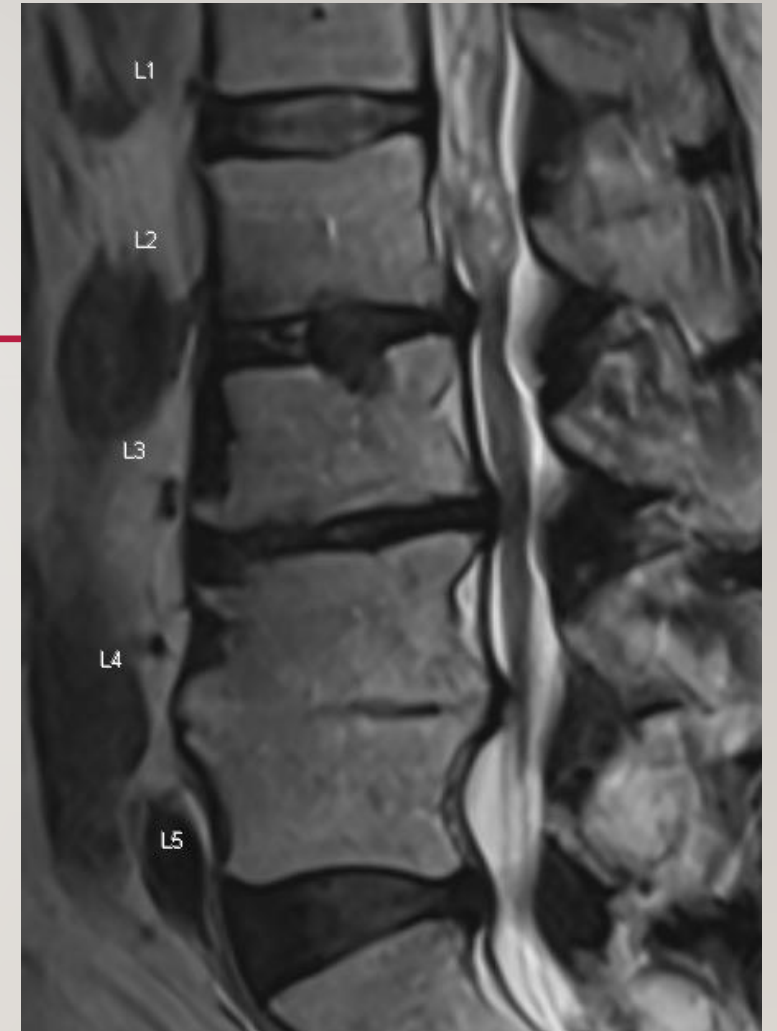
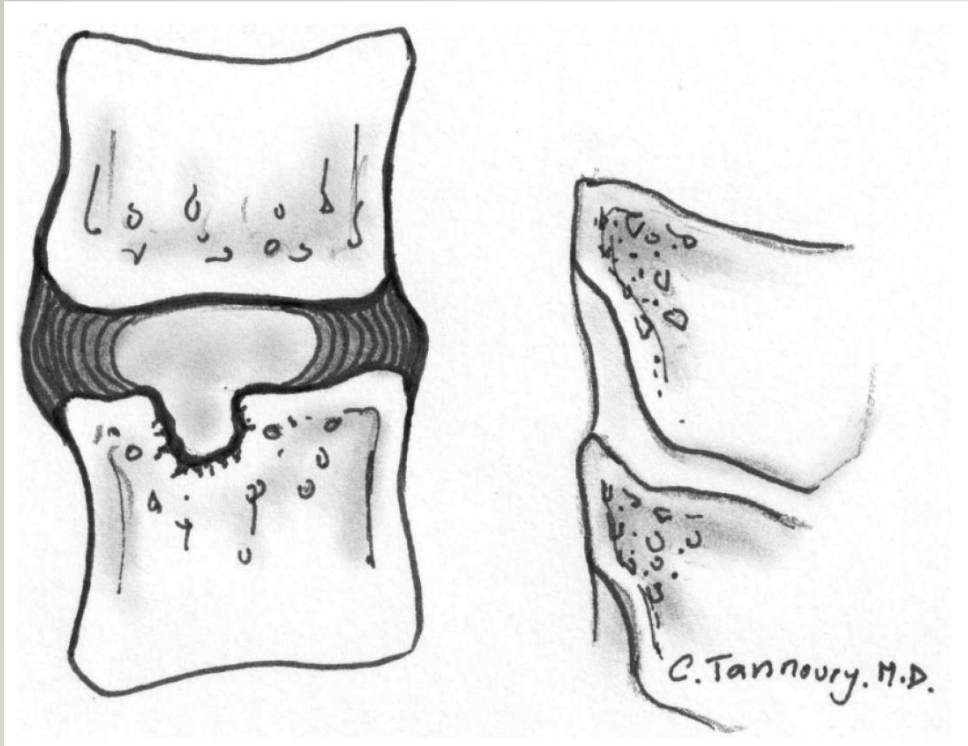
Diameter of displaced disc greater than the base

DISC SEQUESTRATION



Extruded disc in which the displaced disc material has lost all connection with the disc of origin.

SCHMORL'S NODES

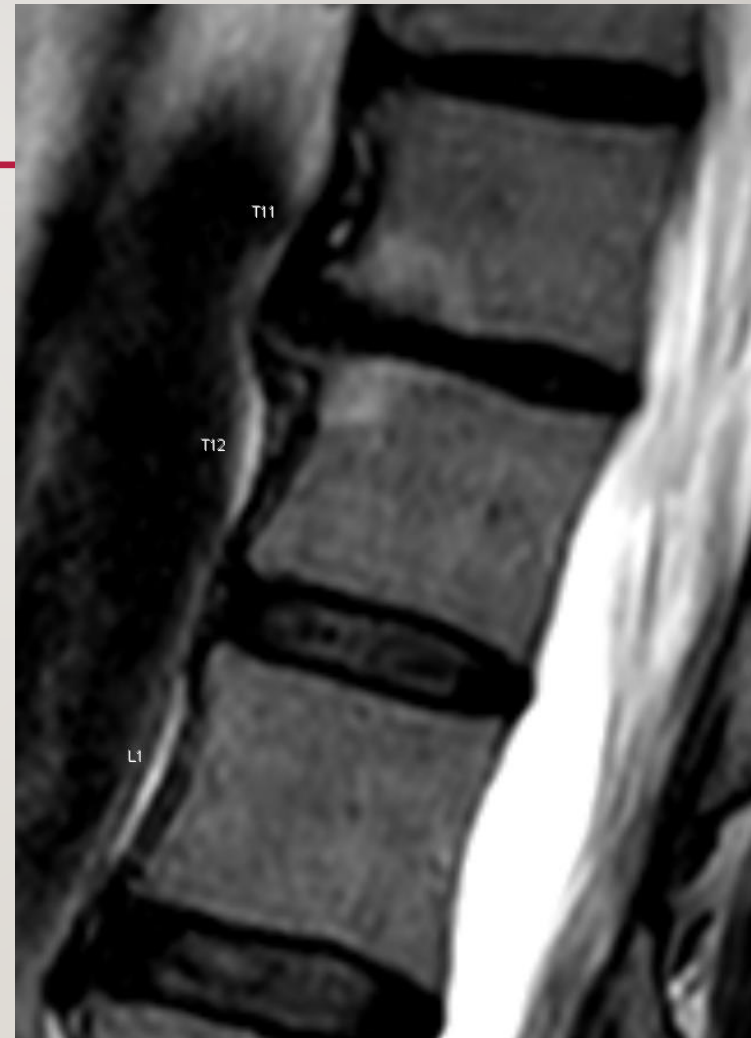


- Herniated discs in the craniocaudal (vertical) direction through a gap in the vertebral body endplate
- Also referred to as intravertebral herniations

