Diagnosis of Low Back Pain Syndromes

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Cedar-Apple rust
Gymnosporangium juniperi-virginianae

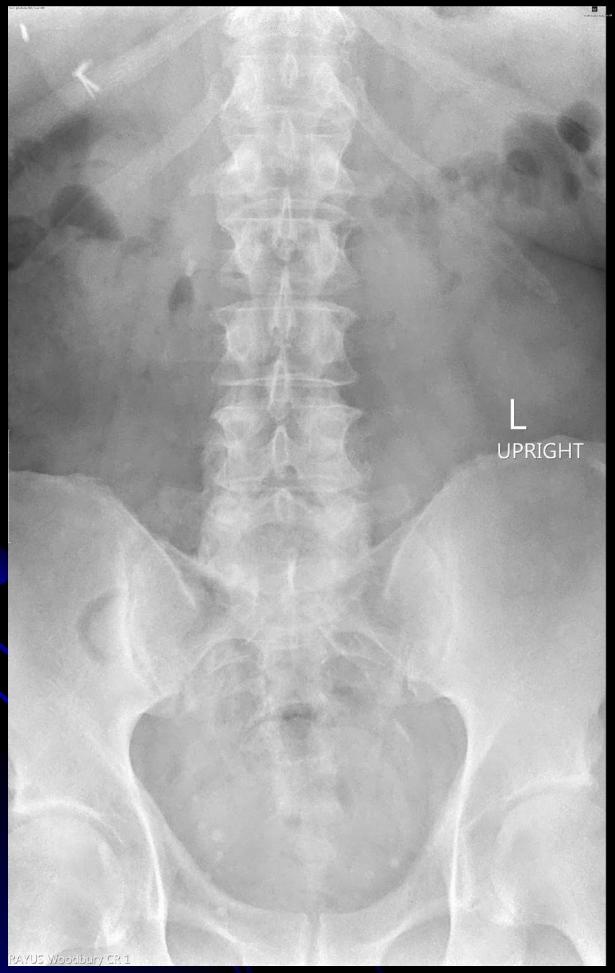
Acute back and leg pain: Natural history

- In the majority of patients presenting with LBP, symptoms and function will improve rapidly over the first month of care.
- Up to 90% of patients with disc herniations and radiculopathy will have a good or excellent response to conservative therapy over a 6 week period of time if the patient's pain can be controlled.

Initial Evaluation: Back and Leg Pain

- Focused history and neurologic exam
- Triage
  - **Red Flags** for urgent or emergent imaging
  - Nonspecific low back pain
  - Radiculopathy (Sciatica)
  - Lumbar spinal stenosis (with Neurogenic Claudication)
- Screen for psychosocial risk factors.
- Assess pain level (VAS) and functional level (Oswestry).

Indications for Plain Radiographs in patient with back pain syndromes



Indications for Plain Radiographs in patient with back pain syndromes

- Significant trauma (not “lifting something”, “bending to pick up something” etc).
- Back pain unresponsive to conservative therapy for 4-6 weeks.
- Uncontrolled pain or pain with significant limitation of function
- Associated motor deficit.
- Associated fever/systemic symptoms, h/o previous spinal infection or h/o IV drug use
- Known history of malignancy
- Suspected insufficiency fx, h/o osteoporosis, chronic corticosteroid use or alcohol abuse.

Indications for Advanced Imaging: Red Flags

Indications for advanced imaging: Cancer

- ***Immediate imaging*** is indicated in patients with clinical suspicion of cancer, impending cord impingement and/or a major or progressive neurological deficit (Chou 2011).
- ***Immediate imaging*** can be considered in patients with the new onset of moderate to severe low back pain and a history of cancer. "History of cancer" is the strongest risk factor for spinal neoplasm with a likelihood ratio of about 15. Based on this likelihood ratio, a history of cancer would increase the incidence of cancer in the tested population to about 9% (Chou 2011; Henscke 2007).
- Age ≥ 50 years, unexplained weight loss and failure to improve after one month are weaker risk factors with positive likelihood ratios of 2.7-3.0. With 1 of these risk factors, the likelihood of cancer only increases to approximately 1.2% (Chou 2011).
- Advanced imaging could be deferred for several weeks in these patients: MRI can be reserved for patients with abnormal radiographs and/or ESR. Abnormalities on plain radiographs and an elevated ESR have a 78% sensitivity and 67% specificity for neoplasm on MRI (Chou 2007).

67 yo with new onset moderate to severe back pain with a history of prostate cancer

Clinical, laboratory or radiographic suspicion for cancer: Guideline summary

- MRI is generally preferred over CT as it does not use ionizing radiation and provides better visualization of soft tissue, the vertebral marrow and the spinal canal (*Chou et al.* 2007).

Red Flags: Clinical, laboratory or radiographic suspicion for cancer

- Green – ***MRI*** *with and/or without IV contrast*
- Yellow – ***CT in a patient unable to undergo MRI***
- Yellow – ***CT to evaluate equivocal MRI findings***
- Yellow – ***CT as the initial study*** (particularly to evaluate an area of osteolysis on x-ray or to evaluate an abnormality on bone scan)
- Yellow – ***bone scan to evaluate for multiple bone lesions*** to evaluate equivocal or worrisome findings on MRI or CT
- Orange – ***bone scan*** without prior MRI or CT
- Orange – ***PET or PET/CT*** except to evaluate indeterminate lesions on CT or MRI in patients with known PET sensitive cancer
- Red – bone scan as a primary diagnostic test in patients with known or suspected multiple myeloma

Indications for advanced imaging: Infection

- *Immediate imaging* is recommended in patients when features suggest vertebral infection. Timely diagnosis may prevent serious sequelae with this entity (Chou et al., 2011).
- Clinical features predicting the presence of vertebral infection have not been well studied, but may include back pain with a fever above 38 C (100.4 F) for greater than 48 hours, new moderate or severe pain following an invasive spine procedure (Chou et al., 2007; *Institute for Clinical Systems Improvement* ((*ICSI*) Goertz et al., 2012), and disproportionate back pain (*panel consensus opinion*).
- Risk factors for spinal infection include intravenous drug use, immunosuppression, recent infection, and history of tuberculosis or active tuberculosis (Chou et al., 2007; *ICSI*, (Goertz et al., 2012)).
- An ESR and/or CRP can be useful to direct care in patients with equivocal findings on MRI and/or CT. The ESR is elevated in 88-100% of patients with confirmed spine infections and shows a correlation with epidural abscess. (Beronius, Bettini, Carragee, Chelsom and Hopkinson) The CRP is less sensitive but more specific.

