SIJ IMAGING AND SACROILIITIS

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- I HAVE NO DISCLOSURES

Part 1: Outline

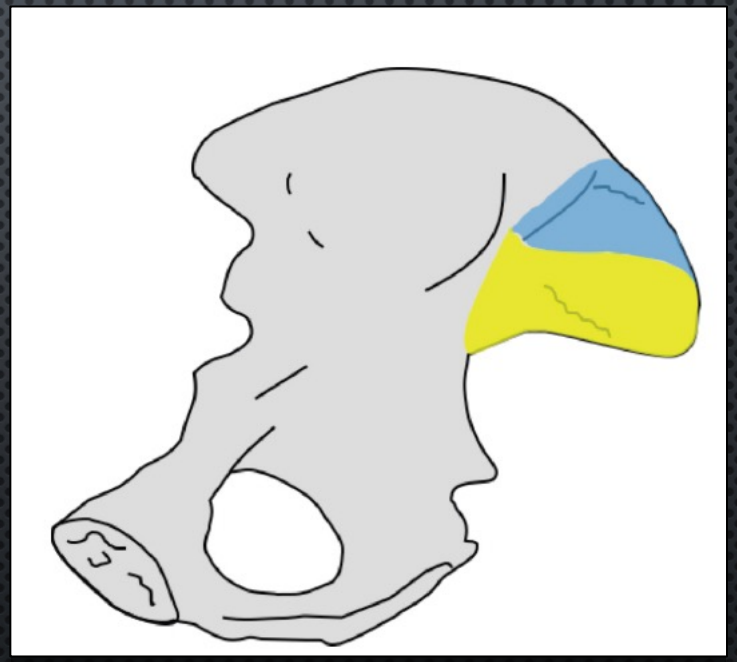
- Anatomy overview
- SIJ imaging
- Sacroiliac joint (SIJ) pathology
- Sacroiliitis imaging assessment

Outline

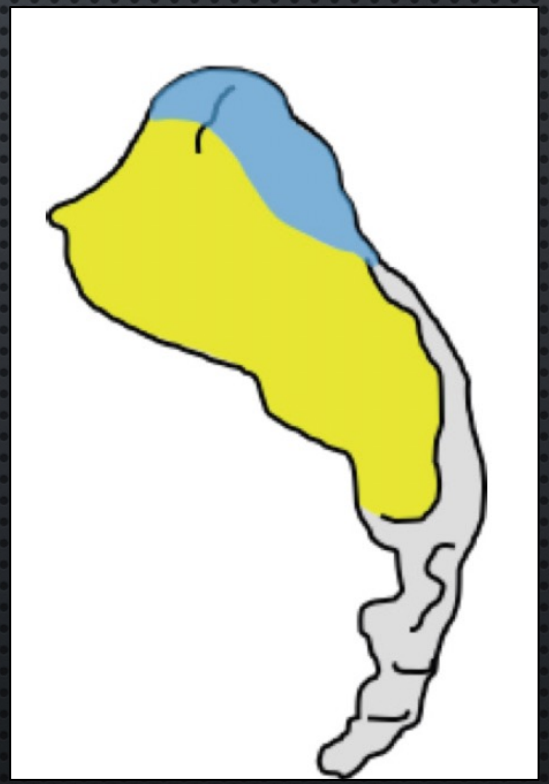
- **Anatomy overview**
- SIJ imaging
- Sacroiliac joint (SIJ) pathology
- Sacroiliitis imaging assessment

SACROILIAC JOINT ANATOMY

- Two parts:
  - Synovial joint (anterior - intraarticular portion)
  - Syndesmosis (posterior – extraarticular portion)
  - Testut & latarjet (1949): "diarthro-amphiarthrosis"
- Specialized joints that allow stable but flexible support of the upper body
- Cartilage thin on iliac side, thick on sacral side



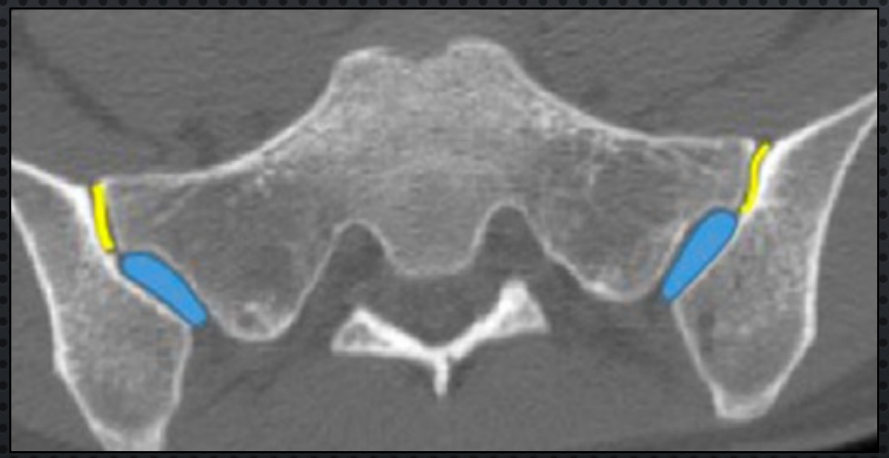
Imaging of sacroiliitis



SIJ: synovial part (yellow) and ligamentous part (blue)

SACROILIAC JOINT ANATOMY

- Divided into 3 parts craniocaudally
  - Superior: posterior syndesmosis up to the superior-most anterior portion
  - Middle: posterior syndesmosis; anterior synovial
  - Inferior: synovial