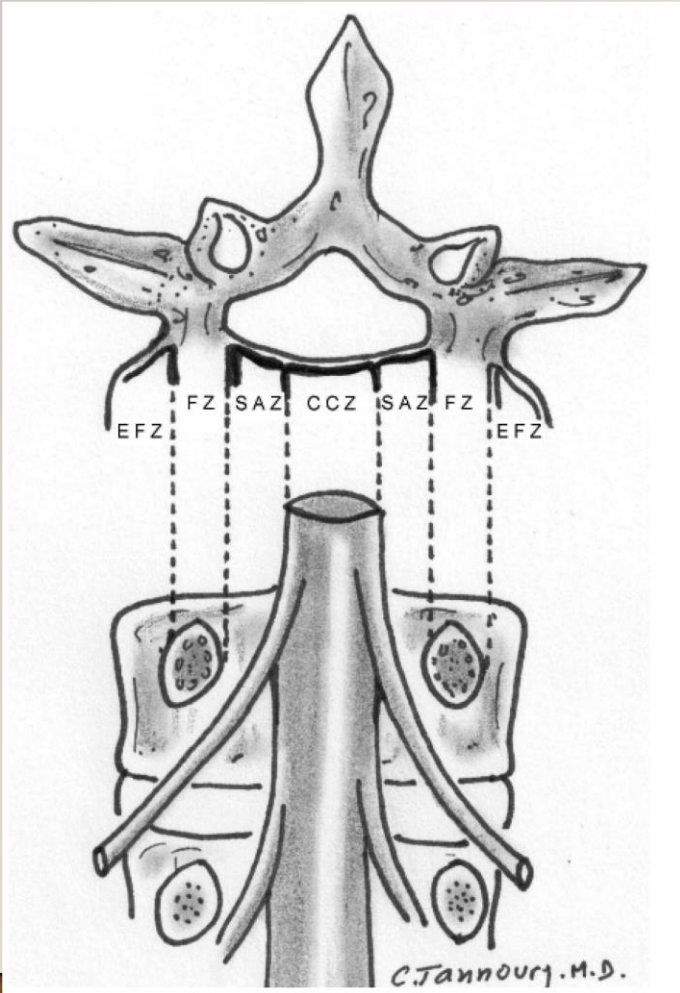
ACUTE SCHMORL'S NODE

- Associated with concentric edema
- Source of back pain
- DD: infection

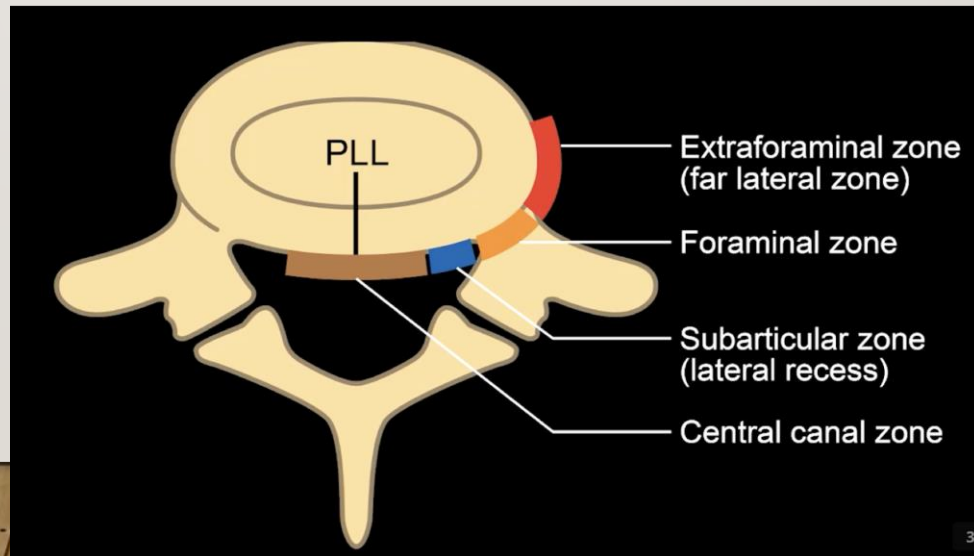
Focal endplate involvement without significant disc destruction or paraspinal abnormality



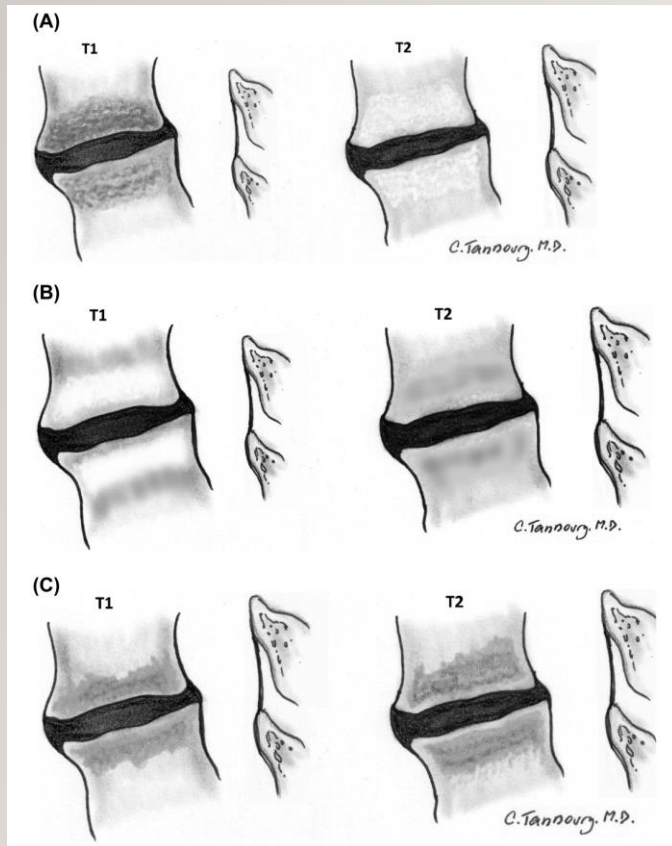
DESCRIPTION OF LOCATIONS



- CCZ – central zone
- SAZ – subarticular zone
- FZ – foraminal zone
- EFZ – extraforaminal zone



