



SOUTHWEST OHIO
PAIN INSTITUTE

Patient Care Education Research

Imaging for Lumbar Degenerative Disc Disease

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Spectrum of Imaging Modalities

- Radiography,
- Fluoroscopy and techniques modified with contrast (myelography discography),
- Computed tomography (CT),
- Magnetic resonance (MR), and
- Scintigraphy (isotope bone scan).

Basics, (not very basics)

- A probe, or energy source, is applied to a patient whereby there is a physical interaction that alters the probe (changes the energy output) and this is recorded by a detector
- Ionizing Radiation (electrons or nucleus) or Non Ionizing Sources (RF or sonication)
- Projectional or cross-sectional

Performance Capability

- Spatial resolution
- Contrast resolution
- Temporal resolution

Spatial Resolution

- Ability to see spatial detail
- Radiography has the greatest spatial resolution
- CT and MR has intermediate resolution
- Scintigraphy has the least resolution

Contrast Resolution

- Ability to distinguish between signal values at different locations
- Radiograph requires 10% change in signal to detect contrast differences
- CT can detect 0.5% differences.
- MR is superior as it can perform different pulse sequences to exploit different types of soft tissue contrast.
- Nuclear Medicine can also detect 10% difference in radioactivity
- “contrast agent” improve contrast resolution

Temporal Resolution

- Ability to distinguish temporal difference.

MRI

- Type of image “weighting” determines MR contrast.
- Most common are T1-weighted, T-2 weighted, intermediate weighted (proton density), and short tau inversion recovery (STIR).