Superior

Middle

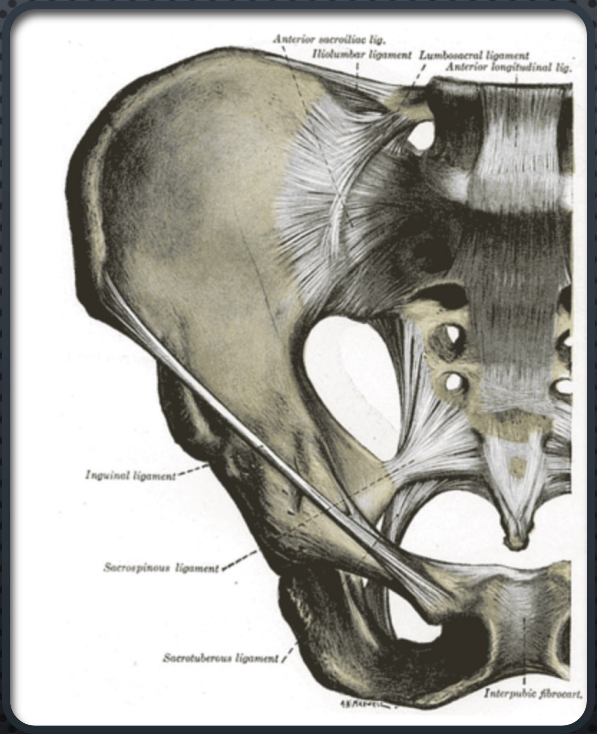
Inferior

Yellow = synovial joint
Blue = syndesmosis

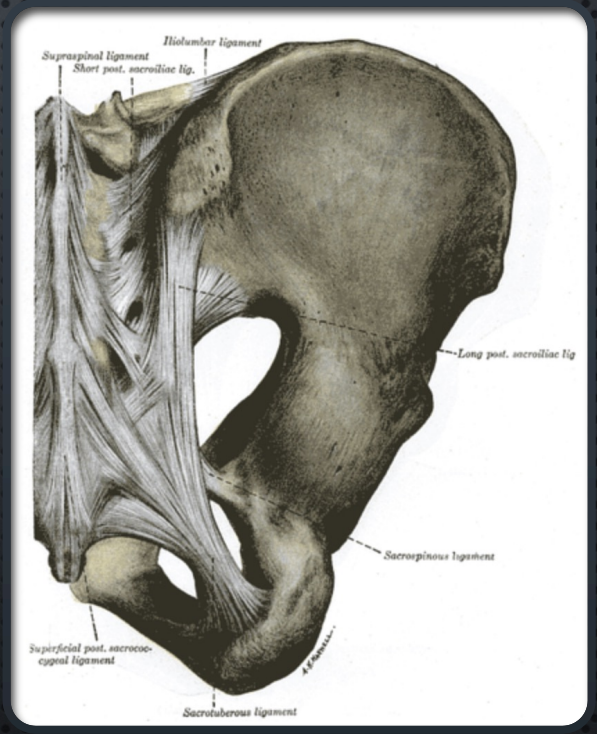
SACROILIAC JOINT ANATOMY

- Numerous strong core ligaments
  - Ventral, dorsal, interosseous
    - Interosseous sacroiliac ligament is the strongest SIJ supporting structure
  - Superficial anterior and posterior sacroiliac ligaments
  - Iliolumbar ligaments connected to both the dorsal and ventral sacroiliac ligaments
- Dynamic stabilizers: gluteus maximus, piriformis, and biceps femoris

Anterior



Posterior



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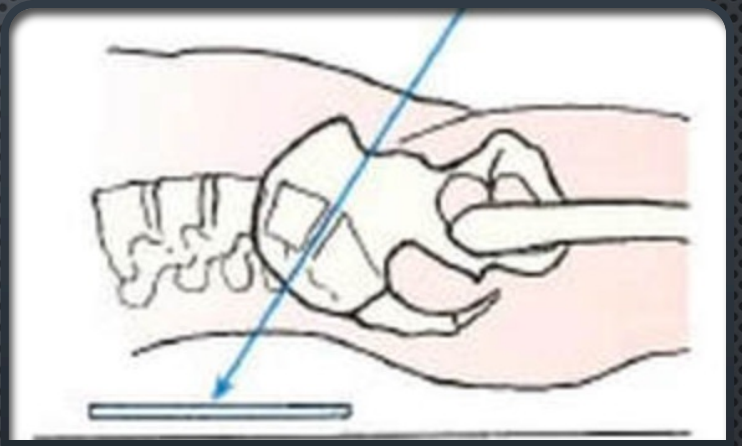
Outline

- Anatomy overview
- **SIJ imaging**
- Sacroiliac joint (SIJ) pathology
- Sacroiliitis imaging assessment

SIJ IMAGING: XR

- Initial imaging of choice for sacroiliitis/SIJ pain
  - Pros: Easily available, inexpensive, quick exam
  - Cons: low sensitivity
- Standard views for SIJ evaluation:
  - Anterior-posterior (AP) view
  - Modified Ferguson view
    - Centered at L5-S1 and projected cranially 30-35 degrees
    - More direct view of SIJs
  - +/- 15 degree lateral views of each SIJ

Modified Ferguson projection



Elements of radiography

Sacroiliac joint imaging

Sacroiliac joint imaging

Axial (top) and oblique coronal (bottom) through pelvis demonstrating osseous erosion (arrow) and subchondral sclerosis (arrowhead) along the SIJs

