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Diagnostic Imaging of Ankylosing Spondylitis

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Agenda

- Patient presentation
- ACR Appropriateness Criteria for low back pain
- Imaging of the SI joint
- Grading of sacroiliitis on plain film
- Diagnosis of ankylosing spondylitis
- Other imaging modalities
 - MRI
 - Nuclear Medicine
 - US
- Patient's clinical course



Our Patient: Initial Presentation

- Our patient is a 24 year-old male who presented to his PCP with **4 months of low back pain**.
- He does not remember an inciting event for the pain. He says that he experiences the **pain at night** and upon waking up in the morning, but it **gets better as he moves throughout the day**. He also notes some **relief with ibuprofen**.
- He denies fever, weight loss, or urinary and fecal incontinence. All other review of systems negative.
- Physical exam is notable only for **tenderness over the SI joints bilaterally**.

Is Imaging Appropriate?

- Given our patient's prolonged symptoms (>6 weeks), the ACR appropriateness criteria for low back pain are as follows:

Variant 2: Patient with one or more of the following: low-velocity trauma, osteoporosis, focal and/or progressive deficit, prolonged symptom duration, age >70 years.

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without contrast	8		O
CT lumbar spine without contrast	6	MRI preferred. CT useful if MRI is contraindicated or unavailable, and/or for problem solving.	☼☼☼
X-ray lumbar spine	6		☼☼☼
Tc-99m bone scan with SPECT spine	4	SPECT/CT may be useful for anatomic localization and problem solving.	☼☼☼
MRI lumbar spine without and with contrast	3		O
CT lumbar spine with contrast	3		☼☼☼
CT lumbar spine without and with contrast	1		☼☼☼☼
Myelography and postmyelography CT lumbar spine	1	In some cases postinjection CT imaging may be done without plain-film myelography.	☼☼☼☼
X-ray myelography lumbar spine	1		☼☼☼
X-ray discography lumbar spine	1		☼☼
X-ray discography and post-discography CT lumbar spine	1		☼☼☼

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level

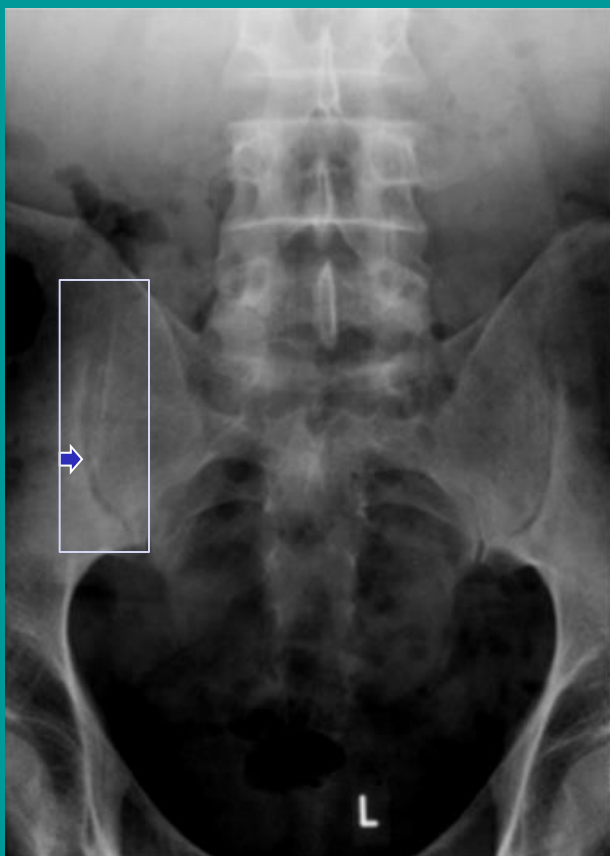


Let's view a companion patient's pelvic plain film with the same stage of disease.



Companion Patient #1

- Although MRI may have been most appropriate, our patient's PCP opted for AP plain radiographs of the pelvis. (Note, representative radiograph is shown)



- Left SI joint has minimal changes (preserved joint space, minimal-to-no sclerosis).
- Right SI joint has evidence of change (sclerosis, **widening of the SI joint**).