ENDPLATE DEGENERATIVE CHANGES



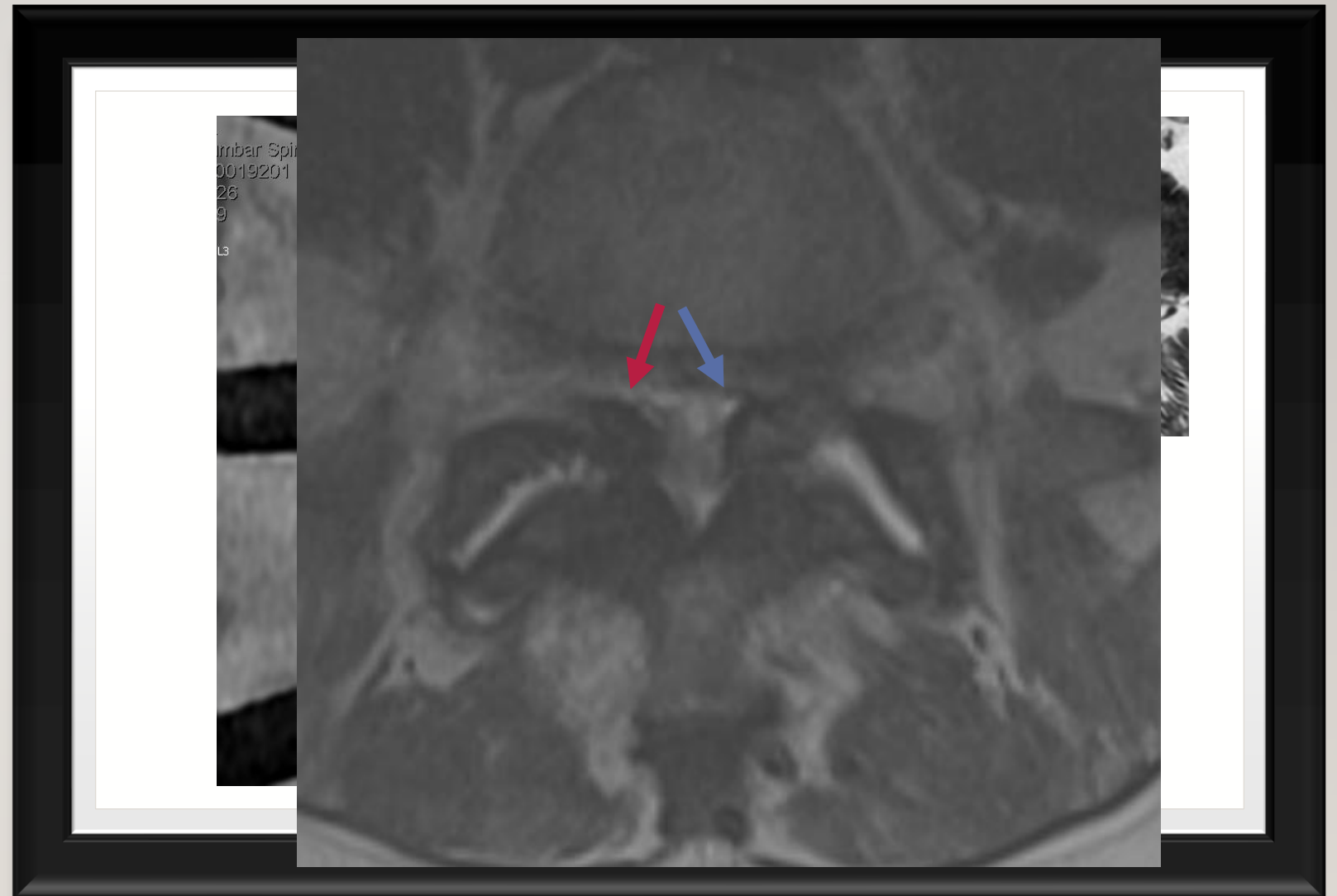
Modic type	Feature	T1	T2
I	Edematous	Normal	Bright
II	Fatty	Bright	Bright
III	Sclerotic	Dark	Dark

Pearl: Modic type changes are becoming more important as they are criteria for basivertebral plexus ablation

Only Modic I and 2 are eligible for the procedure

FACET JOINT DEGENERATION

- Joint space narrowing
- Hypertrophy
- Effusion- marker of instability
- Synovial cyst formation
- Facet joints are major pain generators



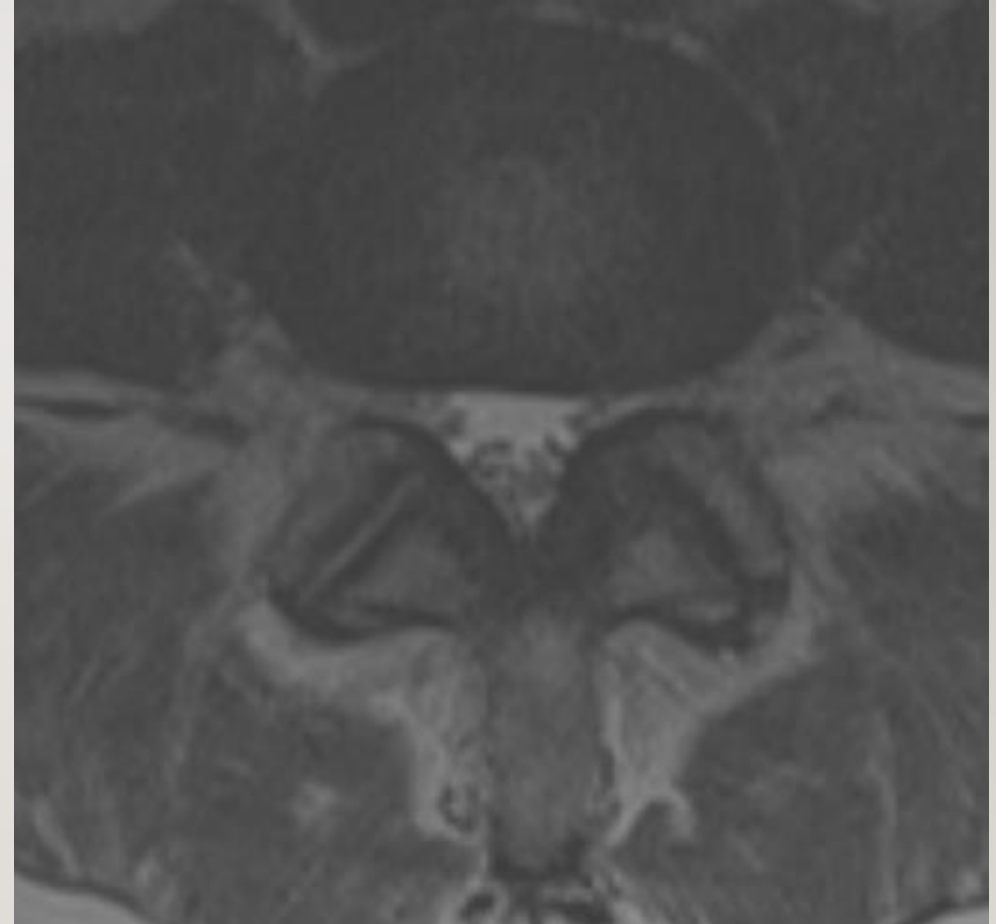
SYNOVIAL CYST

- Extension of the facet synovium secondary to degenerative changes
- Fluid usually communicates with the joint itself
- Treatment:
 - Surgical excision
 - Image-guided lysis