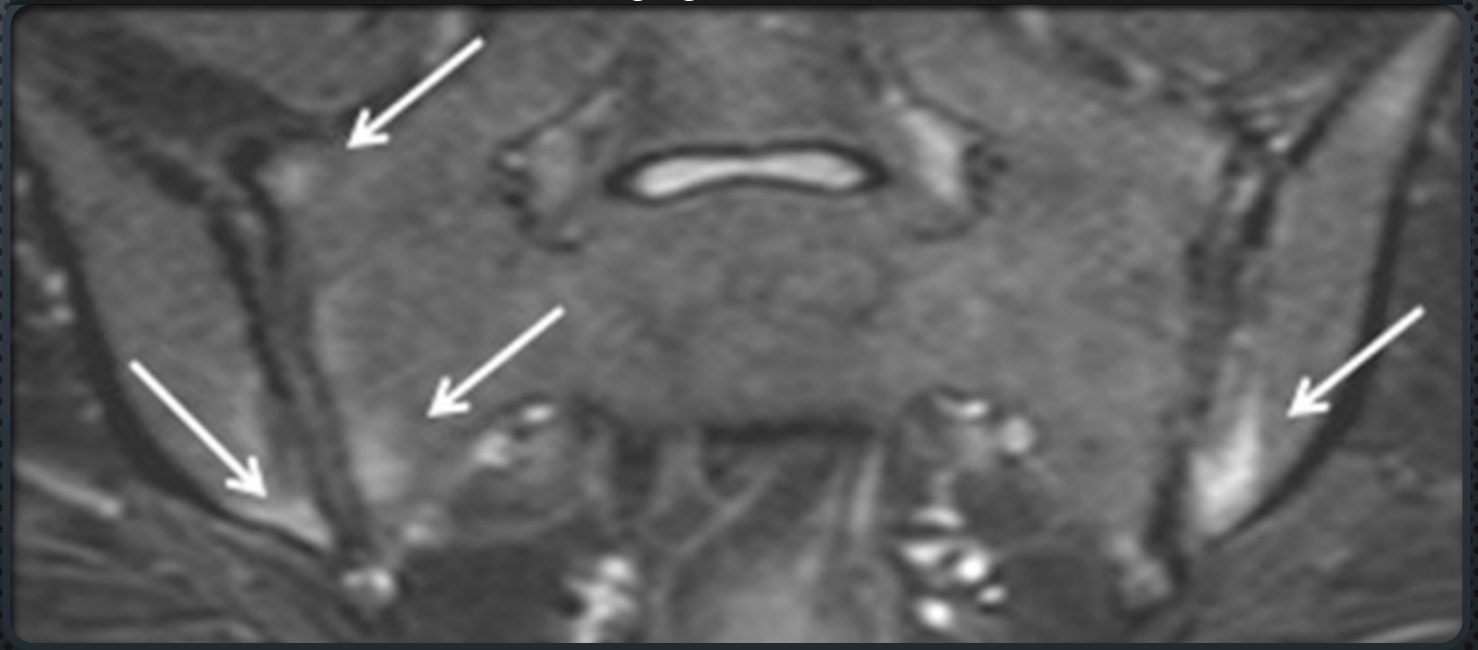
SIJ IMAGING: CT

- Pros:
  - Better osseous detail (compared to CT)
  - Can evaluate soft tissues
- Cons:
  - higher radiation dose
  - Cannot easily detect synovitis or marrow changes

SIJ IMAGING: MR

- Pros
  - No radiation
  - Can detect bone marrow edema
  - Soft tissue assessment
- Cons
  - Relatively poor osseous detail
  - Expensive
  - Less readily available

Imaging of sacroiliitis



Multifocal bone marrow subchondral edema along bilateral SIJs

Outline

- Anatomy overview
- SIJ imaging
- **Sacroiliac joint (SIJ) pathology**
- Sacroiliitis imaging assessment

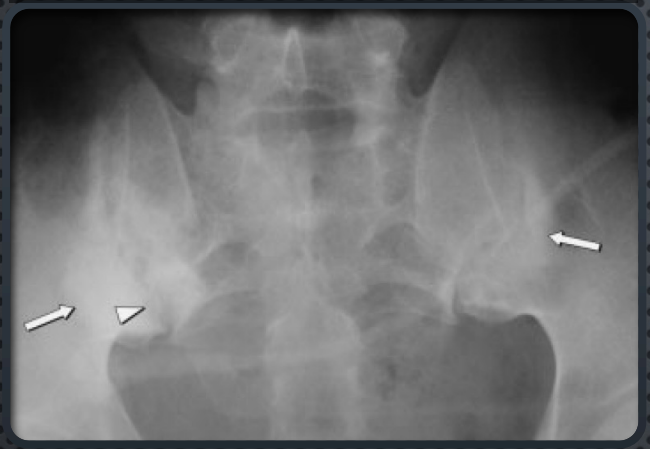
SIJ PATHOLOGY: OSTEOARTHRITIS

- Common!
  - ~40 years of age
- Imaging
  - Joint space narrowing
  - Subchondral sclerosis and cystic change
    - Iliac > sacral side
  - Intra-articular gas
  - Anterior osteophytes
- Extra-articular ankylosis common
  - Intra-articular ankylosis exceedingly rare with osteoarthritis

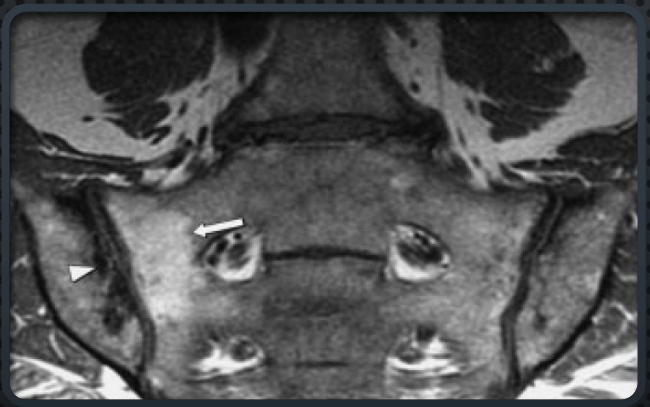
Sacroiliac joint imaging

Typical features of SIJ osteoarthritis: subchondral sclerosis (arrow), anterior osteophyte formation (curved arrow), bridging osteophyte (arrowhead)