From Assessment of SpondyloArthritis International Society

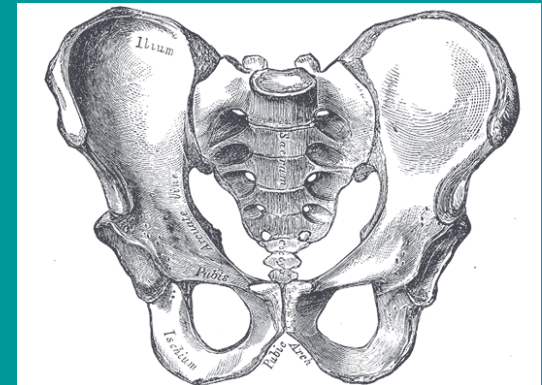


Imaging of the SI joint can be difficult.
Are there ways in which we can
manipulate our patients and equipment to
better view these regions of interest?

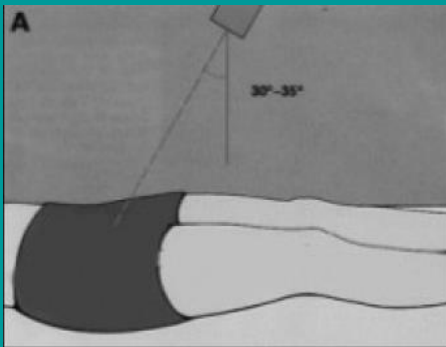


Imaging the SI Joint

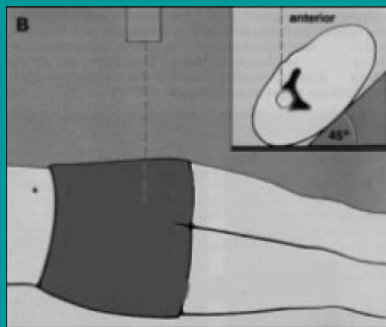
- The normal anatomy of the SI joints makes their imaging particularly challenging.



From Gray's Anatomy of the Human Body, 1918



A. Modified Ferguson view (Cranial angulation of 30-35 degrees) with radiography tube centered at L5/S1



B. Posterior oblique view of the pelvis, patient is supine and anteriorly rotated with unaffected hip elevated 45 degrees.



Now that we know how to image the SI joint, how do we assess the degree and severity of disease in these joints?



Companion Patient #2: Grade 0 sacroiliitis on plain film

Frontal pelvic plain film



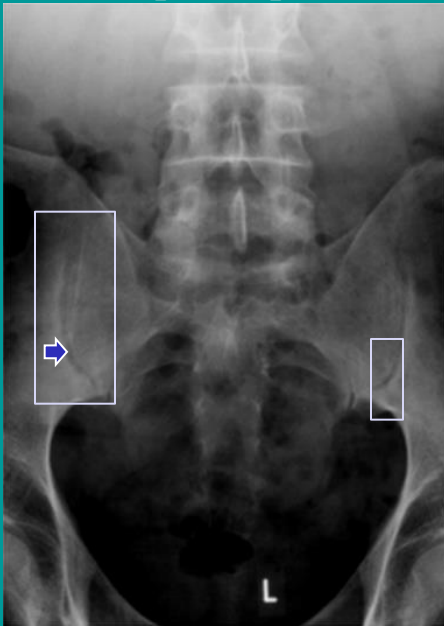
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- Both Joints: Grade 0
 - Normal SI joints. No joint space widening or narrowing, no sclerosis or erosions.