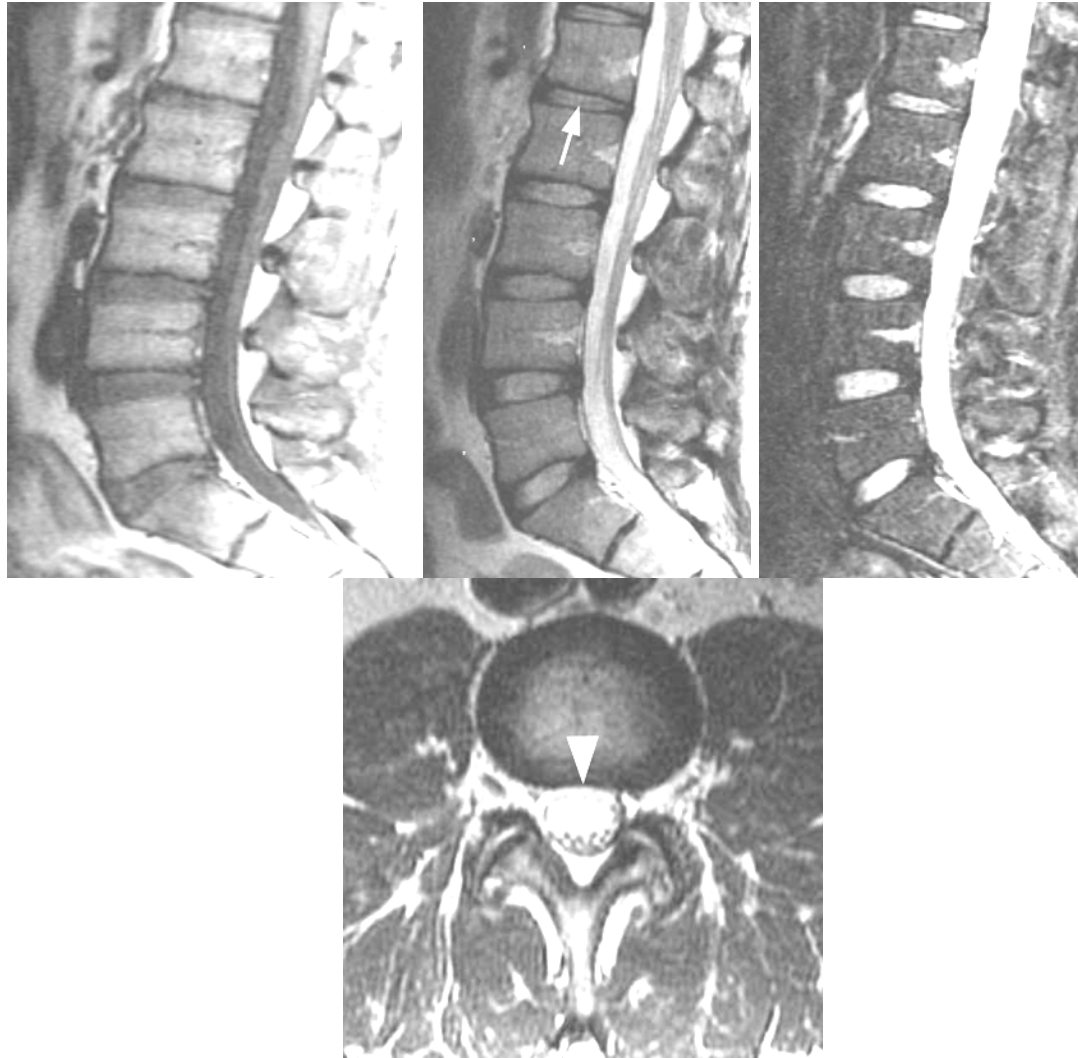
T-1 Weighted images

- Useful for detection of fat, fat appears bright and fluid appears dark
- Fat acts as natural contrast agent
- Used for detection of epidural or paraspinal lesions, marrow infiltration or replacement, hemangiomas
- Also used after contrast with fat suppression.

T-2 Weighted Images

- Fluid appears bright, so CSF appears bright
- Useful for detection of bone marrow edema, and critical in showing disc pathology
- Specific uses include, diagnosis of disc dessication, hyperintensity zones and Modic end plate findings.

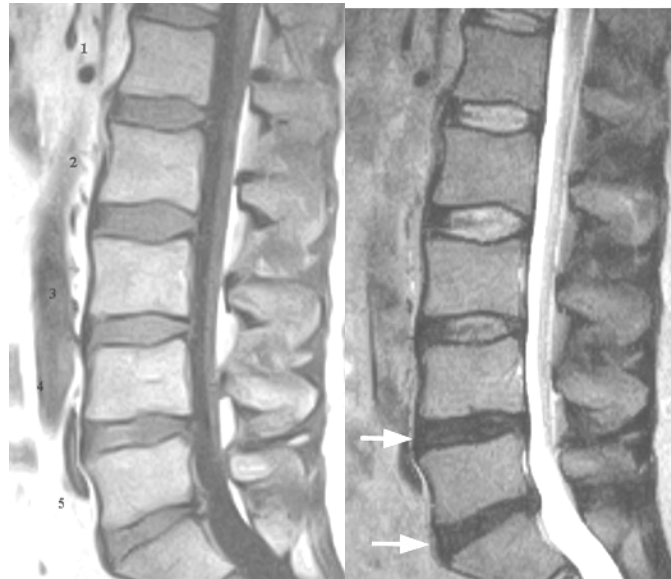
MR of normal lumbar disc



Imaging findings of Degenerative disc disease

- Disc structure
 - Annulus fibrosis-Type 1 collagen
 - Nucleus pulposus- glycosaminoglycans (85-90% water)
 - Cartilagenous end plate
- Disc increases in size from cephalad to caudad except for the lumbosacral junction
- The posterior disc margins are concave in upper spine and straight or slightly convex at L4-5 and L5-S1
- Often there is a horizontally oriented developmental cleft.

