EVALUATING THE LUMBAR MRI:

HOW I DO IT
AKA DON'T MISS THE GOOMBA
AKA FINDING WALDO
AKA HOW NOT TO "F" IT UP

Matthew Harris, MD
Neuro & Emergency Radiology
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OBJECTIVES:

- Know when to use MRI in back pain
- Develop a reliable pattern for assessing spinal MRI
- Identify differences between normal and pathologic degenerative appearances
- Familiarity with lumbar disc nomenclature

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WHY NOT IMAGE IMMEDIATELY?

- Patients with no back pain often show anatomic abnormalities on imaging
- Labeling phenomenon shown to worsen patients' sense of well-being
- Increased rate of imaging linked to increased rate of surgery, by up to 8-fold!
- No clinically significant difference in patient outcomes between those who had immediate lumbar imaging versus usual care

https://www.aafp.org/family-physician/patient-care/clinical-recommendations/all-clinical-recommendations/low-back-pain.html

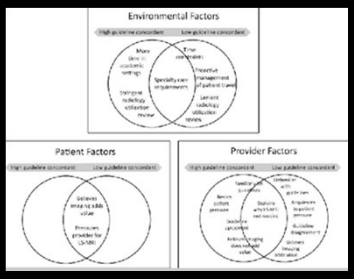
WHEN TO USE MRI IN LUMBAR PAIN

Comprehensive Red Flags and Reasons for Concern as Defined by the American College of Radiology[1]

Red Flag Symptom	Concern
History of malignancy	Malignancy
Unexplained weight loss	Malignancy
Immunocompromise	Infection, malignancy
Urinary infection	Infection, malignancy
Intravenous drug use	Infection, malignancy
Pain not improved with conservative care	Infection, malignancy
Prolonged use of steroids	Fracture
History of significant trauma	Fracture
Minor fall/heavy lift in osteoporotic/elderly individual	Fracture
Acute onset urinary retention or overflow incontinence	Cauda equina syndrome, severe neurologic compromise
Loss of anal sphincter tone or fecal incontinence	Cauda equina syndrome, severe neurologic compromise
Saddle anesthesia	Cauda equina syndrome, severe neurologic compromise
Global or progressive motor weakness in lower limbs	Cauda equina syndrome, severe neurologic compromise

Lancaster B, Goldman J, Kobayashi Y, Gottschalk AW. When Is Imaging Appropriate for a Patient With Low Back Pain? Ochsner J. 2020 Fall;20(3):248-249. doi: 10.31486/toj.20.0077. PMID: 33071654; PMCID: PMC7529135.

WHY ARE SOME PT IMAGED EARLY?



Newdal AL, Lewis ET, Wu J, Jacobs J, Jarvik JG, Chou R, Barnett PG. Factors Influencing Primary Care Providers' Unneeded Lumbar Spine MRI Orders For Acute, Uncomplicated, Low-Back Pain: a Qualitative Study. J Gen Intern Med. 2020 Apr;35(4):1044-1051. doi: 10.1007/s11606-019-05410-y. Epub 2019 Dec 12. PMID: 31832927; PMCID: PMC7174262.

CONCLUSION

- Imaging of the lumbar spine before 6 weeks does not improve outcomes, but it does increase costs
- Imaging should be saved for patients for whom noninvasive, conservative regimens have failed and surgery or therapeutic injection are being considered

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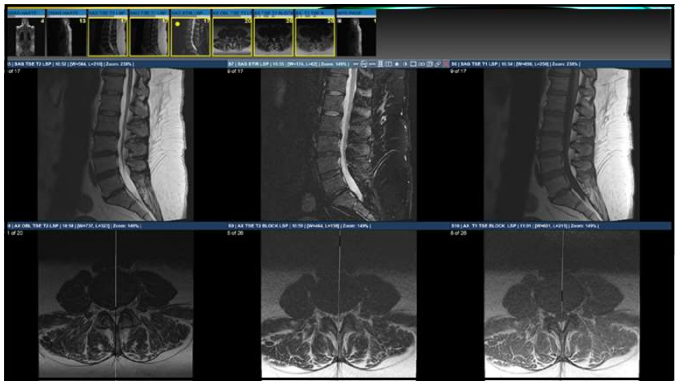
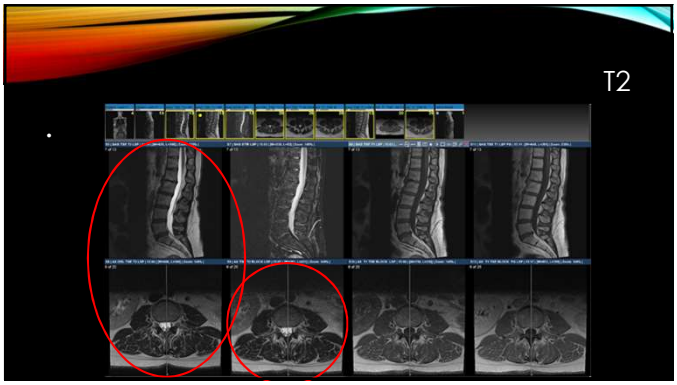
L-SPINE SEQUENCES: USE A PATTERN!!

- Sagittal: t2, t2 fat sat, t1, (post t1)
- Axial: Oblique t2, t2, t1, (post t1)
- Coronal: if avail, scout



T2



T2

- Fluid, fat, some blood: bright
- Metals, including old blood (hemosiderin): dark

STIR, AKA T2 FAT SAT

STIR, AKA T2 FAT SAT

- Fat suppressed, so only fluid bright on T2

T2 STIR

T1

-

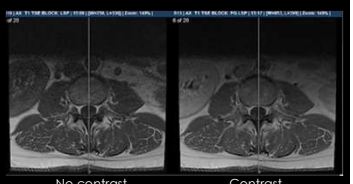
T1

- Fat, gadolinium, some blood, protein: bright
- Fluid, highly cellular tissue: dark

POST CONTRAST (AKA POST, POST CON, CON, +)

POST CONTRAST (AKA POST, POST CON, CON, +)

- Gadolinium agents pool in certain intravascular and interstitial tissues
- Inflammation, some tumors, lost blood/brain barrier: bright



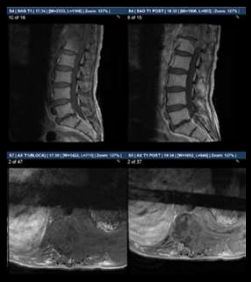
No contrast Contrast

LSPINE ASSESSMENT: USE A CHECKLIST!!

- Surgical changes
- Bones, alignment, marrow, degeneration
- Cord, conus, cauda equina, canal, enhancement
- Paraspinal tissues
- Level by level degenerative assessment
- Check comparisons

WHEN DO YOU ADD CONTRAST?

- Infection
- Neoplasm
- Postop (not hyperacute or late chronic)

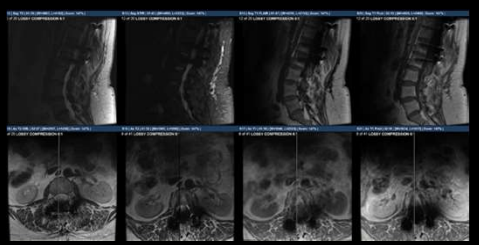


SURGICAL CHANGES

- Construct used
- Approach
- Hardware integrity
- Obvious complications

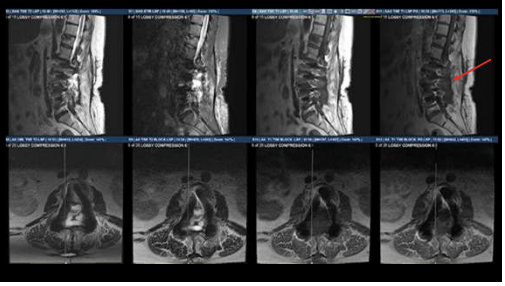
SURGICAL CHANGES

- Multilevel posterior fixation
- Metal artifact obscures detail, esp canal/foramen



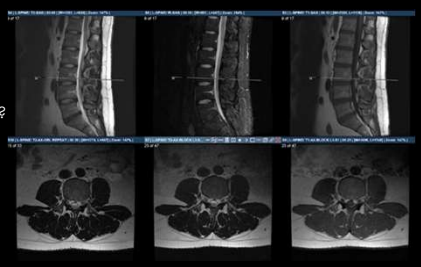
SURGICAL CHANGES

- Postop fluid collection
- Seroma, hemangioma, abscess
- *Incidental comp fx*



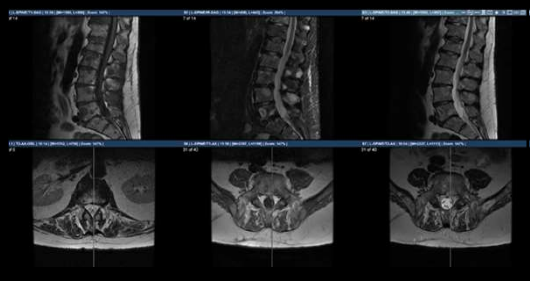
BONES

- Uniform marrow?
- Any edema?
- Hemangiomas
- Congenital anomalies?