54 yo with disproportionately severe back pain and a history of fever

Red Flags: Clinical, laboratory or radiographic suspicion for infection

- Green – MRI with and/or without IV contrast
- Yellow – CT in patients unable to undergo MRI and in patients with equivocal findings on MRI (to evaluate for endplate destruction or poorly demarcated endplate erosions),
- Yellow – CT as the initial study (e.g. with evidence of endplate erosions on plain radiographs)
- Orange – bone scan
- Red – PET

Indications for advanced imaging: Cauda equina syndrome

- Immediate imaging is recommended in patients when features suggest cauda equina syndrome (CES), or for severe or progressive neurologic deficits at one or multiple levels (Chou 2011). Timely diagnosis may prevent serious sequelae with these entities.
- Key signs of cauda equina syndrome include new urine retention/overflow incontinence, saddle anesthesia, fecal incontinence and bilateral leg weakness/parasthesias. Patients should be examined for decreased anal tone, bilateral leg weakness and perineal numbness (ICSI 2012, Ahad 2015, Balasubramanian 2010). Combination of signs and symptoms may increase the specificity for CES.
- MRI is generally preferred over CT as it does not use ionizing radiation and provides better visualization of the distal cord and spinal canal (Chou 2007, ACR 2015).
- CT myelography or x-ray myelography can be used as an alternative in patients with contraindications to MRI (ACR 2015).

40 year old patient presents with low back pain and new onset urinary incontinence

Red Flags: Cauda Equina syndrome

- Green – MRI with and/or without IV contrast
- Yellow – CT orCT myelography in patients unable to undergo MRI, to evaluate equivocal findings on MRI or for surgical planning with or without prior MRI,
- Red – bone scan, PET

Indications for advanced imaging: Suspected fragility fracture

- Predictive factors for fragility fracture are osteoporosis, chronic steroid use and age > 55. Disproportionate pain is a sign of fracture.
- *Chou* (2011) recommend plain x-ray for the initial evaluation of patients with suspected vertebral compression fractures in high risk patients.
- Repeat x-ray should be considered if moderate or severe pain persists at follow-up at 2-4 weeks.

78 yo with severe back pain after lifting a suitcase

Low back pain with suspected fragility fracture in patients with abnormal or indeterminate x-rays: Guideline summary

- The *ACR* recommends x-ray (7) as the initial imaging study especially in patients with osteoporosis or chronic steroid use.
- MRI is the most appropriate initial imaging modality following x-ray as the detection of marrow edema is paramount to determining the chronicity of fracture deformities.
- MRI examinations should include sagittal STIR or T2 fat saturations images to evaluate for marrow edema.
- Consider inclusion of coronal MRI images through the sacrum to evaluate for sacral insufficiency fractures which also occur frequently in this patient group.
- CT is useful in patients who cannot undergo MRI or to differentiate benign from pathologic fractures if indeterminate on MRI. Pathologic fractures typically show decrease bone density adjacent to the fractured endplate on CT while benign fractures show increased bony density.
- DEXA or QCT should be considered to test for osteoporosis.

Low back pain with suspected fragility fracture in patients with abnormal or indeterminate x-rays:

- Green – MRI without IV contrast
- Yellow – CT in patients unable to undergo MRI
- Yellow – CT in patients with equivocal findings on MRI
- Yellow – bone scan in patients with equivocal findings on MR or CT
- Red – PET

56 yo male with discogenic low back pain: No red flags and no conservative therapy

Discogenic pain: Increases with activity or axial loading, increases with coughing or sneezing, increases with flexing forward. Relieve with lying flat.

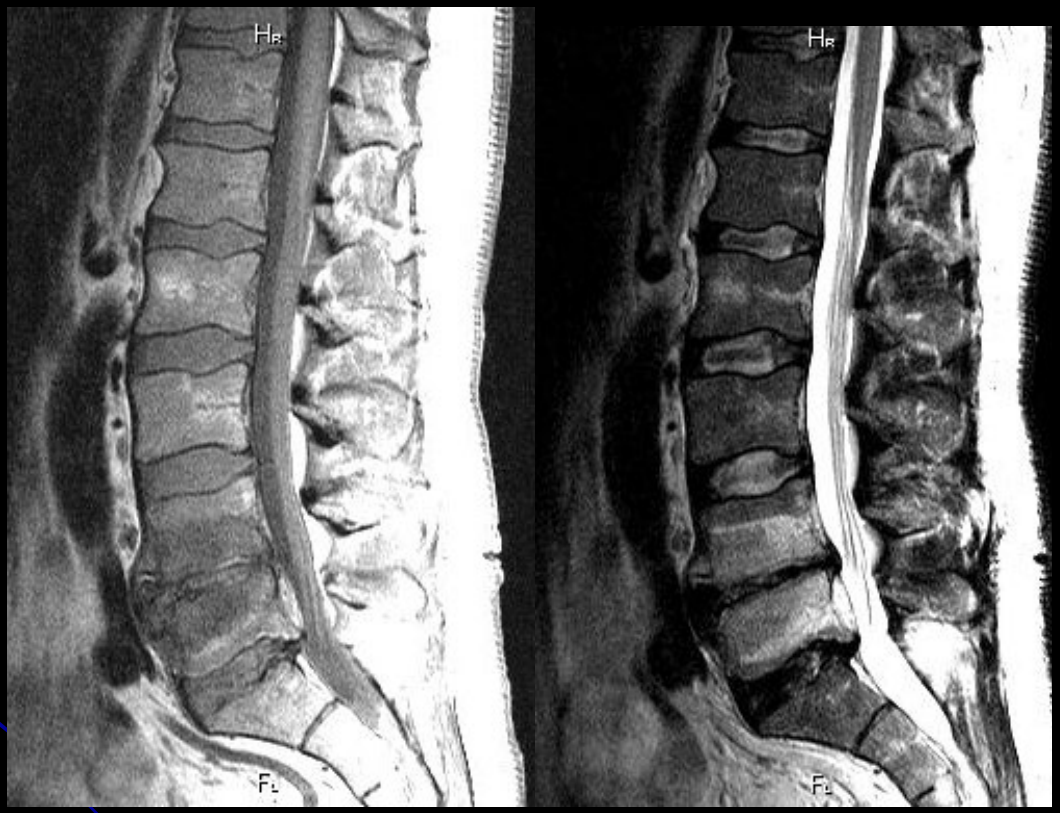
Low back pain: No red flags and no conservative therapy