LIGAMENTUM FLAVUM

- Thickening and buckling
- Contributes to canal stenosis
- Often symmetric

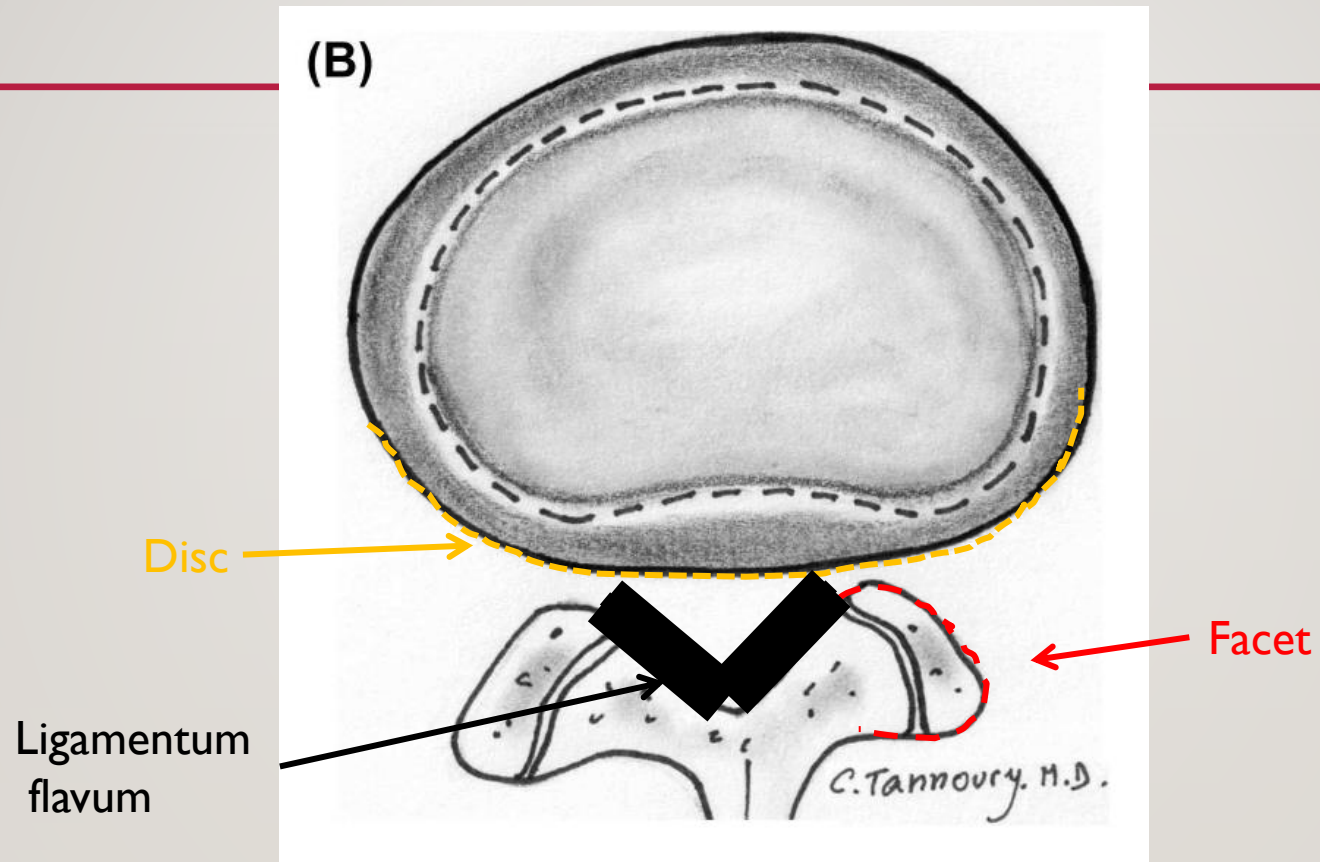


PATTERNS OF STENOSIS

- Central canal stenosis
- Lateral recess stenosis
- Foraminal stenosis

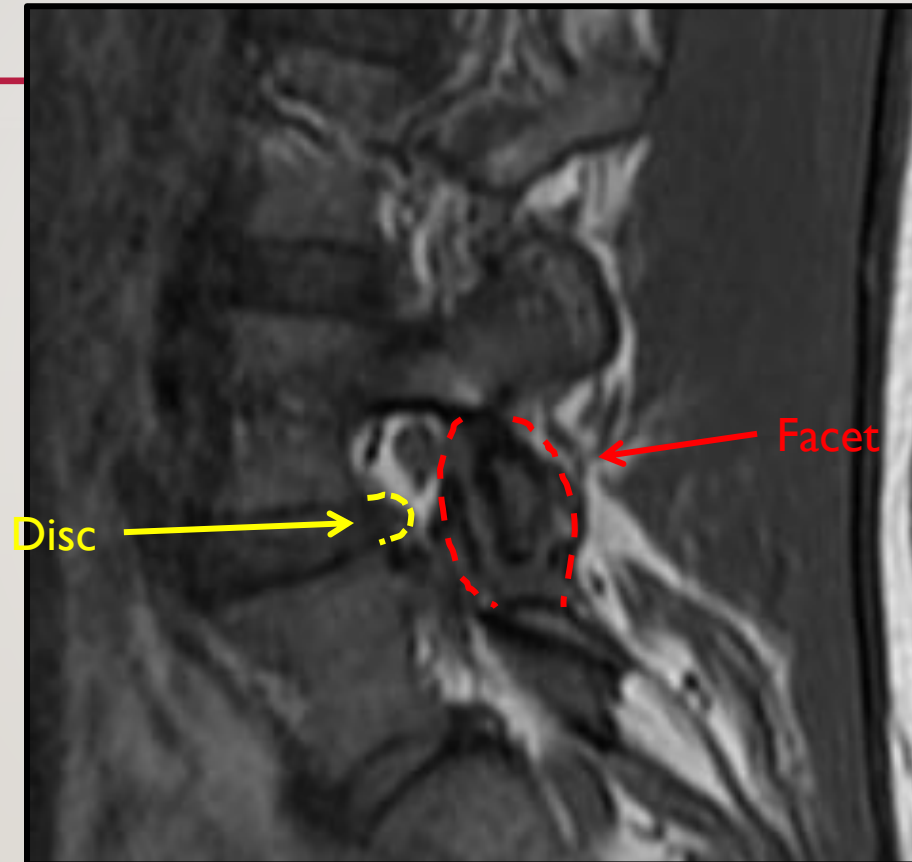
- Key point: Always report: Level, location and severity of stenosis

WHY IS THIS A PROBLEM?



The combination of disc, facet, and ligamentum flavum narrows the spinal canal.

WHY IS THIS A PROBLEM?



The combination of disc and facet impinges the neural foramen.