Disc Dessication



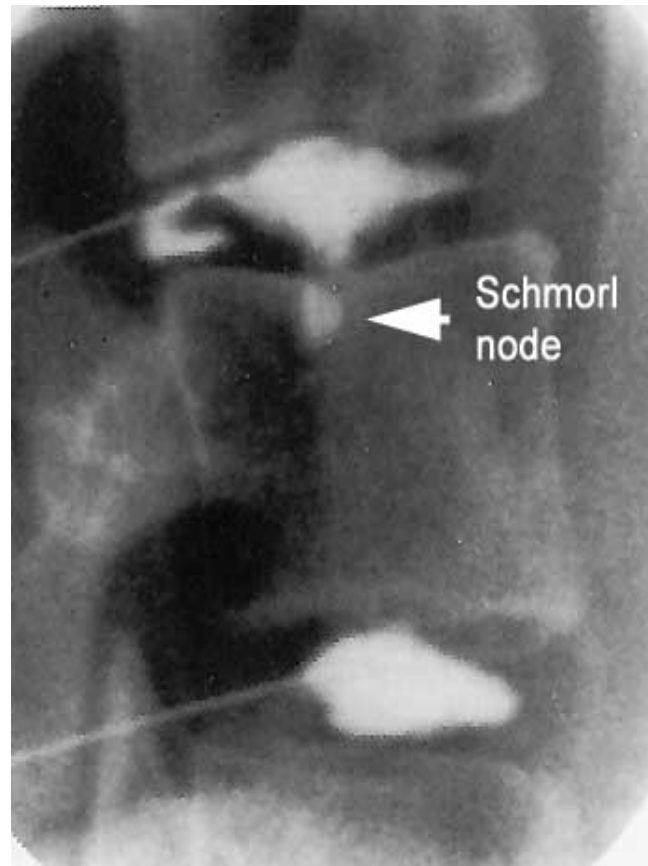
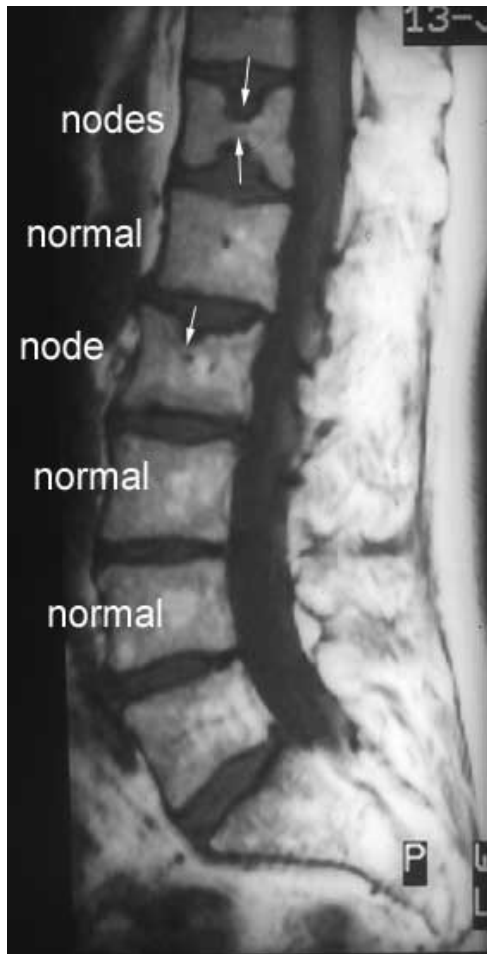
Taxonomy of Degenerative Joint Disease

- Osteoarthritis or osteoarthrosis
- Degenerative Disc Disease
- Spondylosis
- Spondylosis deformans with osteophytosis
- Intervertebral osteochondrosis
- Internal disc disruption

Degenerative changes

- Anterior and Lateral Marginal osteophytes vs posterior osteophytes
- Calcification of anterior and posterior longitudinal ligament
- Diffuse idiopathic skeletal hyperostosis (DISH)
- Schmorl nodes