Sacroiliac joint imaging



Patient with Crohn's disease and sacroiliitis; XR demonstrates bilateral subchondral sclerosis (arrows) and osseous erosion (arrowheads)

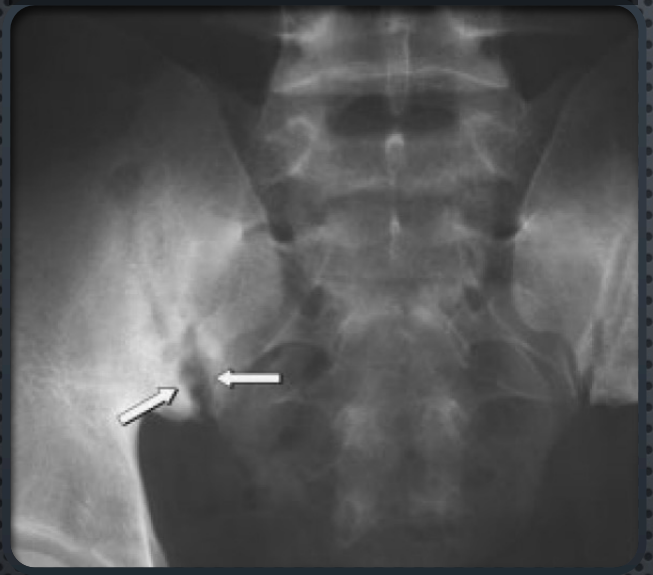


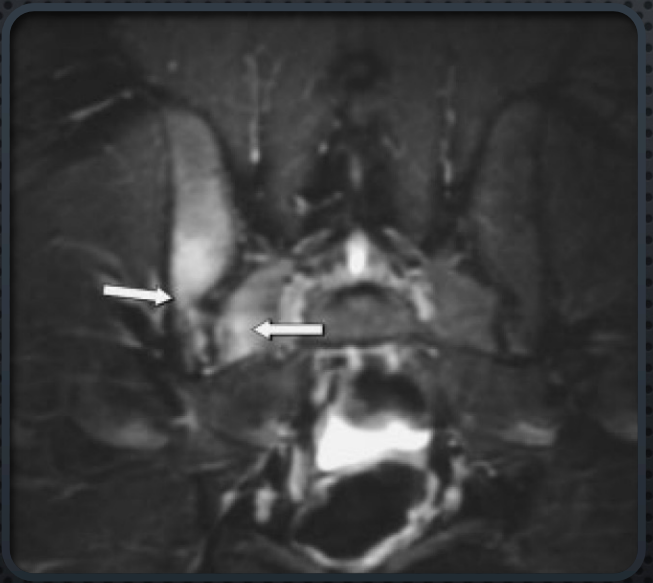
Sequela of chronic sacroiliitis; oblique coronal T1 through sacrum showing fatty marrow conversion along the SIJ (arrow) as well as subchondral sclerosis (arrowhead)

SIJ PATHOLOGY: INFLAMMATORY SACROILIITIS

- Inflammation of the sacroiliac joint
- Acute
  - New-onset severe pain
  - Septic sacroiliitis most common cause
- Chronic
  - Hallmark: ankylosing spondylitis
  - Other spondyloarthropathies: psoriatic arthritis, reactive arthritis, enteropathic arthritis
- Imaging
  - Bone marrow edema, osseous erosions, sclerosis

Sacroiliac joint imaging





XR (top) demonstrating unilateral SIJ erosions and subchondral sclerosis (arrows); MR (bottom) demonstrates unilateral subchondral marrow edema (arrows)

SIJ PATHOLOGY: INFECTIOUS SACROILIITIS

- Septic arthritis
  - Relatively rare
  - Hematogenous seeding of joint
  - Imaging
    - Unilateral
    - Erosions and subchondral sclerosis on both sides of joint
    - +/- detectable effusion
    - Surrounding inflammation +/- abscess formation

SIJ PATHOLOGY: CPPD

- SIJ involvement seen in ~50% of pts with CPPD
- Imaging
  - SIJ erosions, sclerosis, joint space narrowing
  - Osteophytes
  - Chondrocalcinosis (can be difficult to see – CT)