BONES

- Multiple myeloma

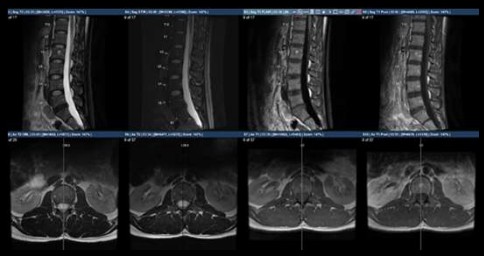


BONES

- Compression Fx
- Vertebral augmentation

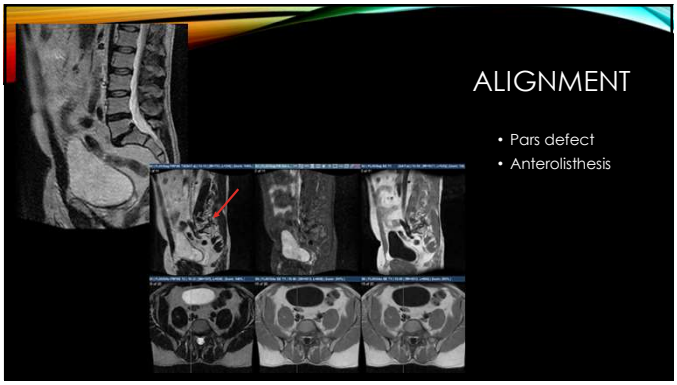
BONES

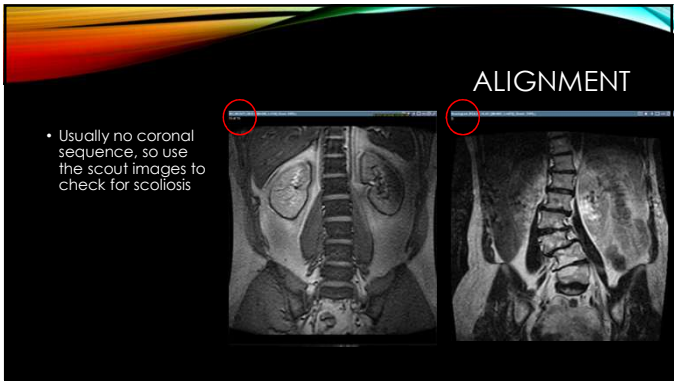
- Hemangioma

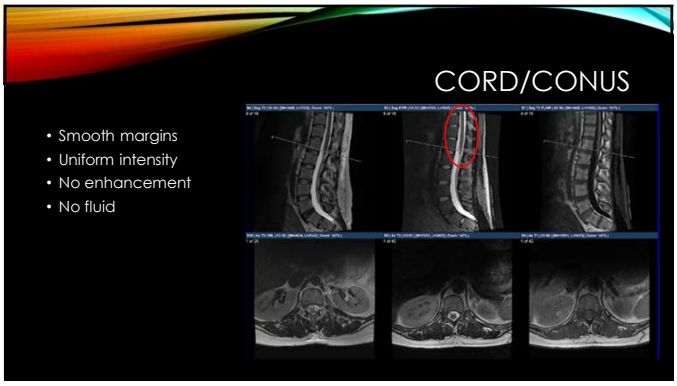


ALIGNMENT

- Spondylolisthesis
- Pars defects vs degenerative facet elongation
- Scoliosis


ALIGNMENT
• Pars defect
• Anterolisthesis


ALIGNMENT
• Usually no coronal sequence, so use the scout images to check for scoliosis


CORD/CONUS
• Smooth margins
• Uniform intensity
• No enhancement
• No fluid

CANAL

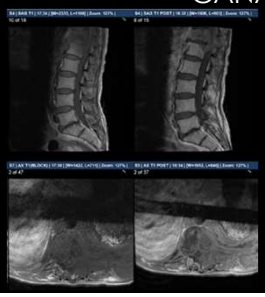
- Enough space?
- Anything in that space?
- Anything pushing the thecal sac?
- Developmental anomalies?

CANAL

- Extrinsic compression w nerve root impingement

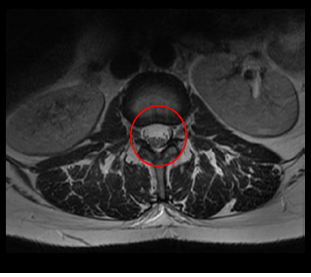
CANAL

- Epidural tumor growth
- Metastatic squamous cell lung ca



CAUDA EQUINA

- Even nerve root distribution
- No nerve root enhancement
- No nerve root thickening

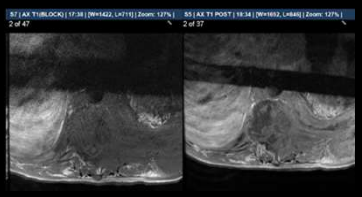


EXTRASPINAL TISSUES

- Paraspinal tissues—abcess, hematoma, phlegmon
- Sacrum, SI joints, pelvis
- Kidneys
- Aorta
- Posterior paraspinal muscles and subq fat
- Other

EXTRASPINAL TISSUE

- Pleura/paraspinal tissue
- Metastatic squamous cell lung ca



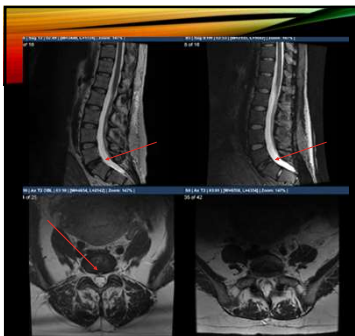
DISC LEVEL ASSESSMENT

- Discs
- Facets
- Canal stenosis
- Foraminal stenosis

DEGENERATIVE CHANGES

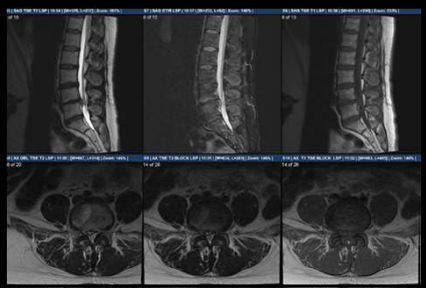
- Disc and facet assessments

- Spondylosis deformans
- Intervertebral Osteochondrosis

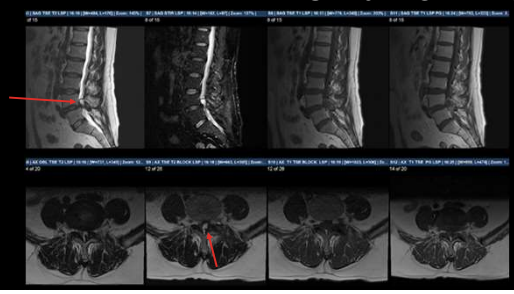


ANNULAR FISSURE

DISC EXTRUSION



FACET-SYNOVIAL CYST



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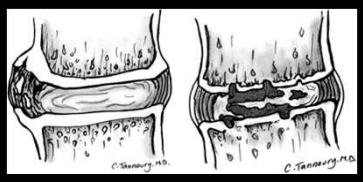
DEGENERATIVE CHANGES: TWO SEPARATE PROCESSES

Spondylosis Deformans



Intervertebral Osteochondrosis

The Spine Journal/2014 142525-2545DOI: (10.1016/j.spinee.2014.04.022)

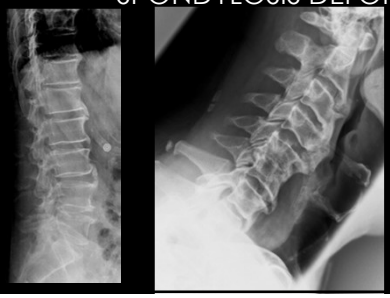
SPONDYLOSIS DEFORMANS = NORMAL AGING PROCESS

- Disc desiccation
- Disc fibrosis
- Mild narrowing of the disc space
- Diffuse mild bulging of the annulus beyond the disc space
- Osteophytes at the vertebral apophysis

SPONDYLOSIS DEFORMANS

Anterior osteophytes

SPONDYLOSIS DEFORMANS



INTERVERTEBRAL OSTEOCHONDROSIS

INTERVERTEBRAL OSTEOCHONDROSIS

- Pathologic process
- Genetic factors

- Nucleus desiccation
- Fibrotic structural disorganization
- Irregular disc contour
- Numerous annular fissures
- Disc space narrowing
- Vacuum phenomenon

- Bone erosions
- Reactive osteosclerosis
- Multidirectional osteophytes (incl. posterior osteophytes)
- Reactive marrow changes (Modic changes)

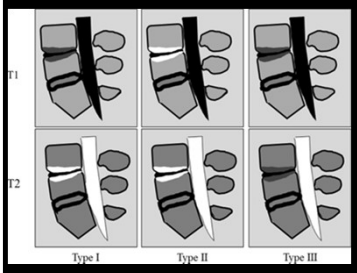
OSTEOCHONDROSIS: THE PROCESS

Disc degeneration leads to ….