Schmorl Nodes



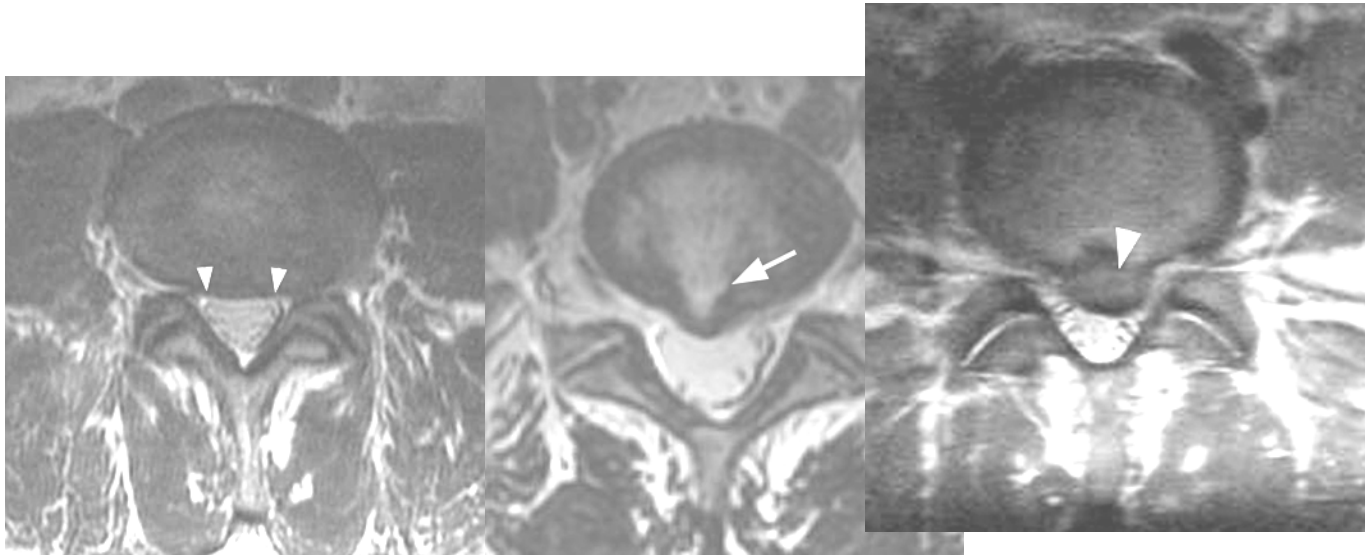
DISH



Disc Contour Changes (bulges and herniation)

- Annular Bulge
- Disc Herniation
 - Protrusion
 - Broad based or focal
 - Extrusion
 - Sequestered