- The first line treatment for low back pain is conservative care (Patel 2015).
- Most clinical guidelines recommend an interval of 4 weeks of conservative care prior to imaging.
- 9/10 guidelines recommend against any form of imaging in patients with low back pain who have not first attempted conservative care (moderate).
- This does not include patients with red flags, patients with severe uncontrolled pain, or patients who are candidates for immediate injection therapy or surgery
- High quality studies have shown that early imaging does not improve outcome and does not result in psychological benefits. Routine imaging is ineffective because acute low back pain has a favorable natural history and shows significant improvement in most patients in the first 4 weeks (Chou 2011).

Low back pain in adult patients with no red flags and no conservative therapy

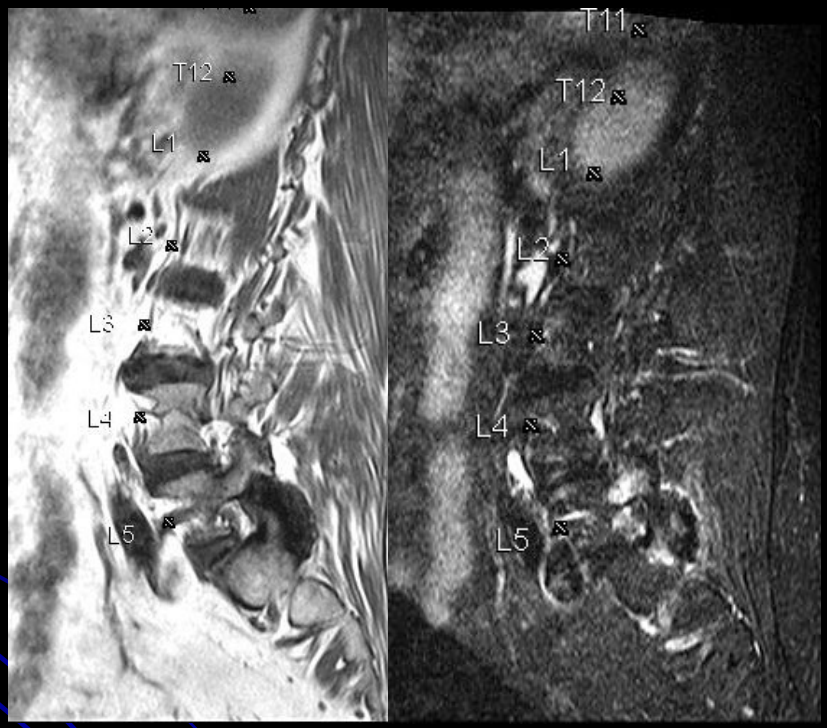
- Green –
- Yellow –
- Orange – MRI, CT, bone scan
- Red – PET

40 yo patient with moderate low back pain for 12 weeks unresponsive to conservative therapy



Discogenic pain – Worse with activity and with axial loading. Aggravated with Prolonged sitting and with flexion. Relieved with lying down.

50 yo female with moderate low back pain for 12 weeks unresponsive to conservative therapy



Facet medicated pain – Worse in the morning and when first getting up from prolonged sitting. Worse with extension. Tender over the facet joint.

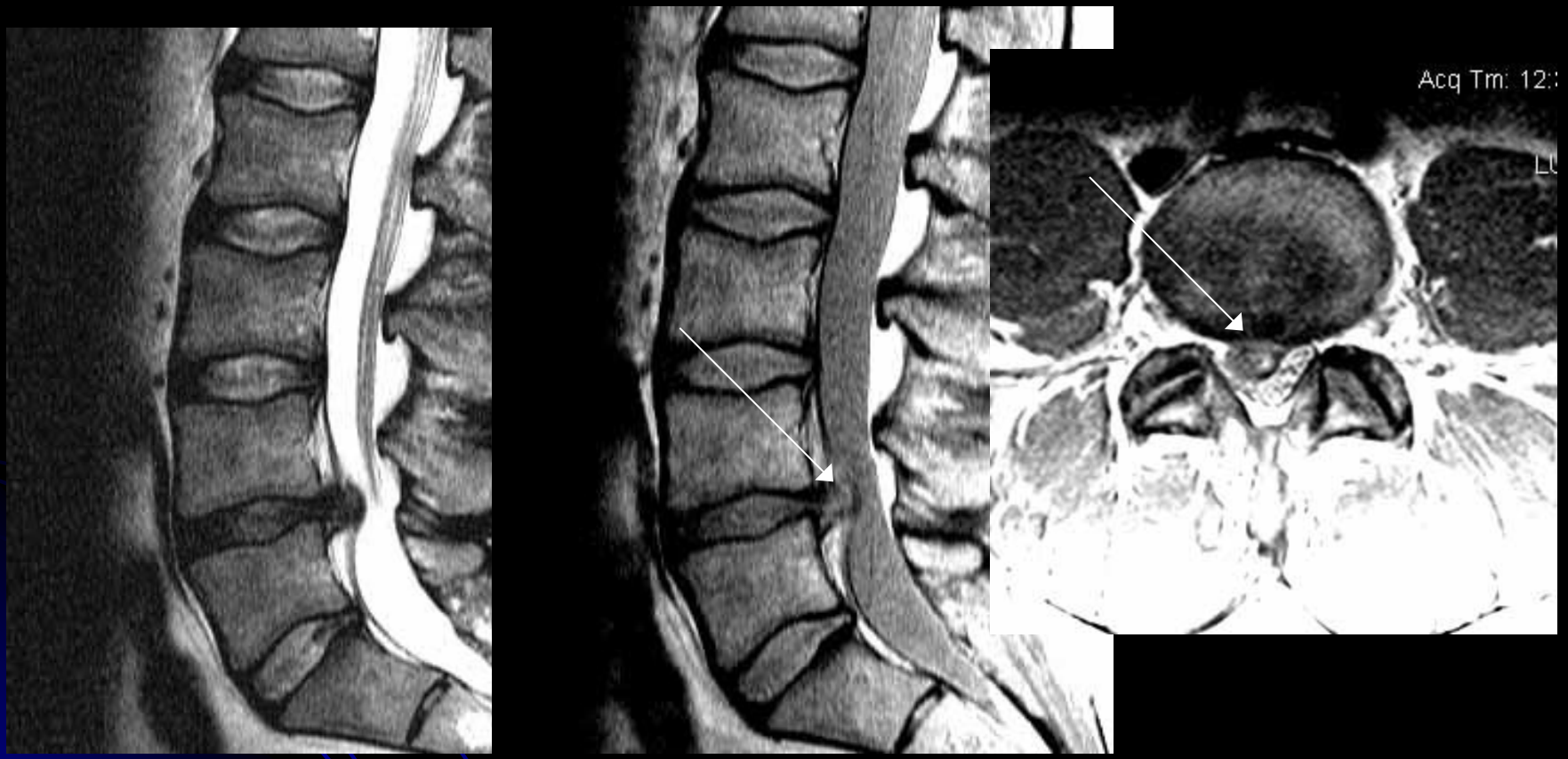
Subchondral marrow edema may indicate symptomatic facet arthropathy