CT features of CPPD

Mild bilateral sacroiliac joint narrowing with chondrocalcinosis

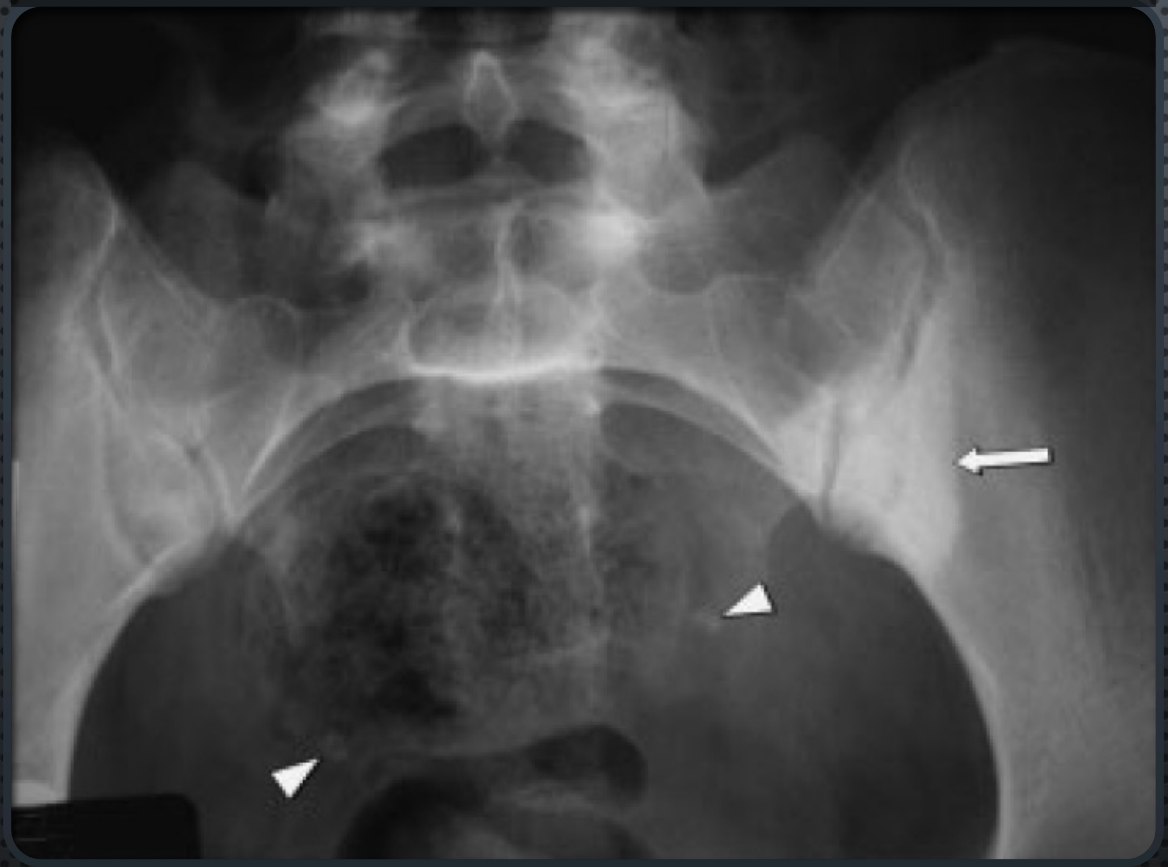
Sacroiliac joint imaging

Bilateral SIJ osseous erosions (arrows) and ill-defined sclerosis

SIJ PATHOLOGY: HYPERPARATHYROIDISM

- Subchondral resorption along SIJs
- Imaging
  - Ill-defined, widened SIJs
  - Bilateral and symmetric
  - No joint space narrowing
  - No ankylosis

Sacroiliac joint imaging



Triangular area of dense sclerosis along the iliac side of the SIJ (arrow) seen in osteitis condesnans ilii; tubal ligation clips in the pelvis (arrowheads)

SIJ PATHOLOGY: OSTEITIS CONDENSANS ILII

- Sclerosis along ilium
  - Typically bilateral and triangular in shape
- Etiology unclear
  - mechanical stress and imbalance across the joint
  - Often seen in women after birth
- Usually asymptomatic
- Imaging
  - Triangular area of sclerosis along the iliac side of SIJ
  - Often bilateral
  - NO erosions, joint space narrowing, or ankylsosis

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- Anatomy overview
- SIJ imaging
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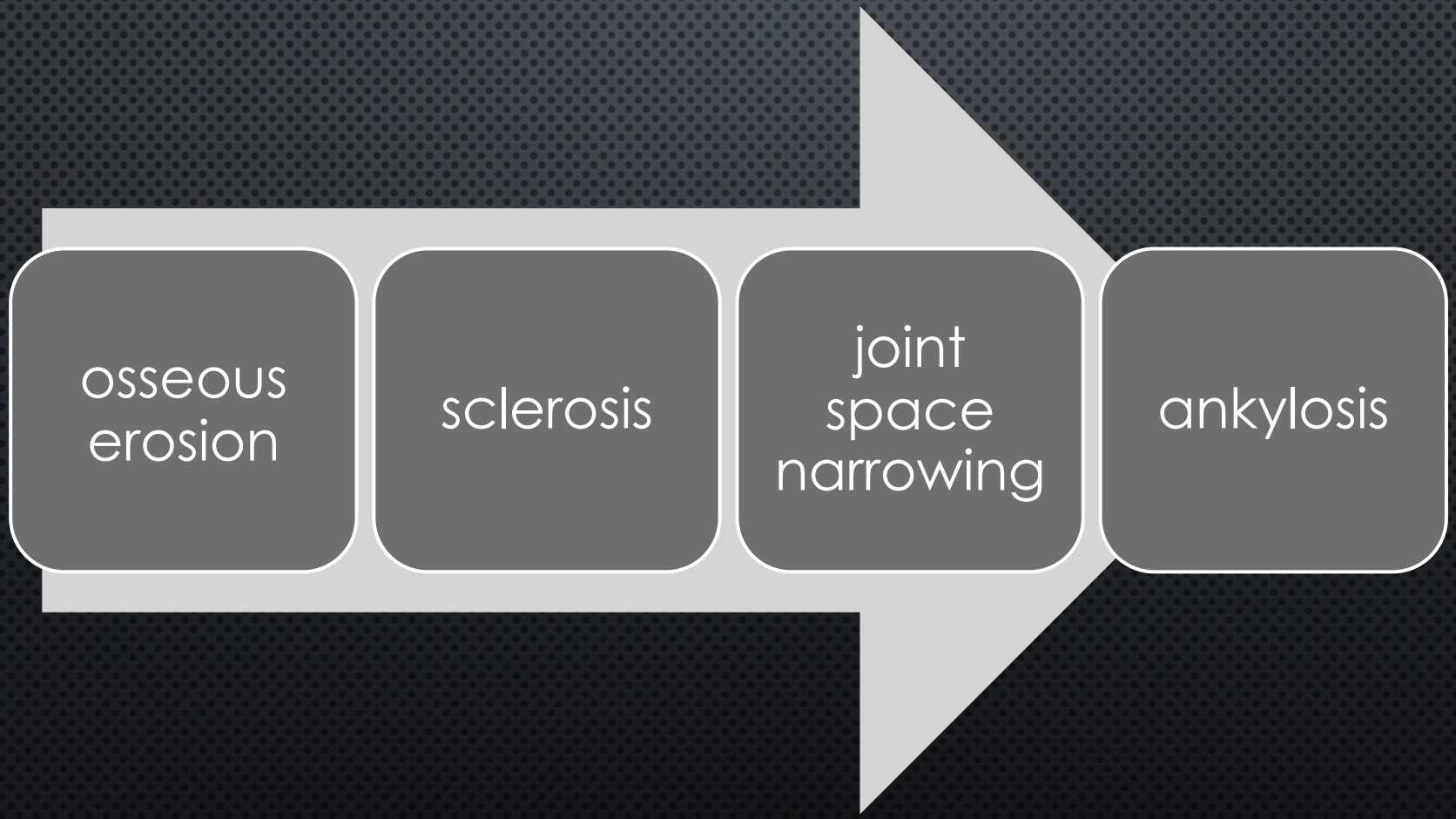
- **Sacroiliitis imaging assessment**