Companion Patient #3: Grade 1, 2 sacroiliitis on plain film

Frontal pelvic plain film



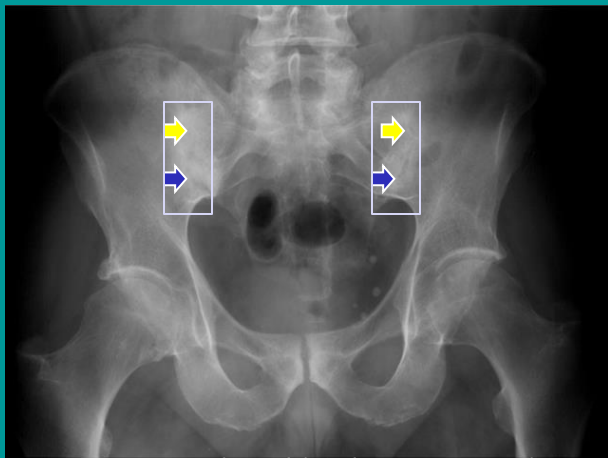
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- Left Joint: Grade 1
 - Suspicious changes: Mild sclerosis surrounding the joint
- Right Joint: Grade 2
 - Small areas of moderate sclerosis with minimal change in joint width



Companion Patient #4: Grade 3 sacroiliitis on plain film

Frontal pelvic plain film



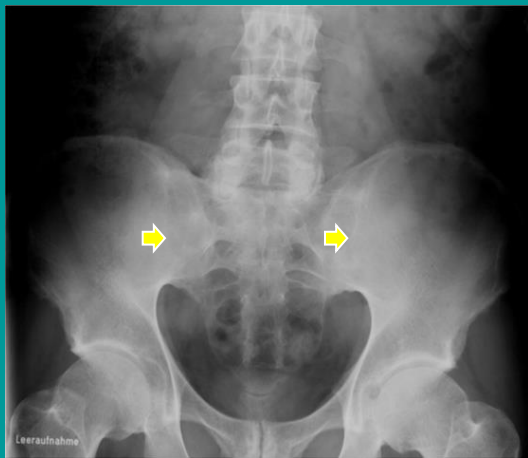
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- Both Joints: Grade 3
 - Evidence of sclerosis, joint space narrowing, and partial ankylosis (fusion).



Companion Patients #5: Grade 4 sacroiliitis on plain film

Frontal pelvic plain film



- Both Joints: Grade 4
 - Evidence of total **ankylosis**.

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Our Patient: Initial Management

- Our patient was told that he had what seemed to be the initial stages of **ankylosing spondylitis (AS)**, a chronic inflammatory disease of the axial skeleton.
- AS is a form of seronegative spondyloarthropathy, in the same category of disease as psoriatic arthritis, reactive arthritis, and the enteropathic arthropathies. These are associated with the HLA-B27 haplotype.
- He was advised to continue taking **ibuprofen** for symptomatic relief, and was referred to a rheumatologist.

We suspect that our patient has early AS,
but how do we actually make the
diagnosis?



AS: Diagnosis with Modified New York Criteria

- Modified New York Criteria: Diagnosed if the radiological criterion is associated with at least 1 clinical criterion
 - Radiological criterion: Sacroiliitis grade ≥ 2 bilaterally or grade 3-4 unilaterally by plain film
 - Clinical criterion:
 - Low back pain and stiffness for more than 3 months which improves with exercise but is not relieved by rest
 - Limitation of motion of the lumbar spine in both sagittal and frontal planes
 - Limitation of chest expansion relative to normal values correlated for age and sex.

AS: Diagnosis with Amor Classification

- Amor Classification Criteria for Spondyloarthritis
 - At least 6 points are necessary

A. Clinical Symptoms/History	Score
1. Pain at night (spine) or morning stiffness	1
2. Asymmetrical oligoarthritis	2
3. Gluteal (buttock) pain (any)	1
or	
alternating gluteal pain	2
4 Sausage like digit or toe (dactylitis)	2
5. Enthesitis (heel)	2
6. Uveitis	2
7. Urethritis/Cervicitis within 1 month before onset of arthritis	1
8. Diarrhoea within 1 month before onset of arthritis	1
9. Psoriasis, balanitis or inflammatory bowel disease	2
B. X-rays	
10. Sacroiliitis (grade 2 bilaterally or grad 3 unilaterally)	3
C. Genetical background	
11. HLA-B27 positive or positive family history for AS, ReA, uveitis, psoriasis or inflammatory bowel disease	2
D. Good response to NSAIDs	
12. NSAIDs show a good response within 48 hours, or relapse within 48 hours after NSAID are stopped	2