- Loss of disc height → ligamentous strain → abnormal motion → accelerated DJD → restricted motion → process repeats in adjacent levels

- Posterior osteophytes → canal & foraminal stenoses
- Disc Degeneration → HNP → canal & foraminal stenoses

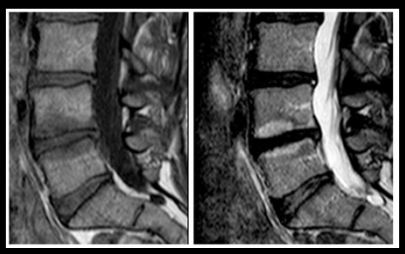
INTERVERTEBRAL OSTEOCHONDROSIS MODIC (REACTIVE MARROW) CHANGES



- Modic 1: Bone Edema
- Modic 2: Increased Subchondral Fat
- Modic 3: Bone Sclerosis

Morabe, H., Sakai T., Omichi, Y. et al. Role of growth-plate [apophyseal ring fracture] in causing modic type changes in pediatric low back pain patients. Eur Spine J 30, 2562–2569 (2021). https://doi.org/10.1007/s00586-021-06885-2

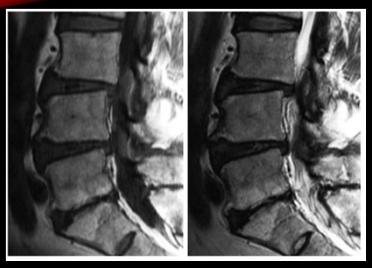
INTERVERTEBRAL OSTEOCHONDROSIS



Modic 1:
Bone Edema

http://scientificspine.com/spine-imaging/modic-changes.html

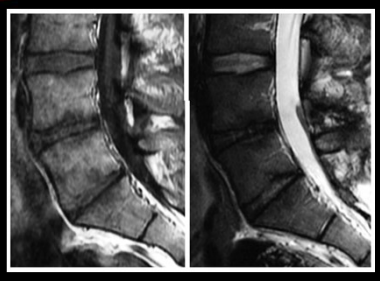
INTERVERTEBRAL OSTEOCHONDROSIS



Modic 2:
Increased
Subchondral Fat

http://scientificspine.com/spine-imaging/modic-changes.html

INTERVERTEBRAL OSTEOCHONDROSIS



Modic 3:
Bone Sclerosis

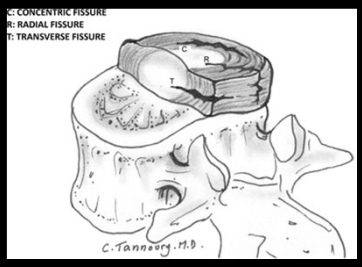
http://scientificspine.com/spine-imaging/modic-changes.html

ANNULAR FISSURE

ANNULAR TEAR = ANNULAR FISSURE

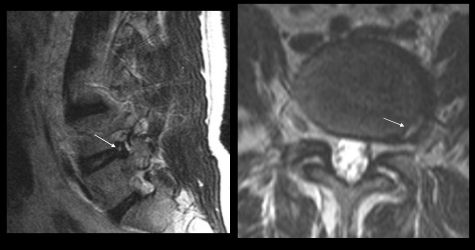
- Pathologic
- Precursor to disc herniation
- Extends from nucleus pulposus to the disc periphery
- Avulsion of disc fibers from vertebral body insertions
- Symptomatic or asymptomatic
- **Annular tears ≠ trauma**

ANNULAR FISSURE



The Spine Journal 2014 142525-2545DOI: (10.1016/j.spinee.2014.04.022)

ANNULAR FISSURE WITHIN FORAMINAL PROTRUSION



RADIAL ANNULAR FISSURE

HERNIATION

DISC HERNIATION

- *Definition*: localized or focal displacement of disc material beyond the normal margin of the intervertebral disc space.
- Disc materials: nucleus pulposus, cartilage, fragmented apophyseal bone, annular tissue and/or combination.

HERNIATION TERMINOLOGY

- *Disc Herniations*
  - Protrusion
  - Extrusion
  - Intravertebral (Schmorls node)
- *If Extruded, the disc can then…*
  - Migrate (connected but rostro-caudal slippage)
  - Sequestration (disconnect & slip)
  - Subligamentous or erode thru the PLL

DEFINITIONS FOR DISC HERNIATION

Need sagittal views. *Axial views are also necessary to obtain sufficient data to make the distinction – usually best defined on the sagittal view with correlation on the axial view*

Protrusion

The width of the herniated material doesn't exceed the width of its base ("fits back into the disc space")

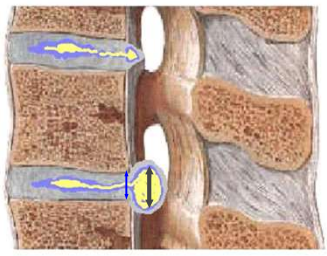
Extrusion

The width of the herniated material exceeds the width of its base ("can't fit back into the disc space")

PROTRUSION VS EXTRUSION

Protrusion
width=base

Extrusion
Width>base

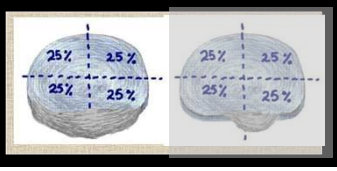


DESCRIPTIONS - DISC HERNIATION

- Shape – Protrusion or Extrusion
- Size – Relative to the size of the canal
- Location within the spinal canal
- Continuity with disc space
- Composition on T1 and T2 sequences
- Relationship to the PLL

PROTRUSION

- *Protrusion <25%*
- *Asymmetric Bulging >25%*



PROTRUSION

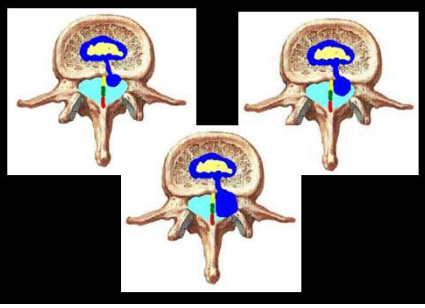
EXTRUSION

SIZE / VOLUME

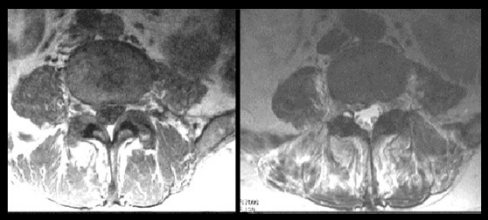
- Degree of canal compromise, in the axial plane, produced by disc displacement