Nonspecific Low Back Pain in adult patients unresponsive to conservative care: Evidence summary

- The *ACR* recommends MRI (8), CT (5) or x-ray/CT myelography for patients with acute, subacute or chronic low back pain who are surgical or intervention candidates with persistent or progressive symptoms during or following a course of conservative management.
- *ICSI* recommends MRI or CT should be done to rule out underlying pathology or for those who are considering *surgery or injection therapy* (strong recommendation, moderate quality evidence).
- *Patients with chronic low back pain resistant to conservative care are typically referred to the spine or pain management subspecialists.* The decisions by the spine subspecialist to image the patient are largely predicated on the need to exclude underlying pathologies, to identify potential pain generators, to assess for injection therapy, an Intracept procedure, treatment with a spinal cord stimulator and to assess for surgery.

Giant Puffball: Really good fried in butter or with Soy Sauce!

30 year old patient with new onset right leg pain 3 days ago

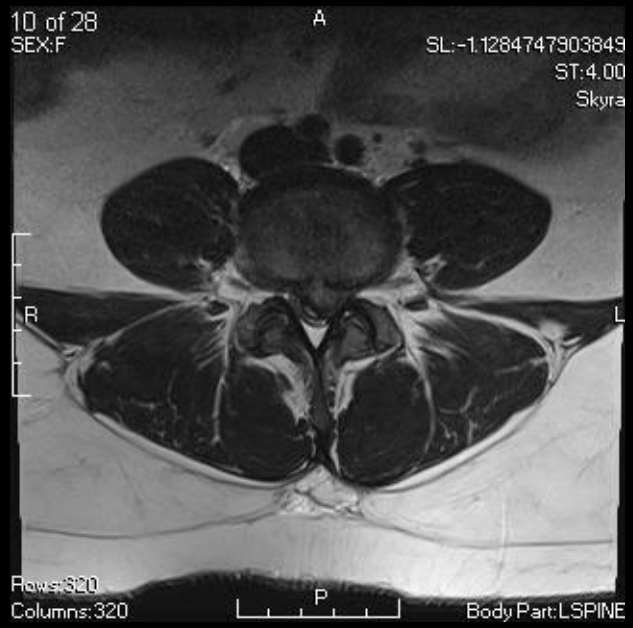


Lumbar radiculopathy

Lumbar Radiculopathy: Clinical Notes

- Initial treatment for lumbar radiculopathy is conservative care which may consist of PT, oral medications and/or manipulation.
- Failure of conservative care can be defined as moderate to severe persistent symptoms following an appropriate period of conservative care (typically 4-6 weeks).
- Advanced imaging and injection therapy are indicated in patients with failure of conservative therapy, uncontrolled pain, marked limitation of function, increasing pain during conservative care or inability to participate in noninvasive care for an appropriate period of time.
- Findings on MRI and CT are nonspecific and require strict correlation of symptoms and findings on physical exam to determine the significance.

51yo with severe left low back and thigh pain and no improvement following 4 weeks of conservative care with oral medications



Lumbar Radiculopathy

Lumbar Radiculopathy: Evidence summary

- The *ACR* recommends MRI (8), CT (5) or CT myelography/x-ray myelography (5) for the imaging of patients with persistent or progressive symptoms during or following 6 weeks of conservative care.
- *NASS* recommends MRI for the diagnosis of disc herniations in patients with clinical findings consistent with radiculopathy. (Grade A) NASS also states that CT, myelography and CT myelography are appropriate to confirm the presence of a lumbar disc herniation in patients with history and physical examination consistent with radiculopathy (Grade A).
- *Chou et al. (2007)* recommends advanced imaging (MRI or CT) in patients with low back pain and clinical signs of radiculopathy only if they are candidates for surgery or epidural steroid injections (strong recommendation, moderate evidence).
- *ICSI* recommends MRI or CT to rule out underlying pathology for those patients considering epidural steroid injections or surgery.

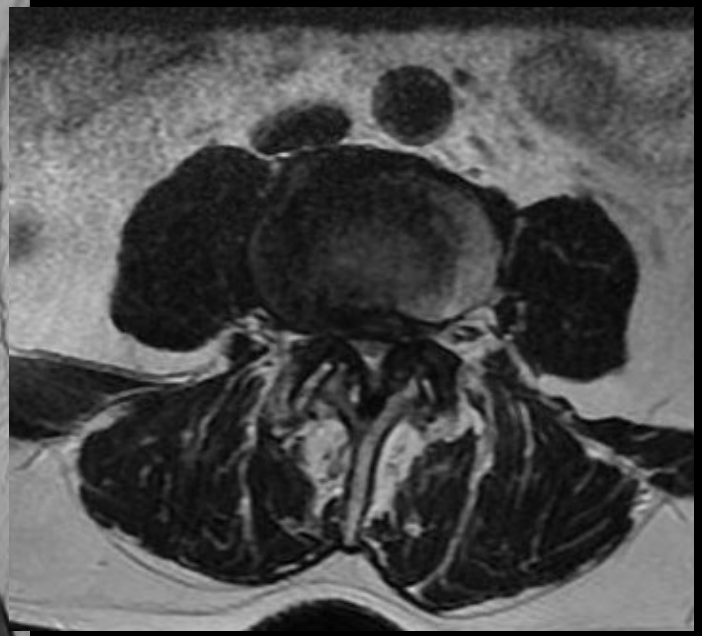
Radiculopathy with moderate to severe pain and/or dysfunction, failure of conservative therapy, or evaluation for injection therapy or surgery