AS: Diagnosis with ASAS Classification

- ASAS Classification Criteria for Axial Spondyloarthritis
 - In patients with ≥ 3 months of back pain and age of onset <45 years, requires:
 - Sacroiliitis on imaging (**active inflammation on MRI highly suggestive of sacroiliitis**, or definite radiographic sacroiliitis in accordance with modified New York criteria) AND >1 feature of spondyloarthritis
 - OR HLA-B27 plus ≥ 2 other axial spondyloarthritis features



AS: Diagnostic features of spondyloarthritis

- ASAS Classification Criteria for Axial Spondyloarthritis
 - Spondyloarthritis features include:
 - Inflammatory back pain
 - Arthritis
 - Enthesitis of the heel
 - Uveitis
 - Dactylitis
 - Psoriasis
 - Crohn's/colitis
 - Good response to NSAIDS
 - Family history
 - Elevated CRP



We've already established plain film as a way to help aid in the diagnosis of AS. Additionally, the ASAS classification criteria mentions the use of MRI to make the diagnosis. Let's review other imaging modalities that can be used to show active, acute, and chronic disease.



AS: Additional radiologic tests

- Include:
 - MRI
 - Nuclear Medicine
 - US



MRI

- Advantages of MRI include:
 - multiplanar imaging capabilities
 - absence of ionizing radiation
 - tissue contrast resolution offering ability to visualize bone marrow, synovium, cartilage, ligaments and tendons.
 - Characteristics can suggest early and late inflammatory joint disease
 - Joint effusions
 - Synovitis
 - Bone marrow edema
 - Bone erosions

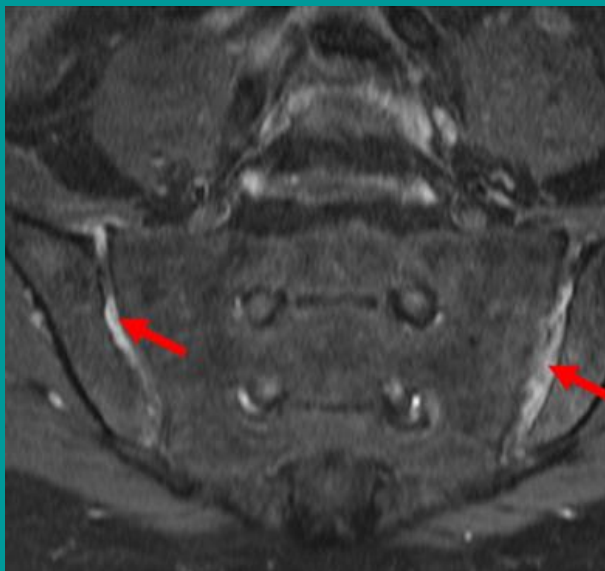


AS: MRI sequences commonly used

Sequence	Spinal fluid	Subcutaneous fat	Active inflammation
T1-weighted	HYPOintense	HYPERintense	HYPOintense
STIR	HYPERintense	HYPOintense	HYPERintense
T2-weighted	HYPERintense	HYPERintense	HYPERintense
T2-weighted, FS	HYPERintense	HYPOintense	HYPERintense
T1-post Gad, FS	HYPOintense	HYPOintense	HYPERintense

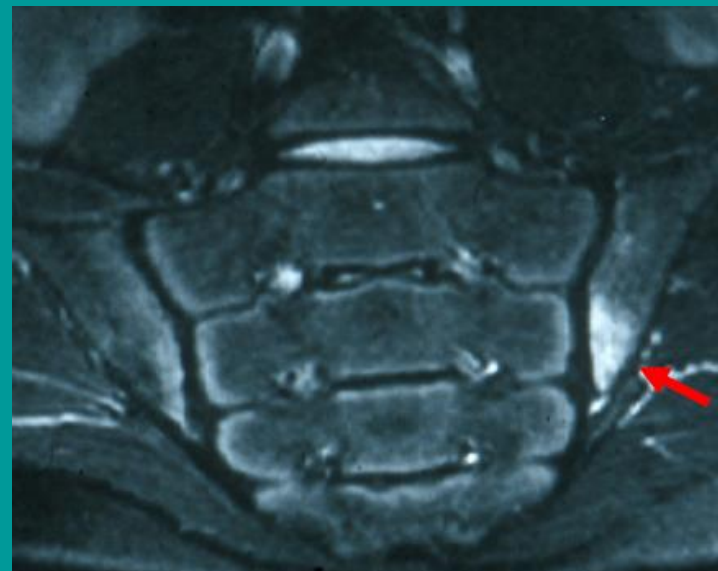


AS: Features on MRI



From Rudwaleit et al, 2009

T1 Post Gad sequence demonstrating **synovitis** of SI Joint, indicative of early sacroiliitis.