- Mild < 1/3 of canal
- Moderate 1/3 and 2/3 of canal
- Severe > 2/3 of canal

SIZE OF THE HERNIATION

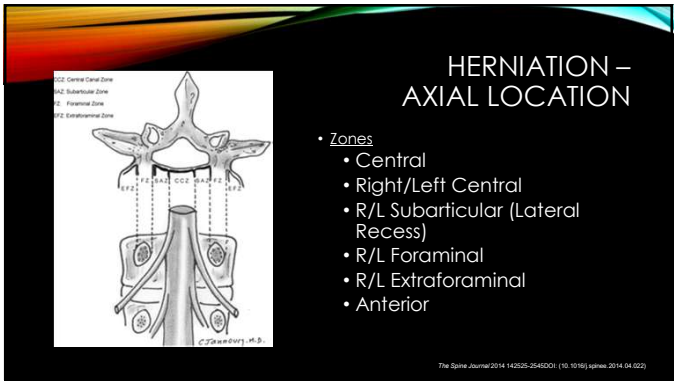


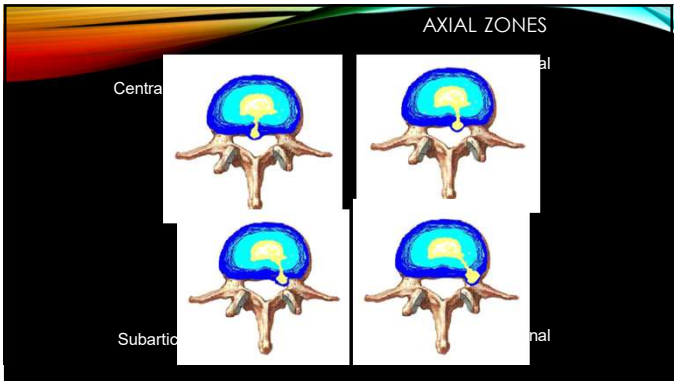
SMALL VOLUME HERNIATION

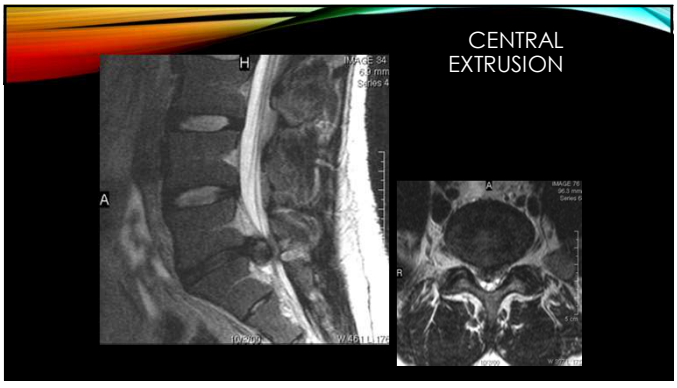


MOD VOLUME HERNIATION

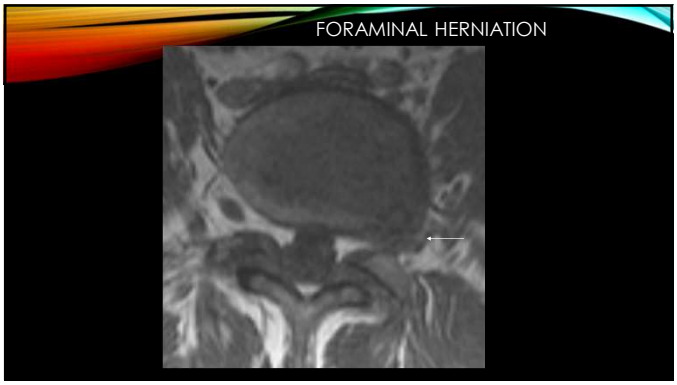
LARGE VOLUME EXTRUSION

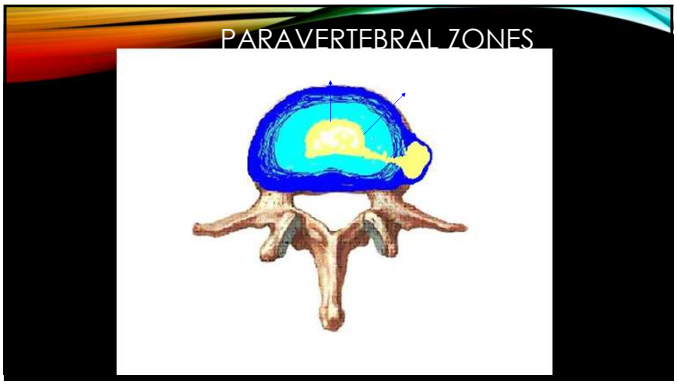

HERNIATION – AXIAL LOCATION
• Zones
• Central
• Right/Left Central
• R/L Subarticular (Lateral Recess)
• R/L Foraminal
• R/L Extraforaminal
• Anterior
The Spine Journal 2014 142525-2545DOI: (10.1016/j.spinee.2014.04.022)


AXIAL ZONES
Centra
Subartic

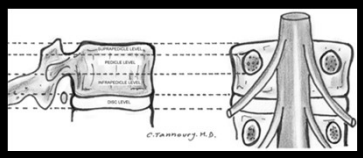

CENTRAL EXTRUSION
H
A


RIGHT
CENTER
EXTRUSION


FORAMINAL HERNIATION


PARAVERTEBRAL ZONES

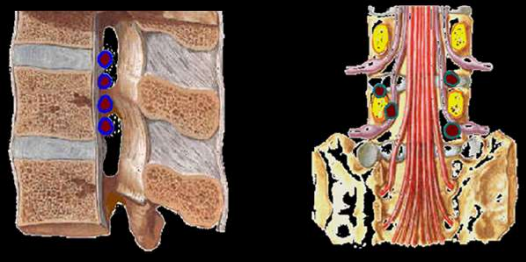
HERNIATION – SAGITTAL LOCATION



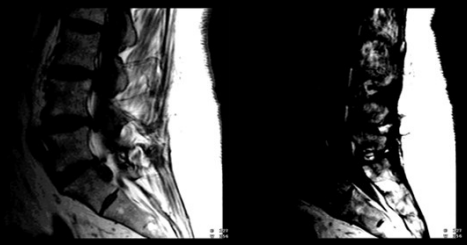
- Levels
  - Suprapedicular
  - Pedicular
  - Infrapedicular
  - Disc Level

The Spine Journal 2014 142525-2545DOI: (10.1016/j.spinee.2014.04.022)

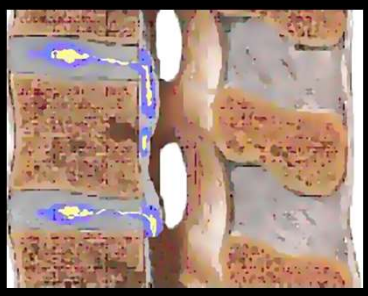
LOCALIZATION IN THE SPINAL CANAL



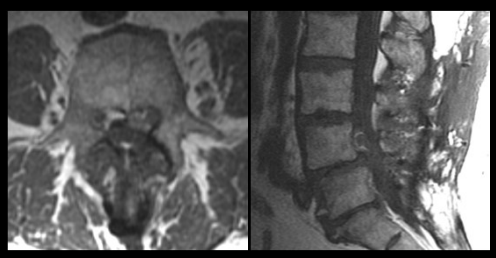
EXTRUSION W/ CAUDAL MIGRATION



MIGRATION/SEQUESTRATION



SEQUESTERED LATERAL RECESS HERNIATION



HERNIATION RELATIONSHIP TO POSTERIOR LONGITUDINAL LIGAMENT

- Subligamentous
- Extraligamentous
- Transligamentous (or perforated)

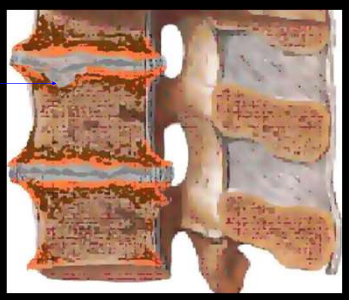
TRANSLIGAMENTOUS

DISRUPTED PLL PLUS EXTRUSION W/ CAUDAL MIGRATION

VARIATIONS OF DEGENERATIVE SPINE PROBLEMS

- **Schmorl's nodes (Lumbothoracic)**
  - Limbus Vertebral body
  - Limbus Avulsion Fracture
  - Traction Osteophytes
  - OPLL

SCHMORL'S NODE



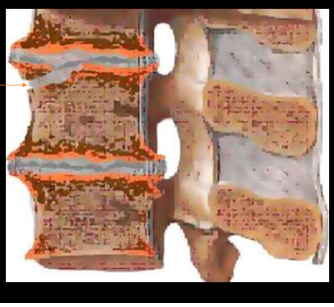
SCHMORL'S NODE

VARIATIONS OF DEGENERATIVE SPINE PROBLEMS

- Schmorl's nodes (Lumbothoracic)
- **Limbus Vertebral body**
- **Limbus Avulsion Fracture**
- Traction Osteophytes
- OPLL

LIMBUS VERTEBRAE

Schmorl's node which exits the front of the vertebral body creating a bucket handle effect



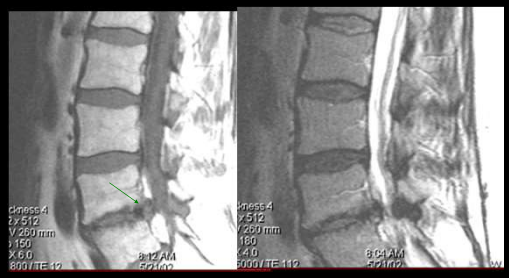
VARIATIONS OF DEGENERATIVE SPINE PROBLEMS

- Schmorl's nodes (Lumbothoracic)
- **Limbus Vertebral body**
- **Limbus Avulsion Fracture**
- Traction Osteophytes
- OPLL (cervical)