- Green – MRI without IV contrast
- Green – MRI with and without IV contrast with history of previous discectomy
- Yellow – CT or CT myelography in a patient unable to undergo MRI, in a patient with discordant MRI findings and symptoms, or in a patient undergoing surgical planning following MRI
- Red – bone scan, PET

Lumbar Spinal Stenosis: Clinical Notes

- Diagnosis with narrowing of the central canal on advanced imaging and clinical symptoms consistent with neurogenic claudication
- Indications for advanced imaging and injection therapy is failure of conservative care for an appropriate period (typically 4-6 weeks), marked resting pain, marked limitation of function which persists after an appropriate trial of conservative therapy.
- Findings on MRI and CT are nonspecific and require correlation of symptoms and findings on physical exam to determine the significance.
- The use of well-defined, articulated and validated criteria for assessing dural sac narrowing on MRI, CT or CT myelography is recommended to improve interobserver and intraobserver reliability. (NASS)

80 year old patient with neurogenic claudication



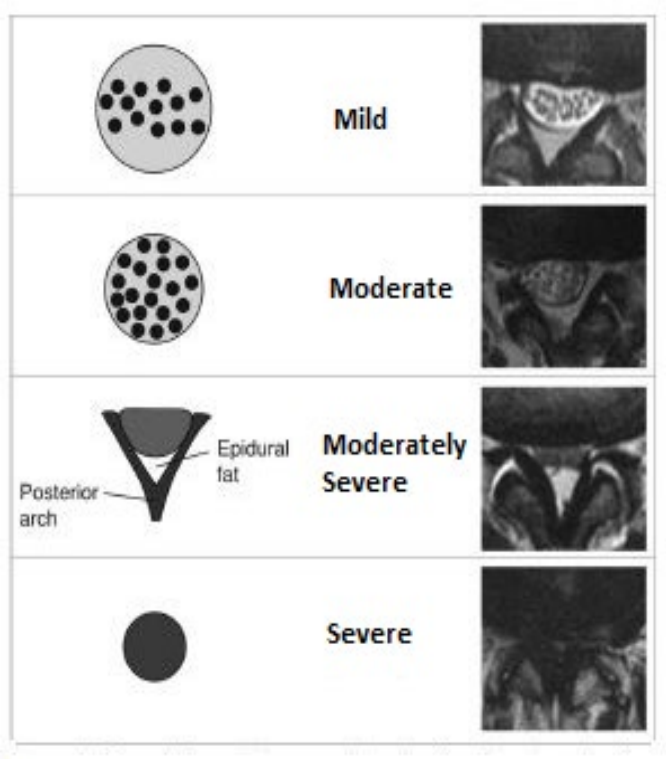
Grading of lumbar stenosis

Dural sac area:

- Mild – 75-100mm^2
- Moderate – 50-75mm^2
- Moderately severe – 25-50mm^2
- Severe - < 25mm^2

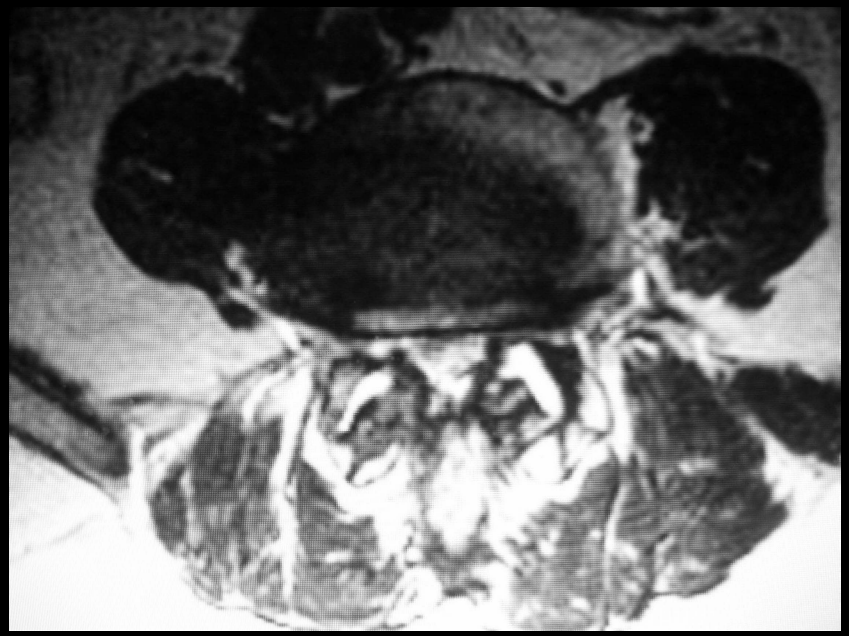
The minimum dural cross sectional area correlates with a shorter walking Distance before claudication, greater leg and back pain, and a lower quality of Life. Ogikubo O, et al. Spine 2007;32:1423.