GRADING

Grade I (mild):

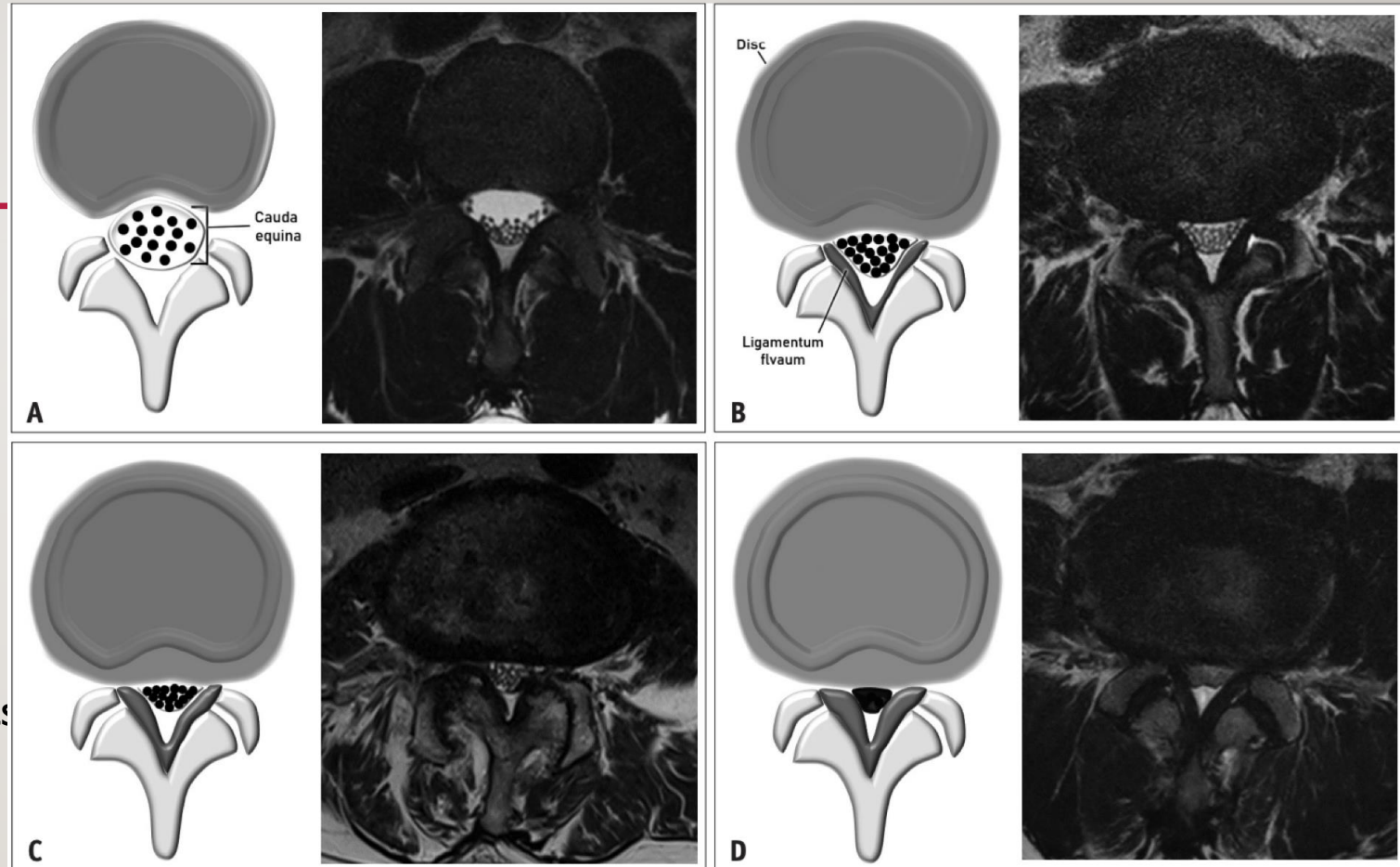
- Nerve roots are separated

Grade 2 (Moderate)

- Crowding of nerve roots

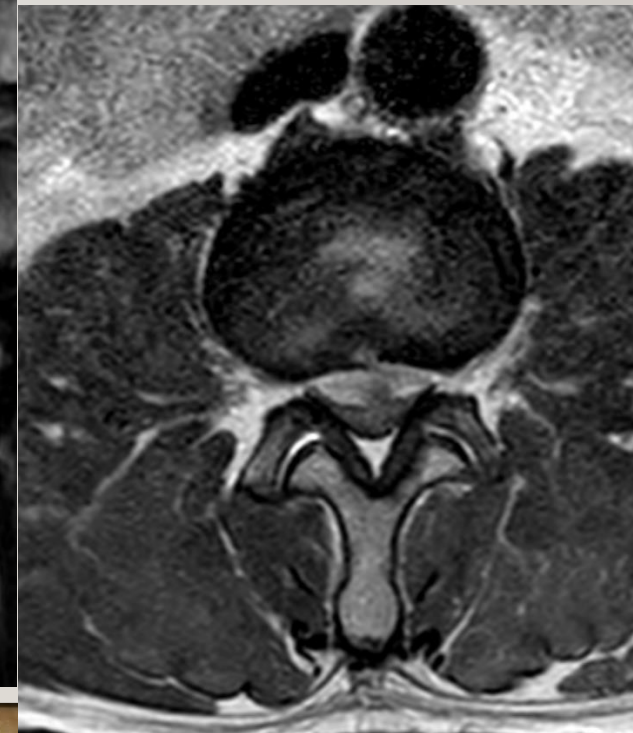
Grade 3 (Severe)

- Single bundle of nerve roots

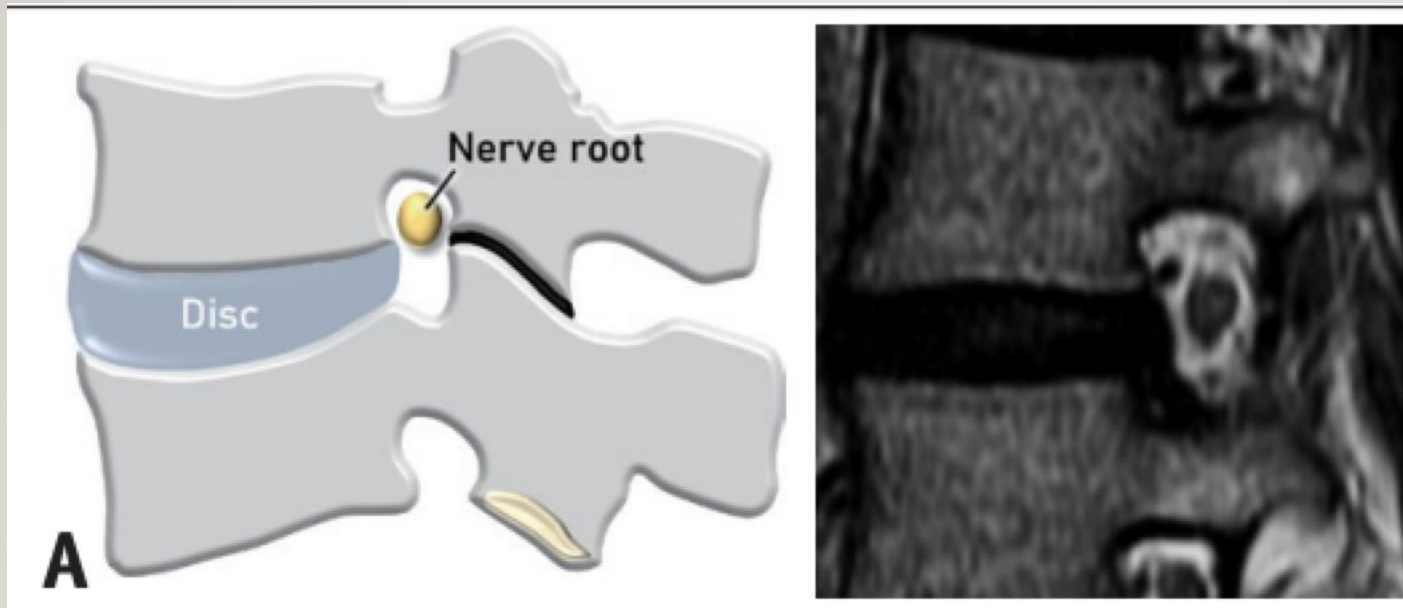


LUMBAR CANAL STENOSIS

- Neurogenic claudication
- Vascular congestion results inflammatory reaction, blood-nerve barrier disruption and wallarian degeneration
- Disrupts CSF flow