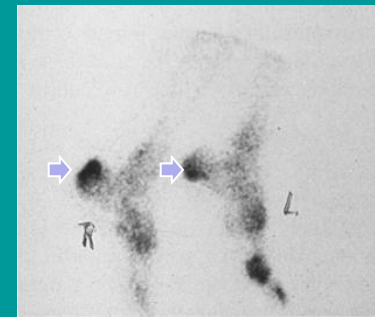


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STIR sequence demonstrating **bone marrow edema**, indicative of early sacroiliitis

AS: Features using nuclear medicine

- Scintigraphy using radiolabeled technetium can confirm presence of hyperemia and inflammation that may not be apparent radiographically.
 - Sensitive but not specific
 - Quantitative methods have been devised comparing ratio of SI joint to sacral uptake of radiotracer, although with controversy
 - While not used routinely, is particularly helpful for diagnosis of **enthesitis**.



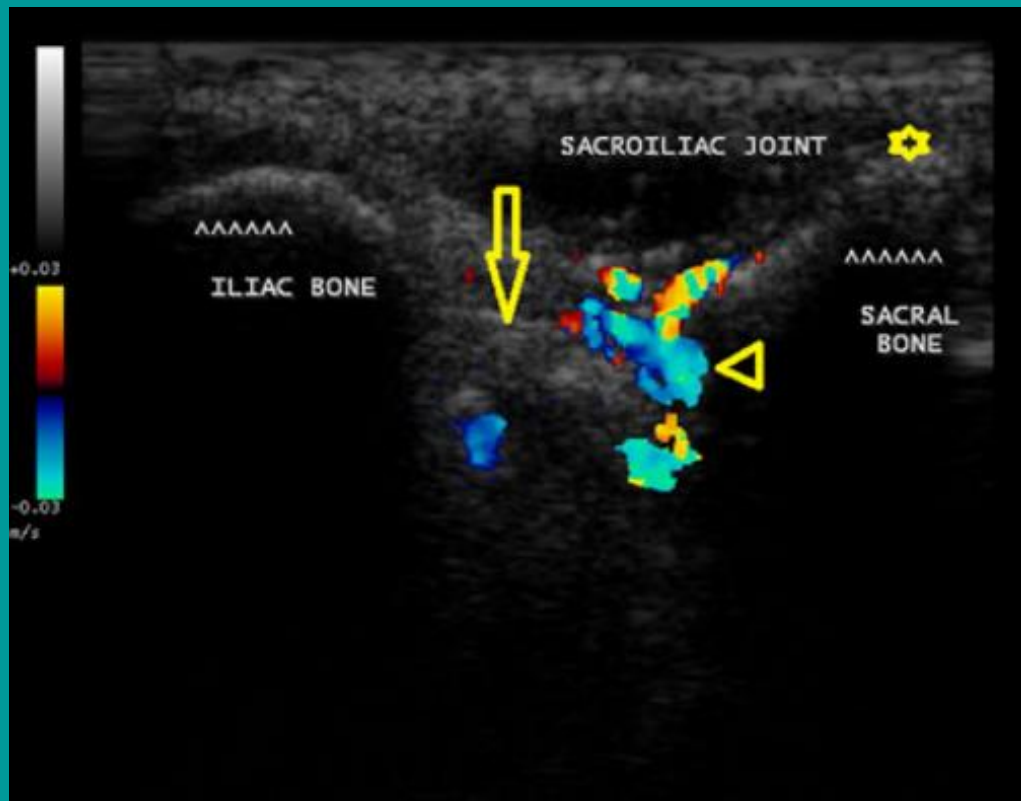
Lateral Feet

*From Assessment of SpondyloArthritis
International Society*



AS: Features on US

- US with color and duplex Doppler can evaluate inflammation of the SI joints and be used to monitor response to therapy.
- Can demonstrate enthesitis and patterns suggestive of edema.