Grading of lumbar stenosis



LSS with neurogenic claudication: redundant nerve root sign

70 year old patient with NIC



Facet diastasis

Occult stenosis with Instability: axial loading

Lumbar spinal stenosis with moderate or severe standing pain, significant limitations of function, failure of conservative therapy and/or evaluation for injection therapy or surgical decompression

- Green – MRI without IV contrast
- Yellow – CT or CT myelography in a patient unable to undergo MRI, in a patient with discordant MRI findings and symptoms, or in a patient undergoing surgical planning following MRI
- Red – bone scan, PET

Activity-related Low Back Pain in adolescent patients

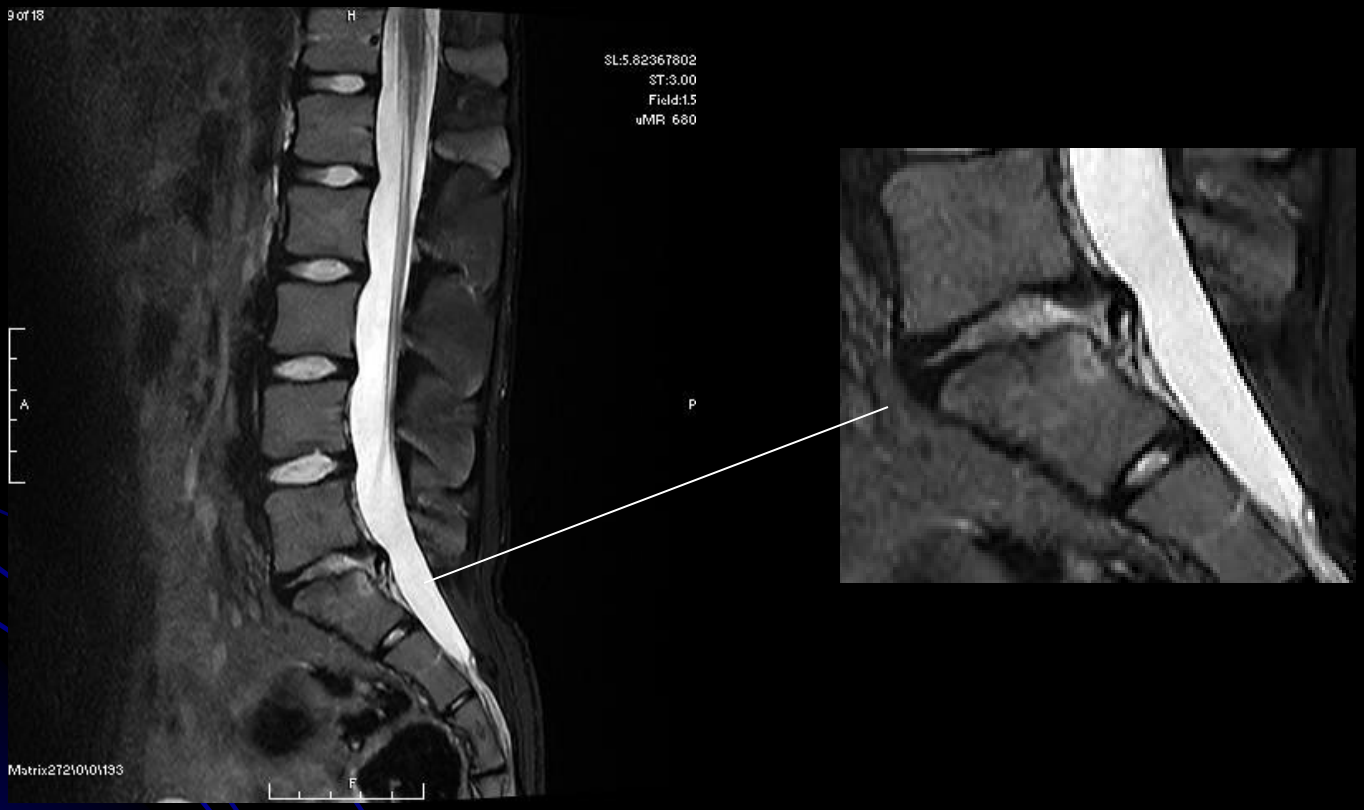
- Spondylolysis with or without spondylolisthesis
- *Symptomatic disc degeneration*
- *Disc herniations*
- Thoracolumbar Scheuermann's disease

Acute or subacute L5 spondylolysis

STIR images increase the sensitivity for spondylolysis

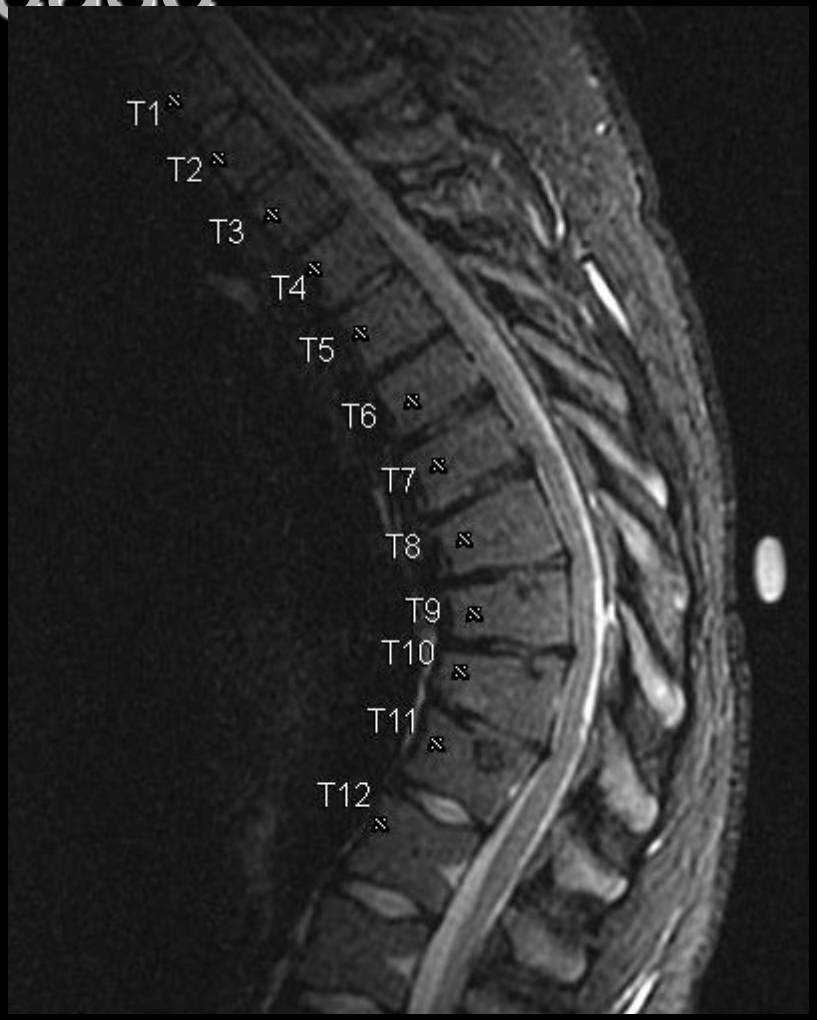
Spondylolysis on CT

Juvenile Disc herniations



Juvenile Disc herniations

Thoracolumbar Scheuermann's Disease



JDD

Hen of the Woods (Grifola frondosa)

Inflammatory Back Pain

- Inflammatory Spondyloarthopathy
- Erosive/Inflammatory Discopathy (Endplate disruption with Modic 1 discogenic signal changes)
- Inflammatory Facet Arthropathy

Inflammatory back pain is worse in the morning. Often improves with a Heating pad or NSAIDs. Patient's symptoms improve with activity throughout The day.