SACROILIITIS IMAGING EVALUATION: XR



MODIFIED NEW YORK CRITERIA

- GRADE 0: NORMAL
- GRADE 1: SUSPICIOUS CHANGES (BLURRING OF JOINT MARGINS)
- GRADE 2: MINIMAL ABNORMALITY (FOCAL EROSIONS OR SCLEROSIS)
- GRADE 3: UNEQUIVOCAL ABNORMALITY (EROSIONS, SCLEROSIS, WIDENING, NARROWING OR PARTIAL ANKYLOSIS)
- GRADE 4: SEVERE ABNORMALITY (ANKYLOSIS)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2


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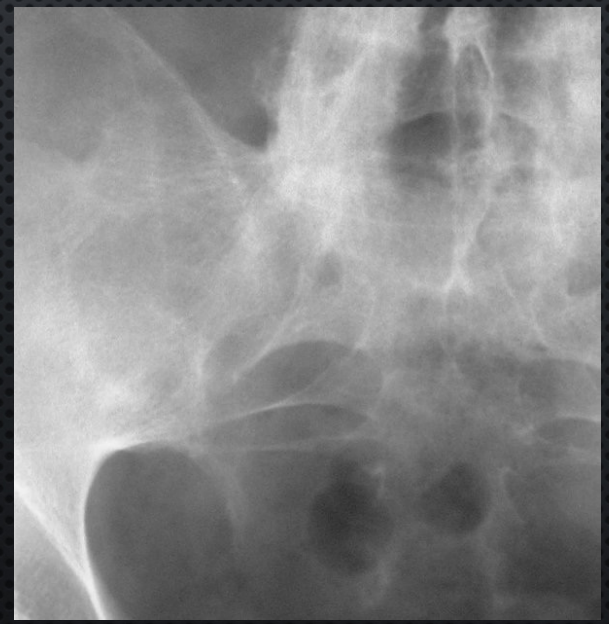
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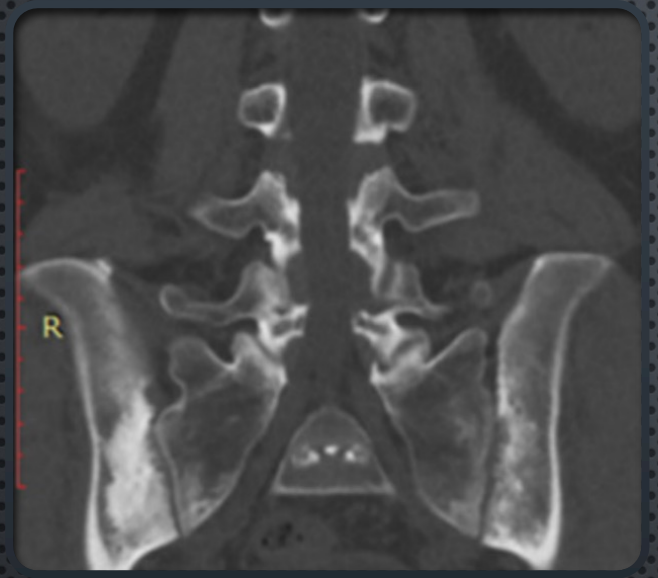
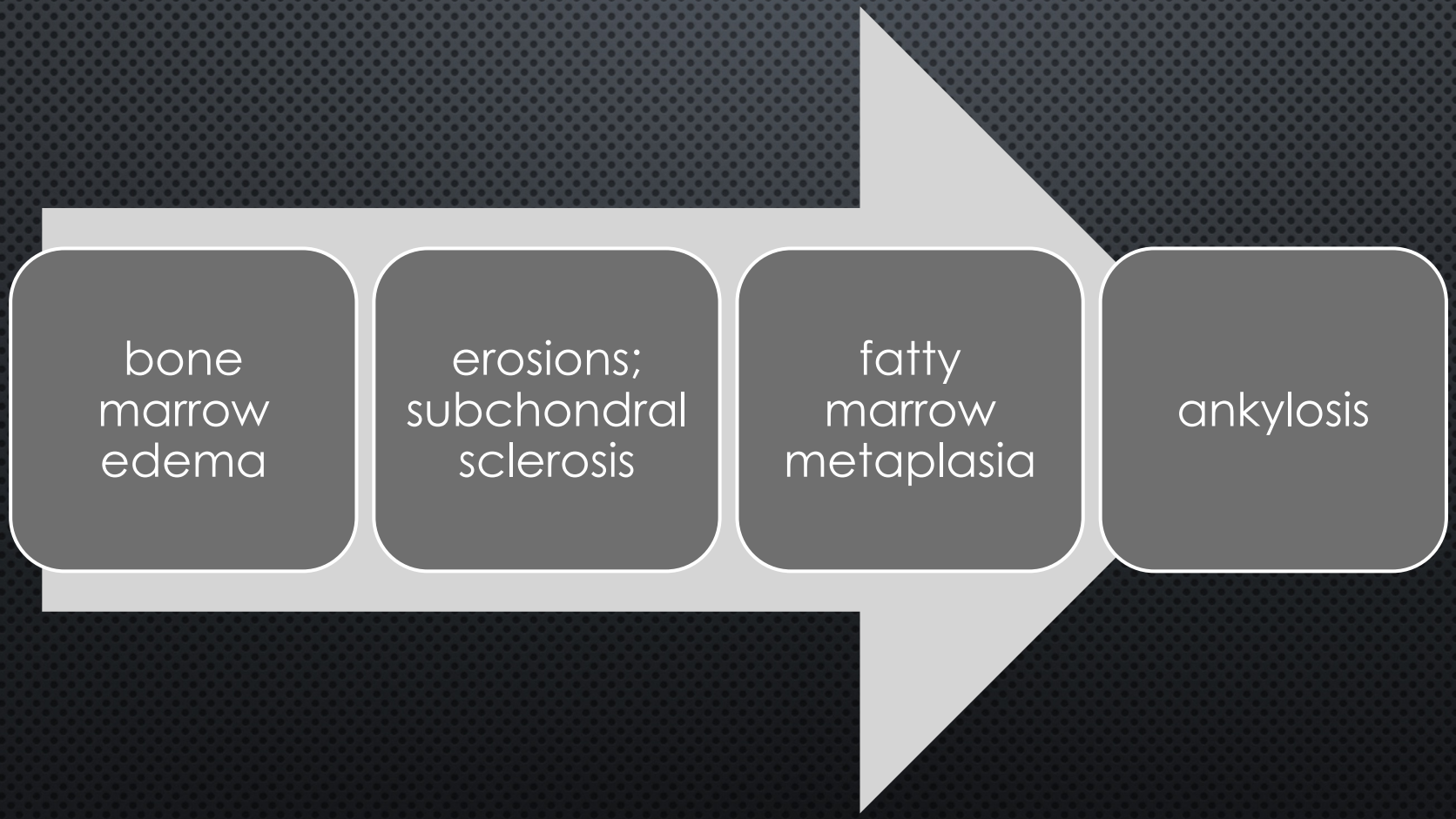