- Color sonogram reveals vascularization in the posterior R SI joint. **Yellow arrow** shows SI joint.



AS: Why is earlier diagnosis important?

- Introduction of disease-modifying therapies such as TNF-alpha inhibitors has made earlier diagnosis of AS crucial. If the disease is diagnosed earlier, these biologic medications can be started earlier to help prevent later complications.



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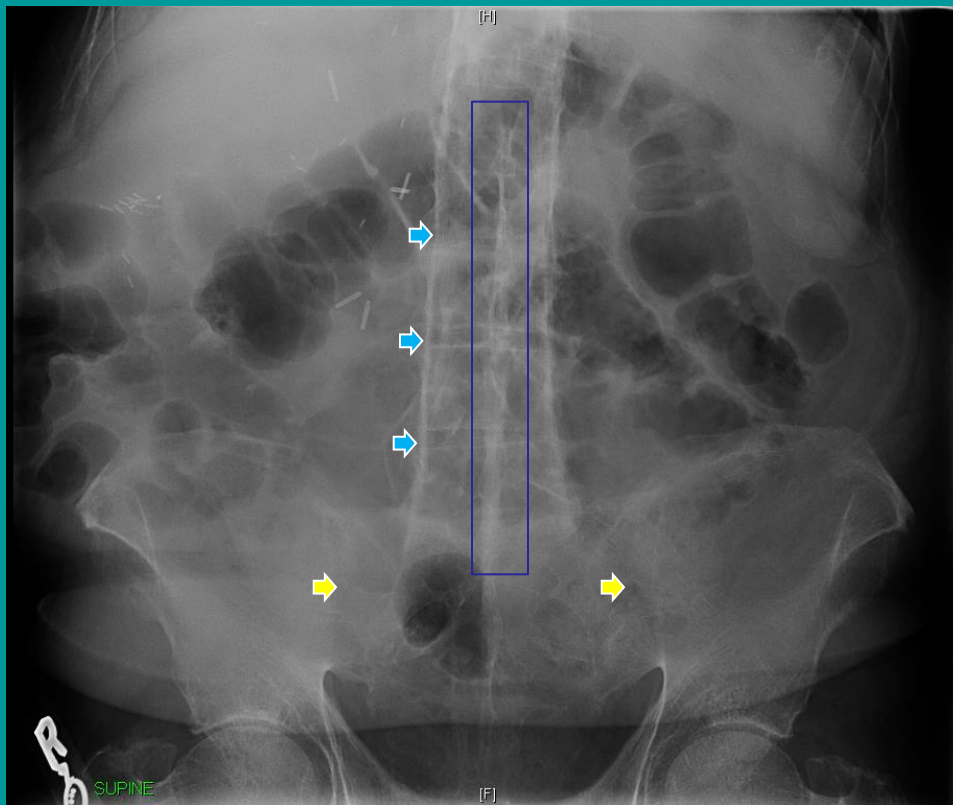


Back to LD

- LD had been **lost to follow-up for over 20 years**. His pain had been well-managed with ibuprofen as needed and felt no need for regular check-ups.
- He had **lost the ability to flex his lumbar spine**.
- Radiographs, CT, and MRI were obtained **demonstrating typical features of advanced AS**.