Axial Spondyloarthropathy

A spectrum of disorders:

- Ankylosing Spondylitis
- Psoriatic spondyloarthropathy
- Reactive spondyloarthropathy
- Enteropathic spondyloarthropathy

Specificity of Inflammatory Back Pain

In a population-based cohort with new onset inflammatory back pain followed over 12 years, only 30% were ultimately diagnosed with axSpA

Wang R, Crowson CS, Wright K, Ward MM.
Clinical evolution in patients with new-onset inflammatory back pain: a population-based cohort study. Arthritis Rheumatol 2018;70:1049-55. doi:10.1002/ art.40460

Axial Spondyloathropathy

Delay from symptom onset to diagnosis of ankylosing spondylitis 11 years in Europe and 13.5 years in the US.

Feldtkeller E, Khan MA, van der Heijde D, van der Linden S, Braun J.
Age at disease onset and diagnosis delay in HLA-B27 negative vs. positive patients wit
Rheumatol Int 2003;23:61-6. doi:10.1007/s00296-002-0237-4

Deodhar A, Mease P, Reveille J, et al.
Prevalence of axial spondyloarthritis among undiagnosed chronic back pain patients in
Ann Rheum Dis 2014;73:198-9. doi:10.1136/ annrheumdis-2014-eular.1135

Rheumatologic diagnosis of Axial inflammatory spondyloarthropathy

Patients with Predominant back pain ≥3months and age at onset <45 years with or w/o peripheral manifestations