LIMBUS AVULSION: A VARIATION OF DISC HERNIATION

Limbus avulsion fx (Sharpeys fiber hold)

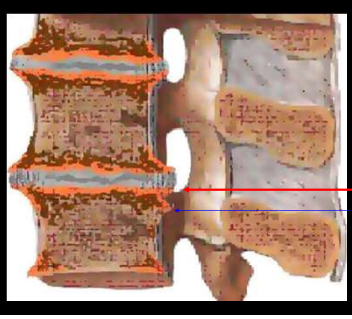
LIMBUS AVULSION / HERNIATION L4-5



VARIATIONS OF DEGENERATIVE SPINE PROBLEMS

- Schmorl's nodes (Lumbothoracic)
- Limbus Vertebral body
- Limbus Avulsion fractures (Lumbar)
- Traction Osteophytes
- OPLL

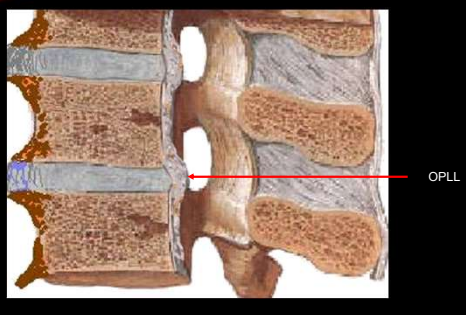
OSTEOPHYTE RIDGE + TRACTION SPUR



VARIATIONS OF DEGENERATIVE SPINE PROBLEMS

- Schmorl's nodes (Lumbothoracic)
- Limbus Avulsion fractures (Lumbar)
- Limbus Vertebral body
- Traction Osteophytes (cervical)
- **OPLL**

OSSIFYING PLL



REVIEW

- Know when to use MRI in back pain
- Develop a reliable pattern for assessing spinal MRI
- Identify differences between normal and pathologic degenerative appearances
- Familiarity with lumbar disc nomenclature

QUESTIONS?

Matthew Harris, MD
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OBJECTIVES:

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OBJECTIVES:

- Know when to use MRI in back pain
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WHY NOT IMAGE IMMEDIATELY?

- Patients with no back pain often show anatomic abnormalities on imaging
- Labeling phenomenon shown to worsen patients' sense of well-being
- Increased rate of imaging linked to increased rate of surgery, by up to 8-fold!
- No clinically significant difference in patient outcomes between those who had immediate lumbar imaging versus usual care

https://www.aafp.org/family-physician/patient-care/clinical-recommendations/all-clinical-recommendations/low-back-pain.html

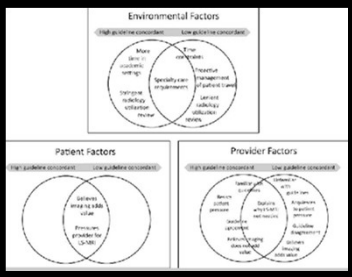
WHEN TO USE MRI IN LUMBAR PAIN

Comprehensive Red Flags and Reasons for Concern as Defined by the American College of Radiology[1]

Red Flag Symptom	Concern
History of malignancy	Malignancy
Unexplained weight loss	Malignancy
Immunocompromise	Infection, malignancy
Urinary infection	Infection, malignancy
Intravenous drug use	Infection, malignancy
Pain not improved with conservative care	Infection, malignancy
Prolonged use of steroids	Fracture
History of significant trauma	Fracture
Minor fall/heavy lift in osteoporotic/elderly individual	Fracture
Acute onset urinary retention or overflow incontinence	Cauda equina syndrome, severe neurologic compromise
Loss of anal sphincter tone or fecal incontinence	Cauda equina syndrome, severe neurologic compromise
Saddle anesthesia	Cauda equina syndrome, severe neurologic compromise
Global or progressive motor weakness in lower limbs	Cauda equina syndrome, severe neurologic compromise

Lancaster B, Goldman J, Kobayashi Y, Gottschalk AW. When Is Imaging Appropriate for a Patient With Low Back Pain? Ochsner J. 2020 Fall;20(3):248-249. doi: 10.31486/toj.20.0077. PMID: 33071654; PMCID: PMC7529135.

WHY ARE SOME PT IMAGED EARLY?



Newdal AL, Lonka ET, Wu J, Jacobs J, Jarvik JG, Chou R, Barnett PG. Factors Influencing Primary Care Providers' Unneeded Lumbar Spine MRI Orders for Acute, Uncomplicated Low Back Pain: a Qualitative Study. J Gen Intern Med. 2020 Apr;35(4):1044-1051. doi: 10.1007/s11606-019-05410-y. Epub 2019 Dec 12. PMID: 31832927; PMCID: PMC7174262

CONCLUSION

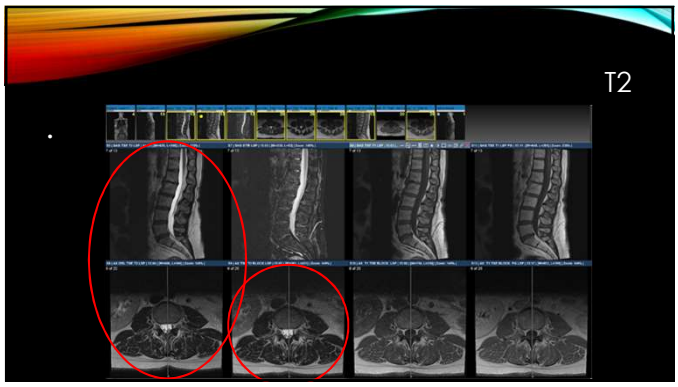
- Imaging of the lumbar spine before 6 weeks does not improve outcomes, but it does increase costs
- Imaging should be saved for patients for whom noninvasive, conservative regimens have failed and surgery or therapeutic injection are being considered

OBJECTIVES:

- Know when to use MRI
- Develop a reliable pattern for assessing spinal MRI
- Identify differences between normal and pathologic degenerative appearances
- Familiarity with lumbar disc nomenclature

L-SPINE SEQUENCES: USE A PATTERN!!

- Sagittal: t2, t2 fat sat, t1, (post t1)
- Axial: Oblique t2, t2, t1, (post t1)
- Coronal: if avail, scout


T2

T2

- Fluid, fat, some blood: bright
- Metals, including old blood (hemosiderin): dark

STIR, AKA T2 FAT SAT

-

STIR, AKA T2 FAT SAT

- Fat suppressed, so only fluid bright on T2

T2 STIR

T1

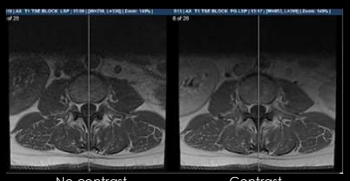
T1

- Fat, gadolinium, some blood, protein: bright
- Fluid, highly cellular tissue: dark

POST CONTRAST (AKA POST, POST CON, CON, +)

POST CONTRAST (AKA POST, POST CON, CON, +)

- Gadolinium agents pool in certain intravascular and interstitial tissues
- Inflammation, some tumors, lost blood/brain barrier: bright



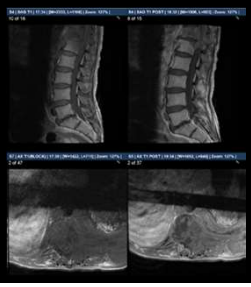
No contrast Contrast

LSPINE ASSESSMENT: USE A CHECKLIST!!

- Surgical changes
- Bones, alignment, marrow, degeneration
- Cord, conus, cauda equina, canal, enhancement
- Paraspinal tissues
- Level by level degenerative assessment
- Check comparisons

WHEN DO YOU ADD CONTRAST?