Our Patient: Advanced AS on frontal plain film

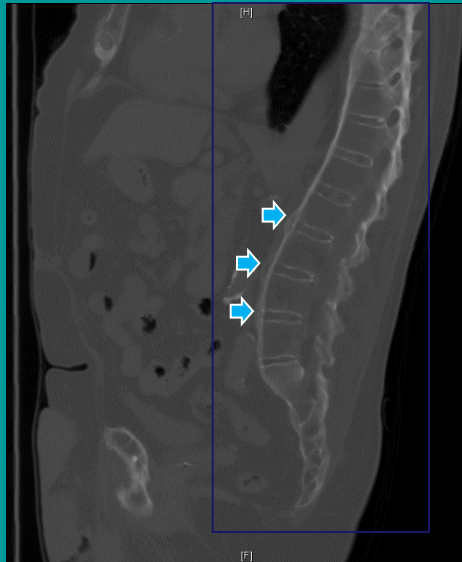


BIDMC PACS

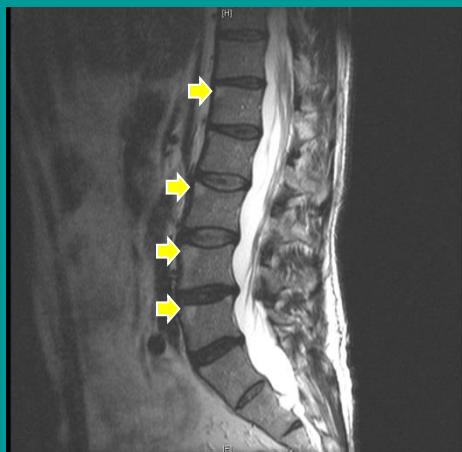
- Total **ankylosis** at SI joints
- Characteristic “Bamboo” spine of **bridging syndesmophytes** and **ossification** of the anterior, posterior, and interspinous longitudinal ligaments.



Our Patient: Advanced AS on sagittal CT and MRI



- Noncontrast lateral CT of abdomen and pelvis demonstrating ossification of paraspinal ligaments and bridging syndesmophytes.



- T2-weighted MRI demonstrating “shiny corners” or “Anderrson lesions” representing osteitis at the edges of vertebral bodies.



Our Patient: Clinical course

- LD inquired about anti-TNF medication such as etanercept to control his AS.
- Due to the chronicity of LD's AS, and the fusion of his lumbar spine, it was believed that biologics may have little-to-no effect.
- He is currently managed on prescription NSAID nabumetone, which has helped relieve his pain.



Let's take a look at the chronic
manifestations of AS in two companion
patients.

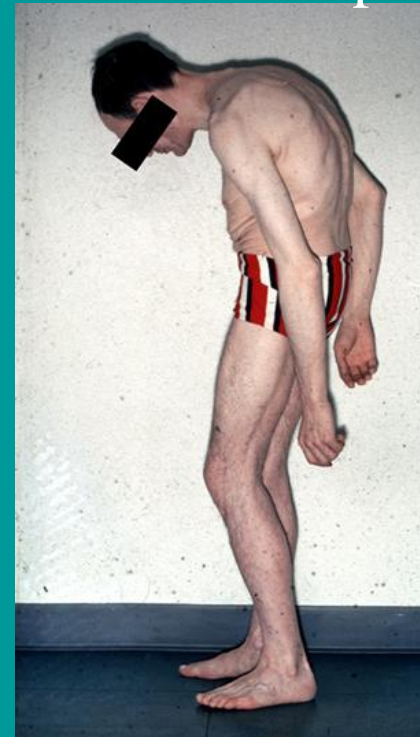
Companion patients # 6, 7: Features of chronic AS

Loss of lumbar flexion



From Assessment of SpondyloArthritis International Society

Severe kyphosis of thoracic
and cervical spine



From Assessment of SpondyloArthritis International Society

Let's briefly mention the extraskeletal manifestations of AS for completeness sake.



AS: Extraskeletal manifestations

- Lungs: Upper lobe interstitial fibrosis (up to 15% of patients)
- Eyes: Unilateral acute anterior uveitis (25-40% of patients)
- Cardiovascular: Aortitis, aortic regurgitation (3-10% of patients), cardiomegaly, conduction defects (up to 33% of patients)



Summary of take home pearls

- You were shown some radiographic techniques used to image the SI joints.
- You learned how to grade sacroiliitis on plain film.
- You were shown several diagnostic criteria for AS.
- You learned the menu of radiologic tests and their utility for imaging features of AS.
- You were briefly shown the extra-articular manifestations of AS, as well as what chronic AS looks like.
- You were given a brief discussion of the importance of why early diagnosis and treatment of AS are important.



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