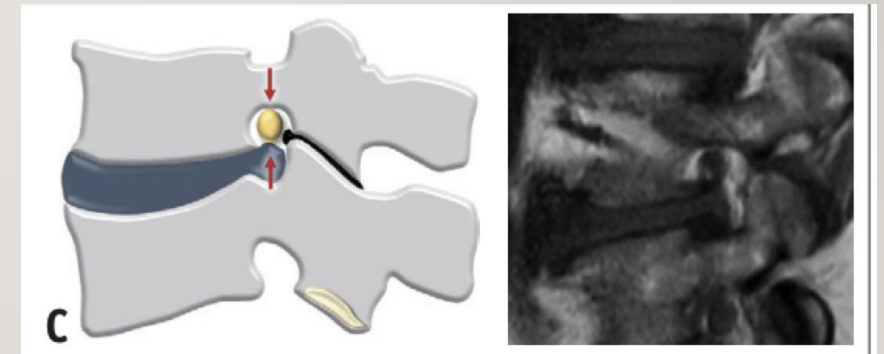
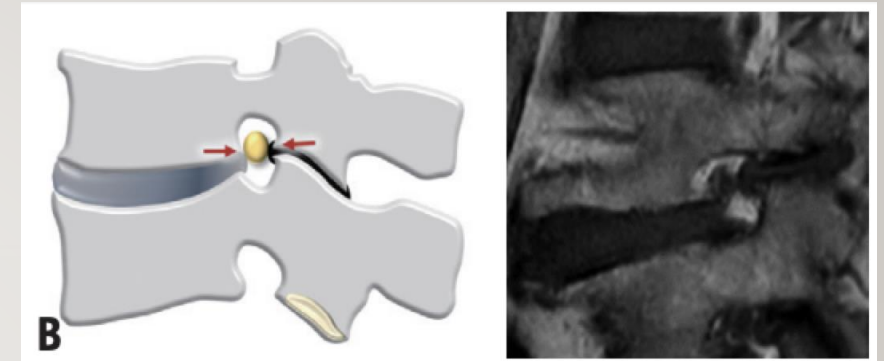


NEURAL FORAMINAL GRADING



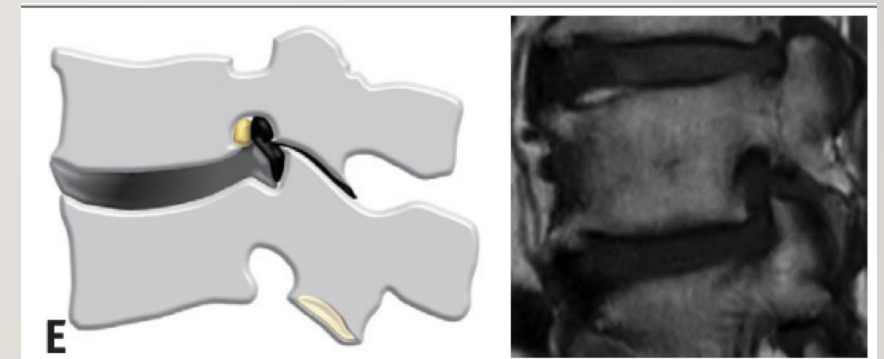
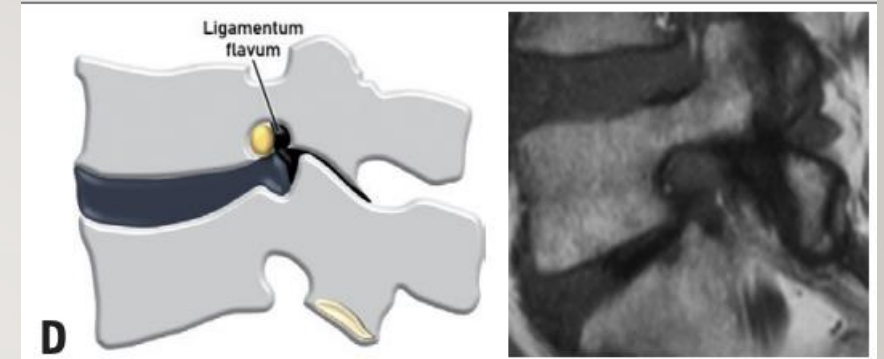
- Mild

- Perineural fat is obliterating in two directions



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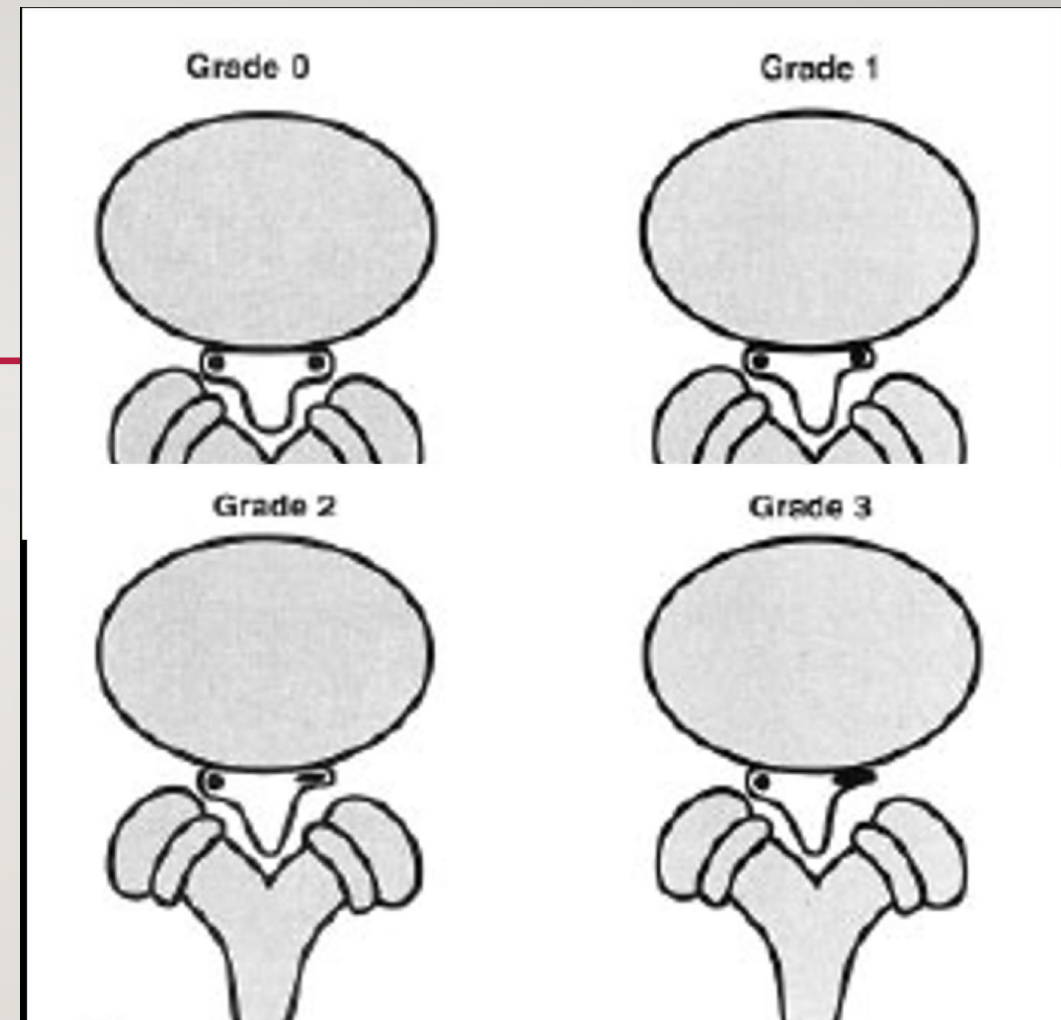
-
- Moderate
 - Perineural fat is obliterating in 4 directions
 - Severe
 - Fat obliteration and nerve root deformity