- Infection
- Neoplasm
- Postop (not hyperacute or late chronic)

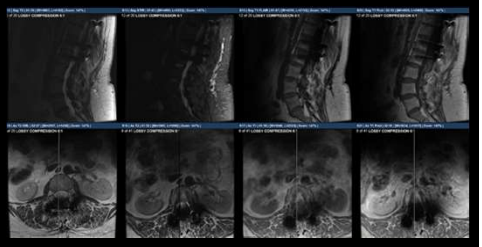


SURGICAL CHANGES

- Construct used
- Approach
- Hardware integrity
- Obvious complications

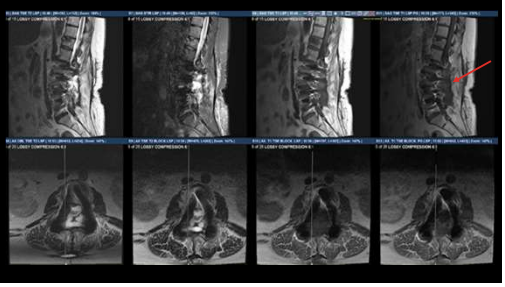
SURGICAL CHANGES

- Multilevel posterior fixation
- Metal artifact obscures detail, esp canal/foramen



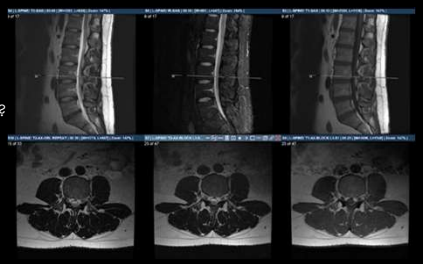
SURGICAL CHANGES

- Postop fluid collection
- Seroma, hemangioma, abscess
- *Incidental comp fx*



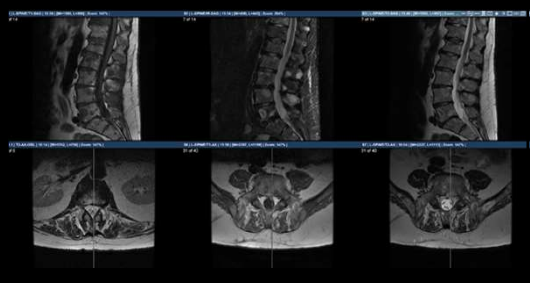
BONES

- Uniform marrow?
- Any edema?
- Hemangiomas
- Congenital anomalies?



BONES

- Multiple myeloma

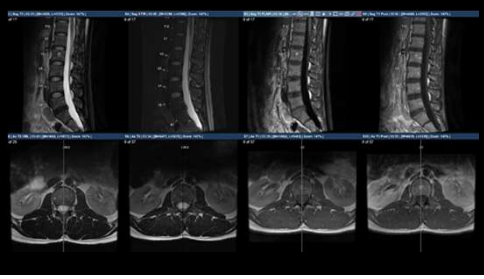


BONES

- Compression Fx
- Vertebral augmentation

BONES

- Hemangioma



ALIGNMENT

- Spondylolisthesis
- Pars defects vs degenerative facet elongation
- Scoliosis

ALIGNMENT

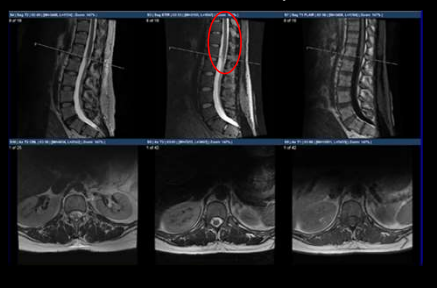
- Pars defect
- Anterolisthesis

ALIGNMENT

- Usually no coronal sequence, so use the scout images to check for scoliosis

CORD/CONUS

- Smooth margins
- Uniform intensity
- No enhancement
- No fluid



CANAL

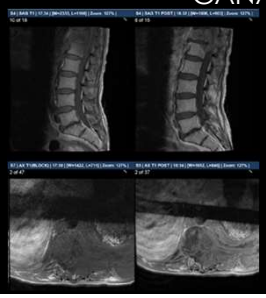
- Enough space?
- Anything in that space?
- Anything pushing the thecal sac?
- Developmental anomalies?

CANAL

- Extrinsic compression w nerve root impingement

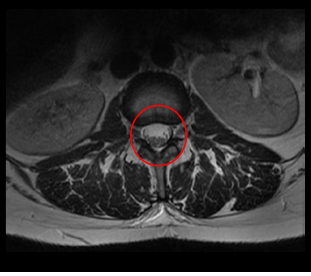
CANAL

- Epidural tumor growth
- Metastatic squamous cell lung ca



CAUDA EQUINA

- Even nerve root distribution
- No nerve root enhancement
- No nerve root thickening

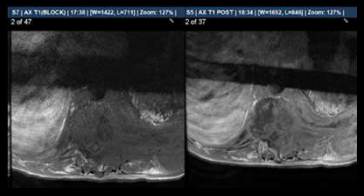


EXTRASPINAL TISSUES

- Paraspinal tissues—abcess, hematoma, phlegmon
- Sacrum, SI joints, pelvis
- Kidneys
- Aorta
- Posterior paraspinal muscles and subq fat
- Other

EXTRASPINAL TISSUE

- Pleura/paraspinal tissue
- Metastatic squamous cell lung ca



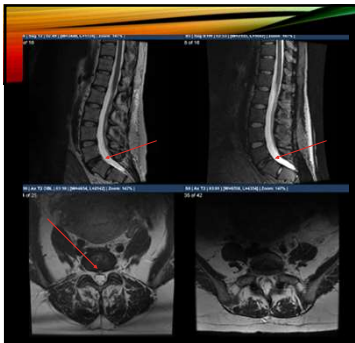
DISC LEVEL ASSESSMENT

- Discs
- Facets
- Canal stenosis
- Foraminal stenosis

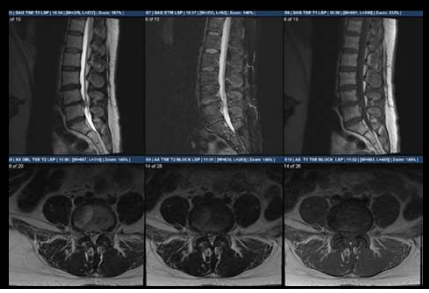
DEGENERATIVE CHANGES

- Disc and facet assessments
- Spondylosis deformans
- Intervertebral Osteochondrosis

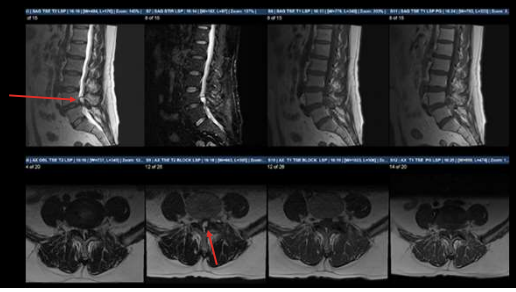
ANNULAR FISSURE



DISC EXTRUSION



FACET-SYNOVIAL CYST



OBJECTIVES:

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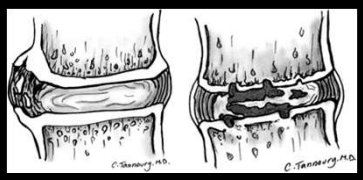
DEGENERATIVE CHANGES: TWO SEPARATE PROCESSES

Spondylosis Deformans



Intervertebral Osteochondrosis

The Spine Journal 2014 142525-2545DOI: (10.1016/j.spinee.2014.04.022)

SPONDYLOSIS DEFORMANS = NORMAL AGING PROCESS

- Disc desiccation
- Disc fibrosis
- Mild narrowing of the disc space
- Diffuse mild bulging of the annulus beyond the disc space
- Osteophytes at the vertebral apophysis

SPONDYLOSIS DEFORMANS

SPONDYLOSIS DEFORMANS

INTERVERTEBRAL OSTEOCHONDROSIS

INTERVERTEBRAL OSTEOCHONDROSIS

- Pathologic process
- Genetic factors

- Nucleus desiccation
- Fibrotic structural disorganization
- Irregular disc contour
- Numerous annular fissures
- Disc space narrowing
- Vacuum phenomenon

- Bone erosions
- Reactive osteosclerosis
- Multidirectional osteophytes (incl. posterior osteophytes)
- Reactive marrow changes (Modic changes)

OSTEOCHONDROSIS: THE PROCESS

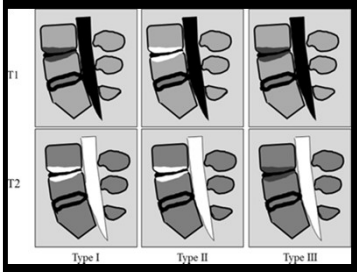
Disc degeneration leads to ….