SACROILIITIS IMAGING EVALUATION: CT

- Provides more osseous detail than XR
  - Erosions, sclerosis, joint space narrowing, ankylosis
  - Better evaluation of soft tissues
    - Surrounding inflammation
  - Like XR, limited in detecting early disease

SACROILIITIS IMAGING EVALUATION: MRI

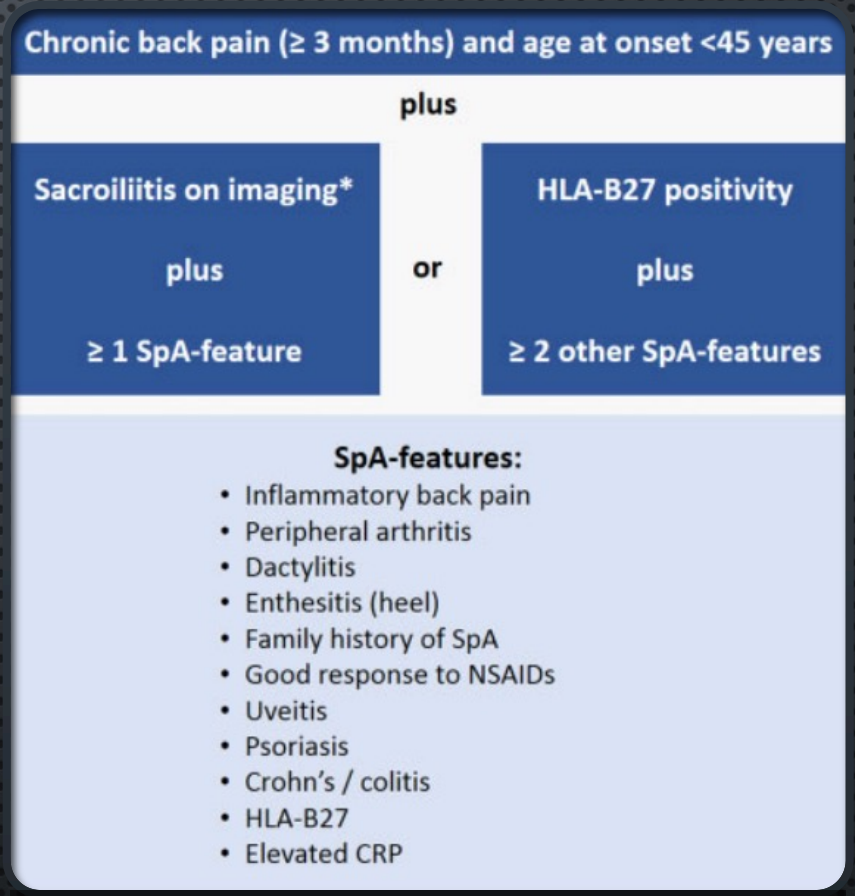


ASAS CRITERIA (IMAGING ARM)