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LATERAL RECESS STENOSIS

- Mild: narrow LR without root compression
- Moderate: narrow LR with root flat
- Severe: CSF obliterated and severe root compression



BARTYNSKI Grading

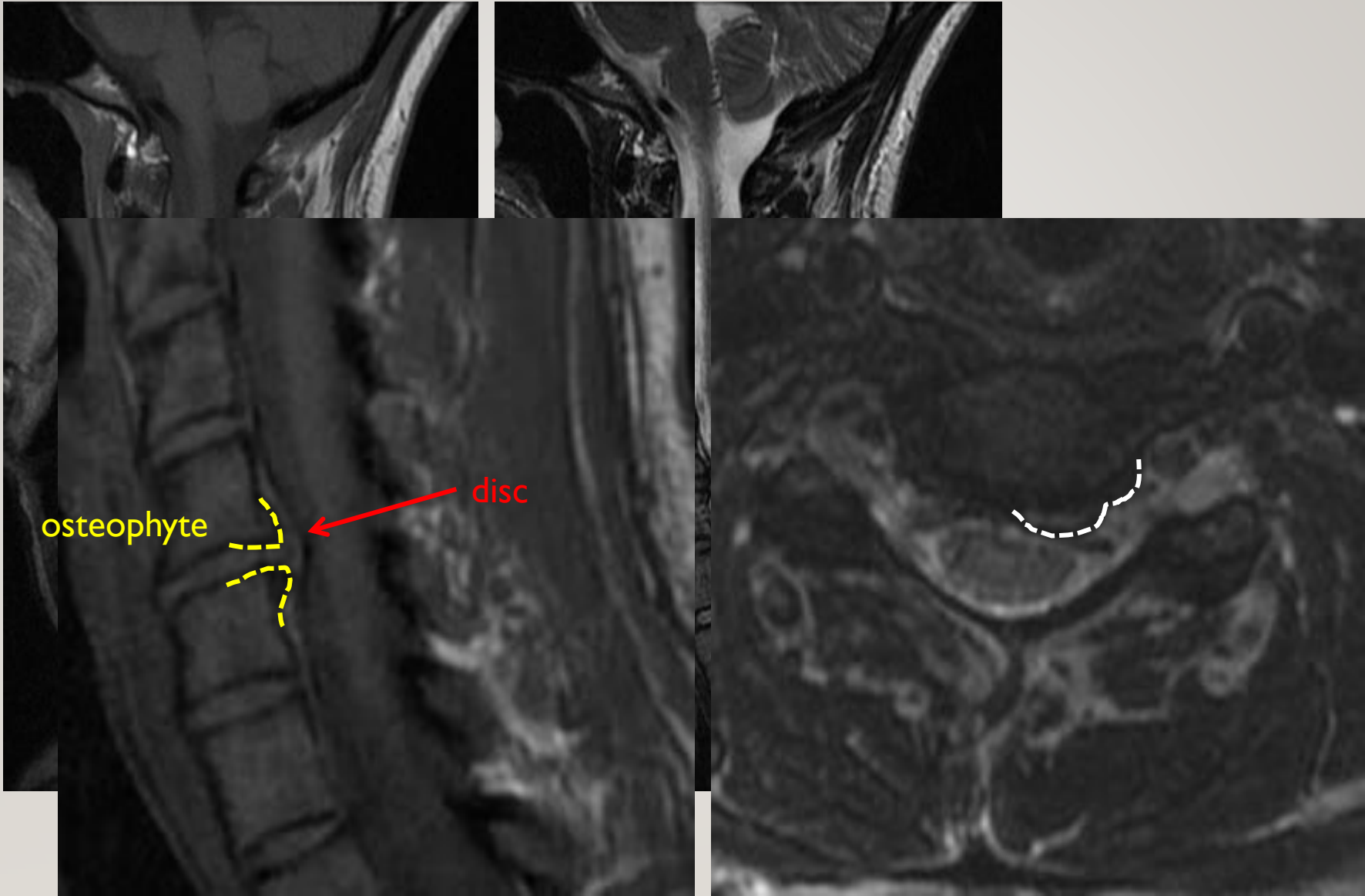
CERVICAL VS LUMBAR DJD

- Cervical
 - Uncovertebral joints
 - Higher risk of myelopathy
- Lumbar
 - Facet joint DJD
 - Radiculopathy is more common

WHAT EXACTLY IS A “DISC OSTEOPHYTE COMPLEX”?

- A bit of a blanket term to denote when there is probably both soft disc and osteophyte or calcified disc contributing to degenerative disease





Example disc osteophyte complex

BAASTRUP'S DISEASE

- Loss of height between spinous processes in the lumbar spine
- Pseudoarticulation and inflammation of the spinous processes
- Can have cystic degenerative changes
- Source of midline back pain especially with extension



OUTLINE

- Spine anatomy
- General principles and terminology
- Degenerative terminology
- Cases