- Loss of disc height → ligamentous strain → abnormal motion → accelerated DJD → restricted motion → process repeats in adjacent levels

- Posterior osteophytes → canal & foraminal stenoses

- Disc Degeneration → HNP → canal & foraminal stenoses

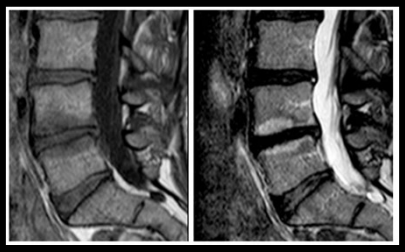
INTERVERTEBRAL OSTEOCHONDROSIS MODIC (REACTIVE MARROW) CHANGES



- Modic 1: Bone Edema
- Modic 2: Increased Subchondral Fat
- Modic 3: Bone Sclerosis

Manabe, H., Sakai, T., Oinishi, T. et al. Role of growth plate (apophyseal ring fracture) in causing modic Type changes in pediatric low back pain patients. Eur Spine J 30, 2965–2969 (2021). https://doi.org/10.1007/s00586-021-06885-2

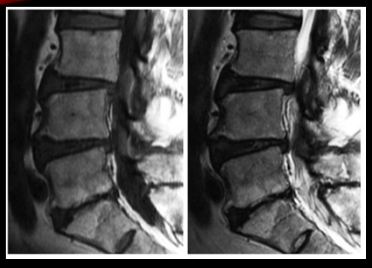
INTERVERTEBRAL OSTEOCHONDROSIS



Modic 1: Bone Edema

http://scientificspine.com/spine-imaging/modic-changes.html

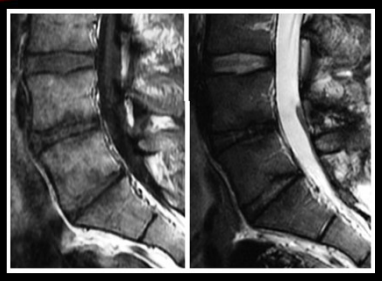
INTERVERTEBRAL OSTEOCHONDROSIS



Modic 2: Increased Subchondral Fat

http://scientificspine.com/spine-imaging/modic-changes.html

INTERVERTEBRAL OSTEOCHONDROSIS



Modic 3:
Bone Sclerosis

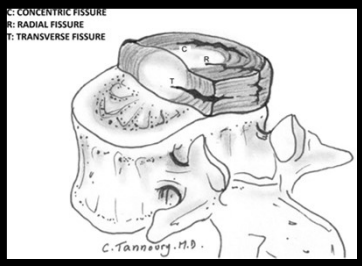
http://scientificspine.com/spine-imaging/modic-changes.html

ANNULAR FISSURE

ANNULAR TEAR = ANNULAR FISSURE

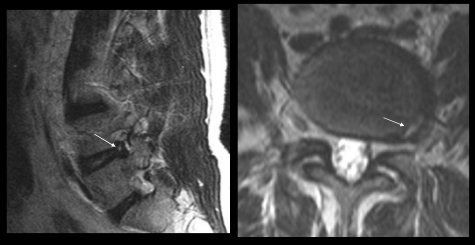
- Pathologic
- Precursor to disc herniation
- Extends from nucleus pulposus to the disc periphery
- Avulsion of disc fibers from vertebral body insertions
- Symptomatic or asymptomatic
- **Annular tears ≠ trauma**

ANNULAR FISSURE



The Spine Journal 2014 142525-2545DOI: (10.1016/j.spinee.2014.04.022)

ANNULAR FISSURE WITHIN FORAMINAL PROTRUSION



RADIAL ANNULAR FISSURE

HERNIATION

DISC HERNIATION

- *Definition*: localized or focal displacement of disc material beyond the normal margin of the intervertebral disc space.
- Disc materials: nucleus pulposus, cartilage, fragmented apophyseal bone, annular tissue and/or combination.

HERNIATION TERMINOLOGY

- *Disc Herniations*
  - Protrusion
  - Extrusion
  - Intravertebral (Schmorls node)
- *If Extruded, the disc can then…*
  - Migrate (connected but rostro-caudal slippage)
  - Sequestration (disconnect & slip)
  - Subligamentous or erode thru the PLL

DEFINITIONS FOR DISC HERNIATION

Need sagittal views. *Axial views are also necessary to obtain sufficient data to make the distinction – usually best defined on the sagittal view with correlation on the axial view*

Protrusion

The width of the herniated material doesn't exceed the width of its base ("fits back into the disc space")

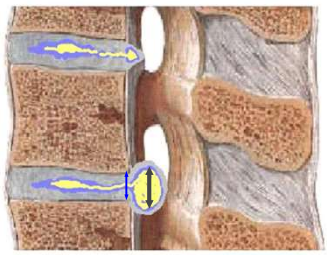
Extrusion

The width of the herniated material exceeds the width of its base ("can't fit back into the disc space")

PROTRUSION VS EXTRUSION

Protrusion
width=base

Extrusion
Width>base

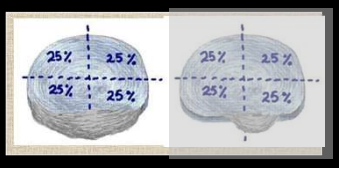


DESCRIPTIONS - DISC HERNIATION

- Shape – Protrusion or Extrusion
- Size – Relative to the size of the canal
- Location within the spinal canal
- Continuity with disc space
- Composition on T1 and T2 sequences
- Relationship to the PLL

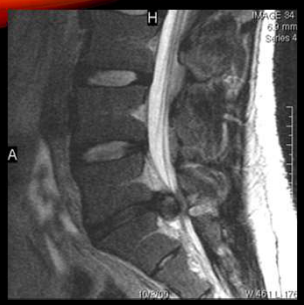
PROTRUSION

- *Protrusion <25%*
- *Asymmetric Bulging >25%*



PROTRUSION

EXTRUSION

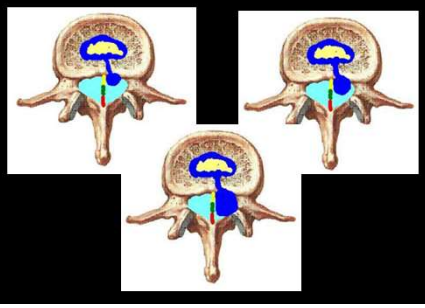


SIZE / VOLUME

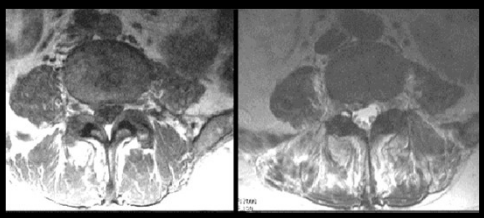
- Degree of canal compromise, in the axial plane, produced by disc displacement