- Sacroiliitis on imaging Plus ≥ 1 SpA feature

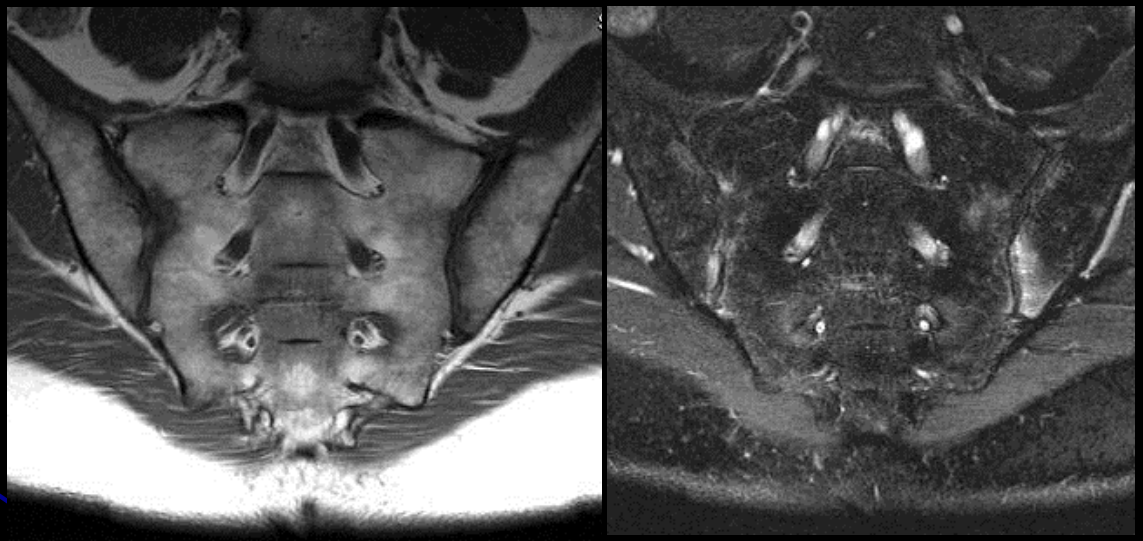
Or

- HLA-B27+ plus ≥ 2 other SpA features

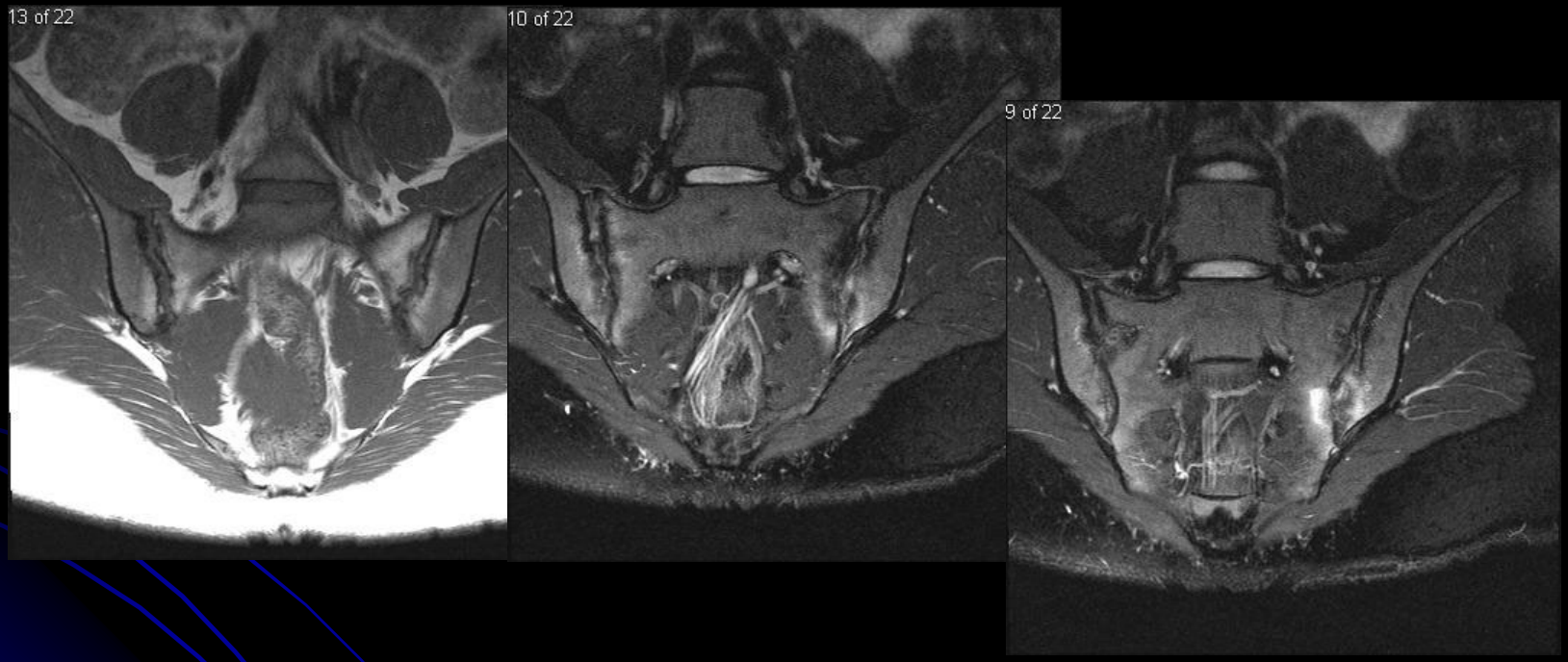
SpA features

- Inflammatory back pain
- Arthritis
- Enthesitis (heel)
- Dactylitis
- Psoriasis
- Crohn's/Colitis
- Uveitis
- FHx of SpA
- + HLA-B27
- Elevated CRP

STIR imaging: Sacroiliitis



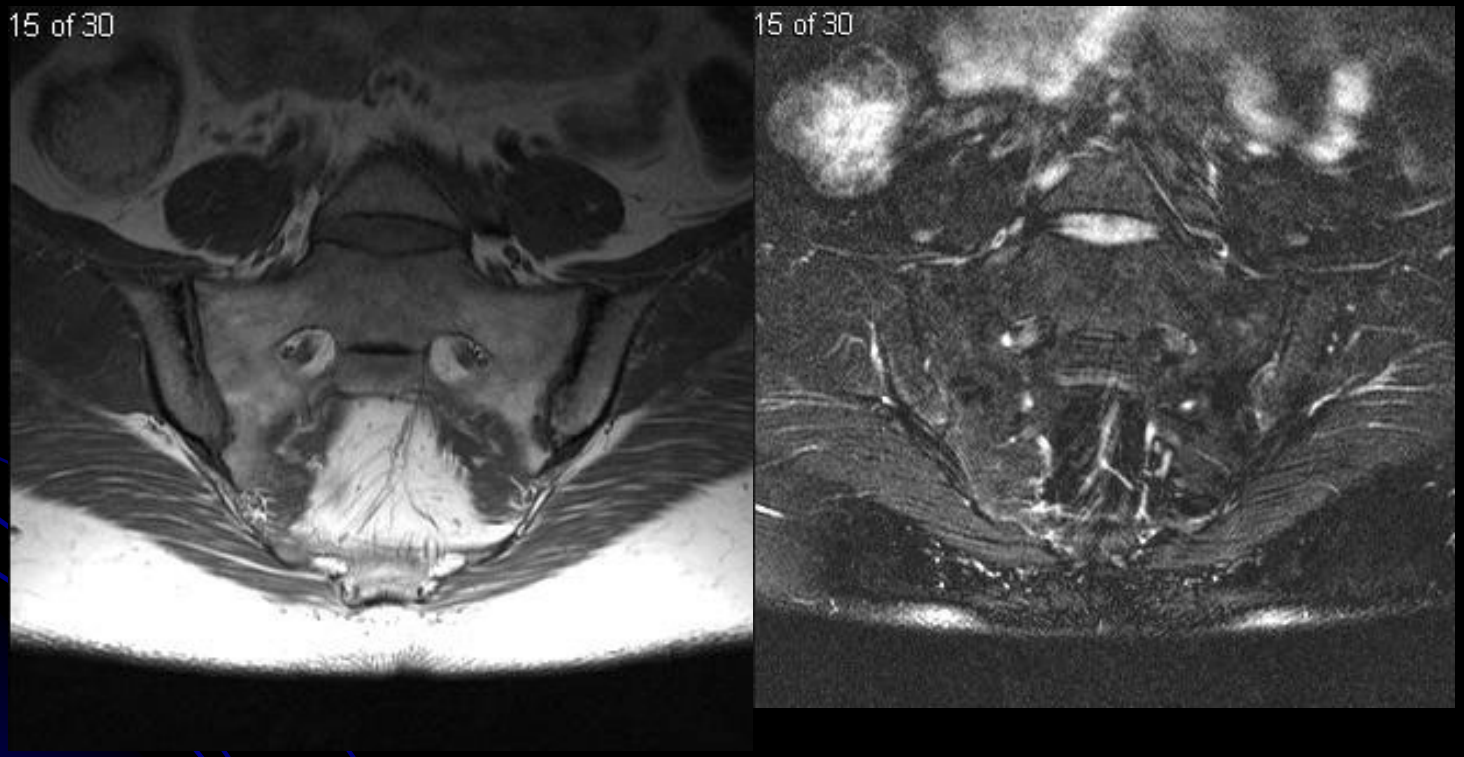
Bone Marrow Edema



Recurrent back pain in a patient with known Ankylosing Spondylitis

Signs of Inflammatory spondyloarthropathy in the spine

38 yo female with thoracolumbar back pain and a history of uveitis



MR spondyloarthropathy study at Rayus

38 yo female with thoracolumbar back pain and a history of uveitis

MR spondyloarthropathy study at Rayus

MRI/CT Imaging: Indications

- Red Flags
- Patient not responding to conservative therapy
- Uncontrolled pain
- Unable to perform the activities of daily living
- Adjunct to a comprehensive Evaluation or therapy program
- Prior to injection therapy or surgery

Summary

- MRI is the primary modality for the evaluation of the spine
- CT and CT myelography is a useful study in patients who cannot undergo MRI
- CT and CT myelography is useful in patients with discordant symptoms and MRI findings
- CT and CT myelography is a useful adjunct for surgical planning

Thank you!

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