T2 wt



Lt parasagittal T1 wt



L2-3



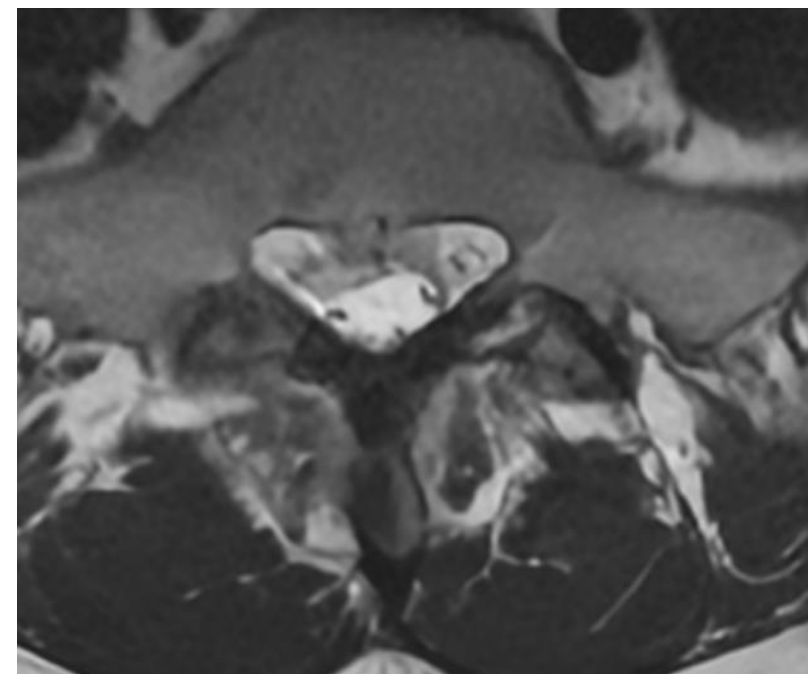
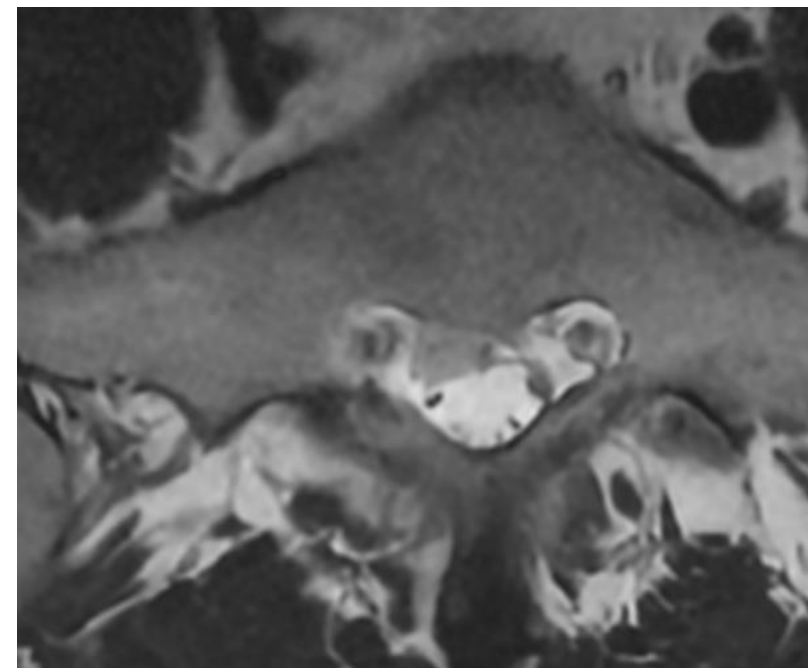
L4-5



L5-S1

CASE I: DISCOGENIC DISEASE

- At L2-3 level, large disc extrusion with cranial migration, resulting in severe canal stenosis with cauda equina compression. No significant neural foraminal stenosis.
- At L4-5, moderate diffuse disc bulge, moderate facet joint DJD with mild lateral recess and neural foraminal stenosis without nerve root indentation. There is mild widening of facet joints with effusion on either side. This is a marker of instability. I would recommend flexion and extension views of radiograph for further evaluation
- At L5-S1, There is asymmetric left lateral disc bulge and superimposed foraminal protrusion, resulting in severe foraminal stenosis with compression of exiting left L5 nerve root.
- Correlate imaging with symptoms-many findings are incidental



MULTILEVEL STENOSIS

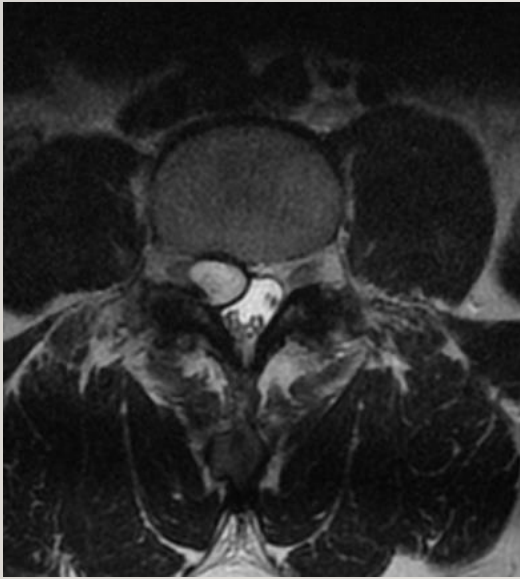
- Combined disc + facet + ligament changes
- Multilevel central and foraminal narrowing
- Identify dominant level for surgical planning

CASE 2

70 year-old man with right leg pain

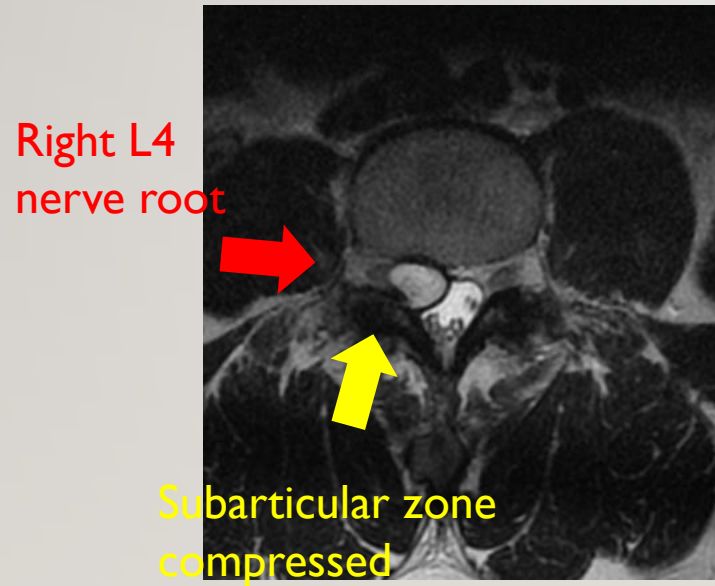






L4-L5 SYNOVIAL CYST

- Narrowing the right L4 foramen
- Completely compressing the right lateral recess (L5 nerve root)



REPORTING FRAMEWORK

- Alignment:
- Vertebral numbering :
 - The most reliable way is to number from above starting at C2
 - If we number some other way (by the last disc as L5-S1, or by number of ribs), you need to say so
- Disc pathology
 - Bulge
 - Protrusion
 - Extrusion
 - sequestration
- Facets
- Ligaments
- Stenosis
 - Central
 - Lateral recess
 - Foraminal
- Neural impact

PITFALLS

- Overcalling bulge as herniation
- Missing lateral recess stenosis
- Ignoring facet joint disease
- Confusing Modic I with infection

TAKE-HOME POINTS

- DJD is multistructural process, characterized by loss of normal anatomic relationships
- Use standardized terminology: consistent and communicate better with clinicians.
- Describe location, severity, neural effect
- Identify the likely pain generator
- Goal is not to list findings, but to identify the clinically relevant pathology



Thank you!