- Mild < 1/3 of canal
- Moderate 1/3 and 2/3 of canal
- Severe > 2/3 of canal

SIZE OF THE HERNIATION

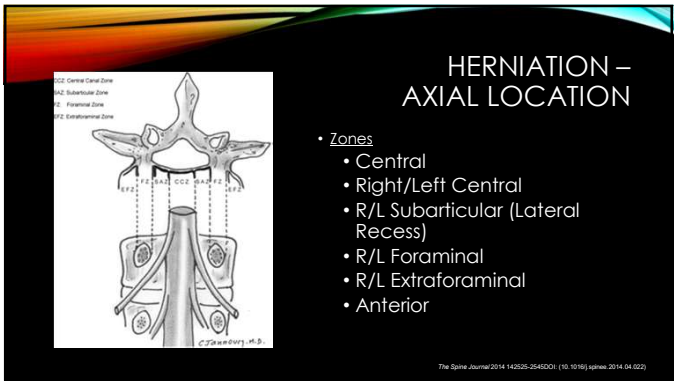


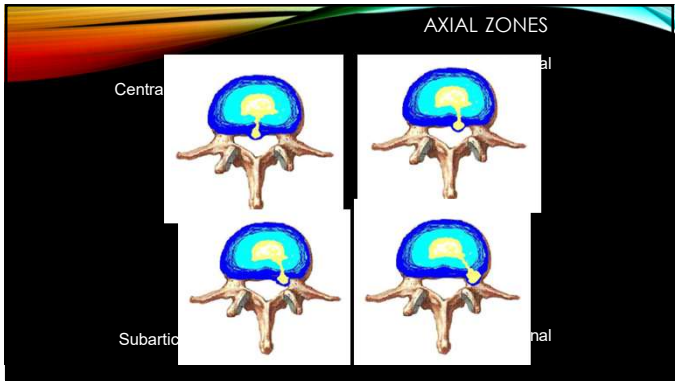
SMALL VOLUME HERNIATION

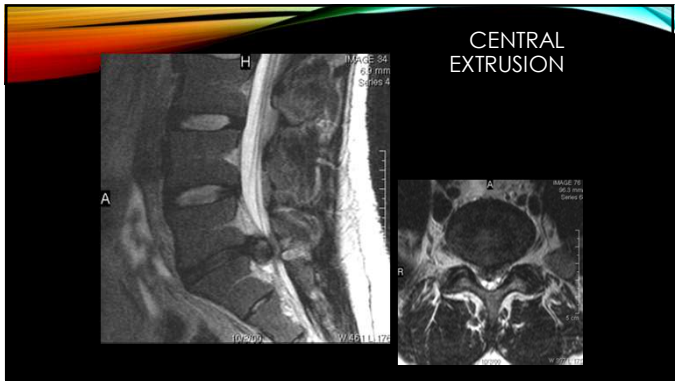



MOD
VOLUME
HERNIATION


LARGE
VOLUME
EXTRUSION
H
A
A
R

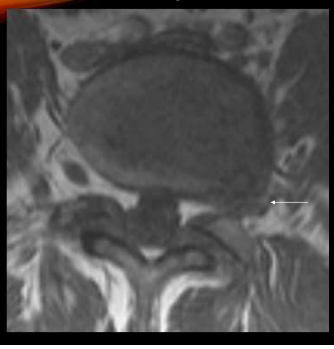

HERNIATION –
AXIAL LOCATION
• Zones
• Central
• Right/Left Central
• R/L Subarticular (Lateral Recess)
• R/L Foraminal
• R/L Extraforaminal
• Anterior
The Spine Journal 2014 142525-2545DOI: (10.1016/j.spinee.2014.04.022)


AXIAL ZONES
Centra
al
Subartic
nal

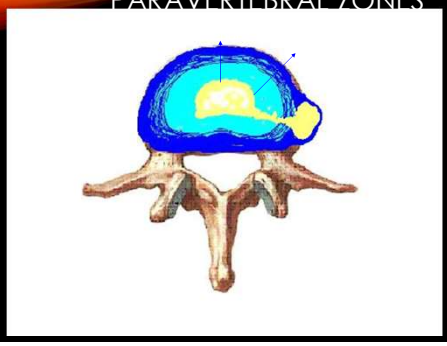

CENTRAL
EXTRUSION
H
A
A
R


RIGHT
CENTER
EXTRUSION

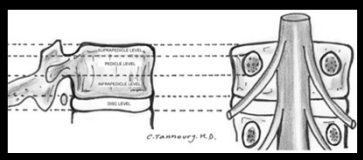
FORAMINAL HERNIATION



PARAVERTEBRAL ZONES



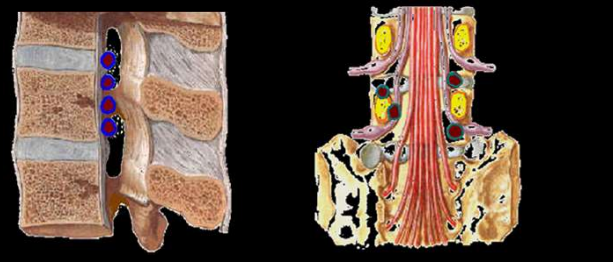
HERNIATION – SAGITTAL LOCATION



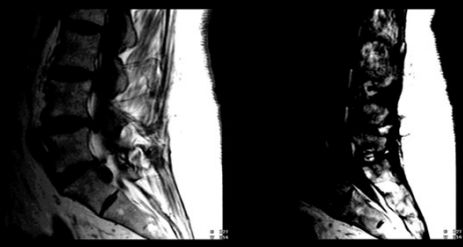
- Levels
  - Suprapedicular
  - Pedicular
  - Infrapedicular
  - Disc Level

The Spine Journal 2014 142525-2545DOI: (10.1016/j.spinee.2014.04.022)

LOCALIZATION IN THE SPINAL CANAL



EXTRUSION W/ CAUDAL MIGRATION

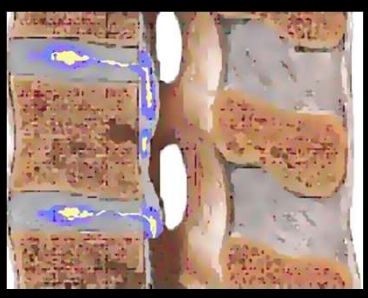


MIGRATION/SEQUESTRATION

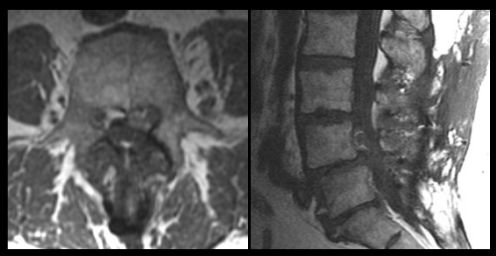
Extruded Fragment (caudal migration)

Sequestered Free fragment

Extruded Fragment (no migration)



SEQUESTERED LATERAL RECESS HERNIATION



HERNIATION RELATIONSHIP TO POSTERIOR LONGITUDINAL LIGAMENT

- Subligamentous
- Extraligamentous
- Transligamentous (or perforated)

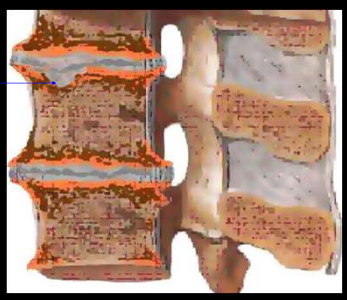
TRANSLIGAMENTOUS

DISRUPTED PLL PLUS EXTRUSION W/ CAUDAL MIGRATION

VARIATIONS OF DEGENERATIVE SPINE PROBLEMS

- **Schmorl's nodes (Lumbothoracic)**
  - Limbus Vertebral body
  - Limbus Avulsion Fracture
  - Traction Osteophytes
  - OPLL

SCHMORL'S NODE



SCHMORL'S NODE

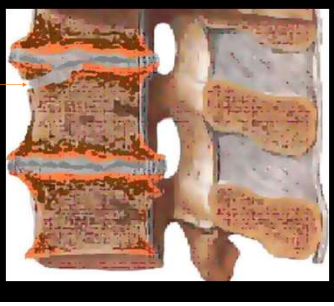
w/ contrast

VARIATIONS OF DEGENERATIVE SPINE PROBLEMS

- Schmorl's nodes (Lumbothoracic)
- **Limbus Vertebral body**
- **Limbus Avulsion Fracture**
- Traction Osteophytes
- OPLL

LIMBUS VERTEBRAE

Schmorl's node which exits the front of the vertebral body creating a bucket handle effect



VARIATIONS OF DEGENERATIVE SPINE PROBLEMS

- Schmorl's nodes (Lumbothoracic)
- **Limbus Vertebral body**
- **Limbus Avulsion Fracture**
- Traction Osteophytes
- OPLL (cervical)

LIMBUS AVULSION: A VARIATION OF DISC HERNIATION

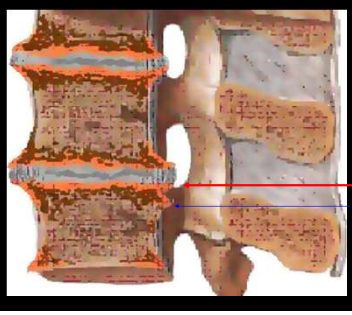
Limbus avulsion fx (Sharpeys fiber hold)

LIMBUS AVULSION / HERNIATION L4-5

VARIATIONS OF DEGENERATIVE SPINE PROBLEMS

- Schmorl's nodes (Lumbothoracic)
- Limbus Vertebral body
- Limbus Avulsion fractures (Lumbar)
- Traction Osteophytes
- OPLL

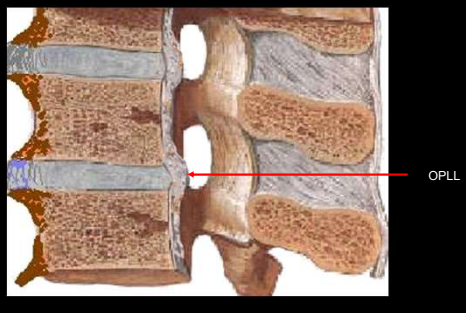
OSTEOPHYTE RIDGE + TRACTION SPUR



VARIATIONS OF DEGENERATIVE SPINE PROBLEMS

- Schmorl's nodes (Lumbothoracic)
- Limbus Avulsion fractures (Lumbar)
- Limbus Vertebral body
- Traction Osteophytes (cervical)
- **OPLL**

OSSIFYING PLL



REVIEW

- Know when to use MRI in back pain
- Develop a reliable pattern for assessing spinal MRI
- Identify differences between normal and pathologic degenerative appearances
- Familiarity with lumbar disc nomenclature

QUESTIONS?

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