Disc contour changes



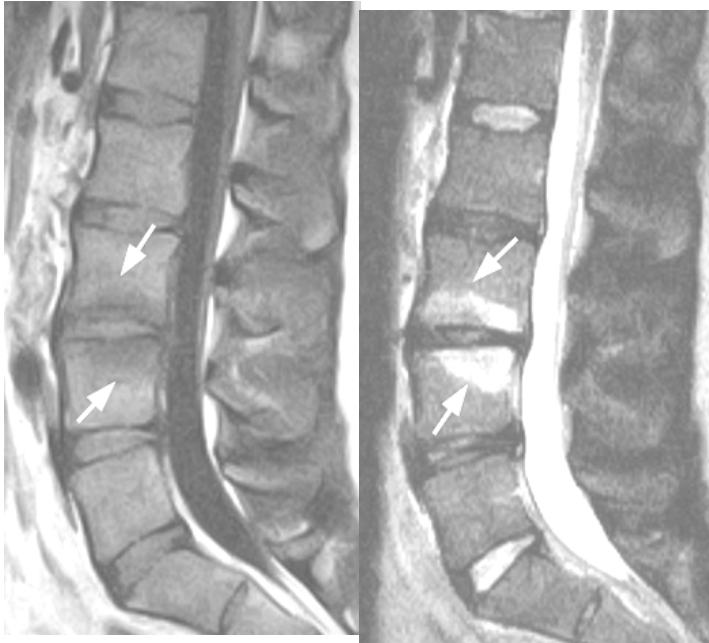
Spinal and Forminal Stenosis

- Mild
- Moderate
- Severe

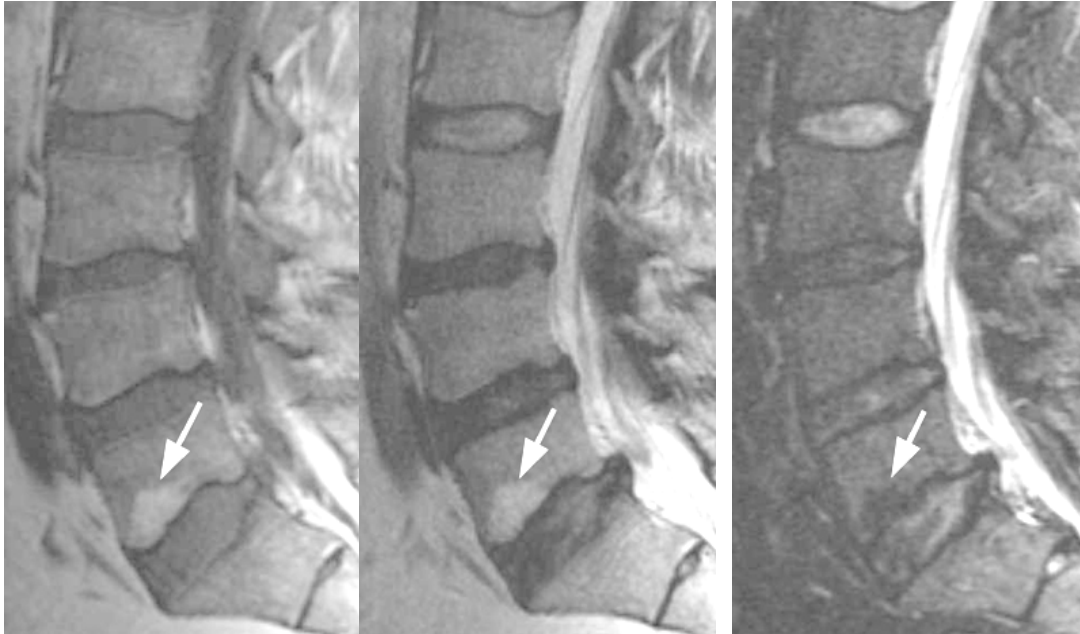
Modic changes

- Type 1 “fluid like”-bone marrow edema
- Type 2 “fat like” – lumbar degeneration
- Type 3 “sclerosis-like”- Discogenic vertebral sclerosis

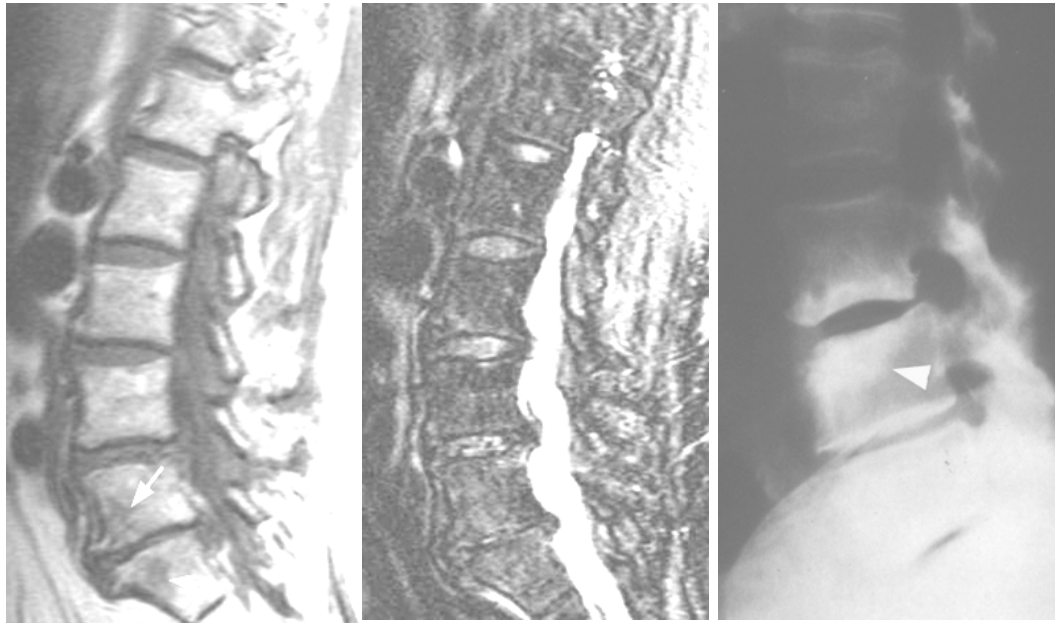
Modic Type I



Modic Type II



Modic Type III



High Intensity Zone

- The finding of an area of hyperintense signal without the periphery of the disc in the region of the annulus fibrosus on T-2 weighted MR Image
 - 25% of back pain patient undergoing MRI
 - 85% of patients with HIZ will have concordant pain on discography.
- Probably represent an area of annular tear with secondary inflammation

Hyperintensity Zone