- Imaging:
  - Evidence of structural damage radiographically

  -OR-

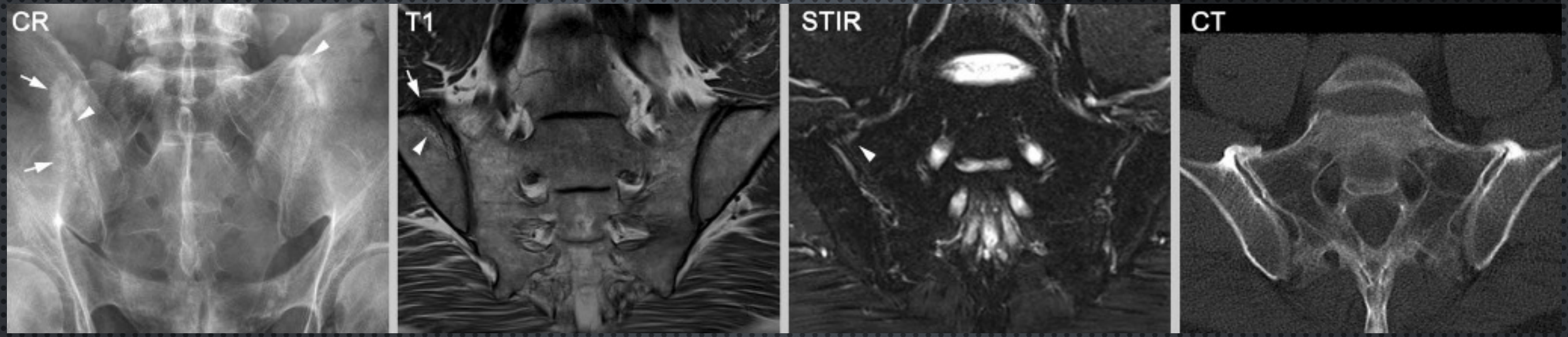
  - Evidence of active inflammation on MRI
    - Bone marrow edema in a typical anatomic area
    - Bone marrow appearance highly suggestive



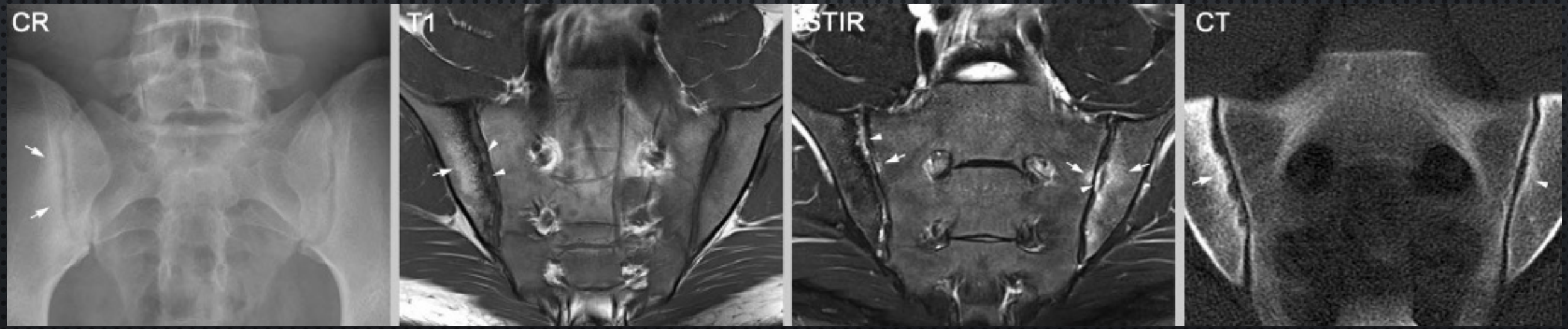
Classification vs diagnostic criteria

Classification vs diagnosis

- MRI very sensitive in detecting bone marrow edema!
- Not all bone marrow edema is sacroiliitis. Can be seen in:
  - Athletes
  - Osteoarthritis
  - Osteitis condensans ilii
  - normal, asymptomatic patients
- Small, focal areas of subchondral edema non-specific



56-year-old male with osteoarthritis; osteophytes on XR and subchondral sclerosis; bridging osteophytes on MR T1; small amount of edema on STIR; bridging osteophytes clear on CT



32-year-old male with sacroiliitis; subchondral sclerosis and erosion on XR; fatty marrow replacement on T1; bone marrow edema along contralateral SIJ; erosion and subchondral sclerosis clear on CT

MRI PROTOCOL

- 4 SEQUENCE PROTOCOL
  - CORONAL OBLIQUE IN T1
  - CORONAL OBLIQUE IN STIR
  - CARTILAGE SEQUENCE
  - SEMIAXIAL PLANE ORTHOGONAL TO SEMICORONAL PLANE
- NO CONTRAST NEEDED!

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SIJ SUMMARY

- Anatomy
  - Part synovial, part fibrous
- Imaging
  - XR: low sensitivity, especially in early disease
  - CT: more clearly delineates osseous detail
  - MR: high sensitivity, able to detect active disease
- SIJ pathology
  - All disease processes that affect synovial joints can involve SIJs
  - Sacroiliitis main concern for inflammatory back pain
- Sacroiliitis imaging assessment
  - bone marrow edema! MRI work horse for this – oblique coronal and axial fat suppressed fluid sensitive sequences are key
  - Evaluation can be difficult – not all bone marrow edema is sacroiliitis

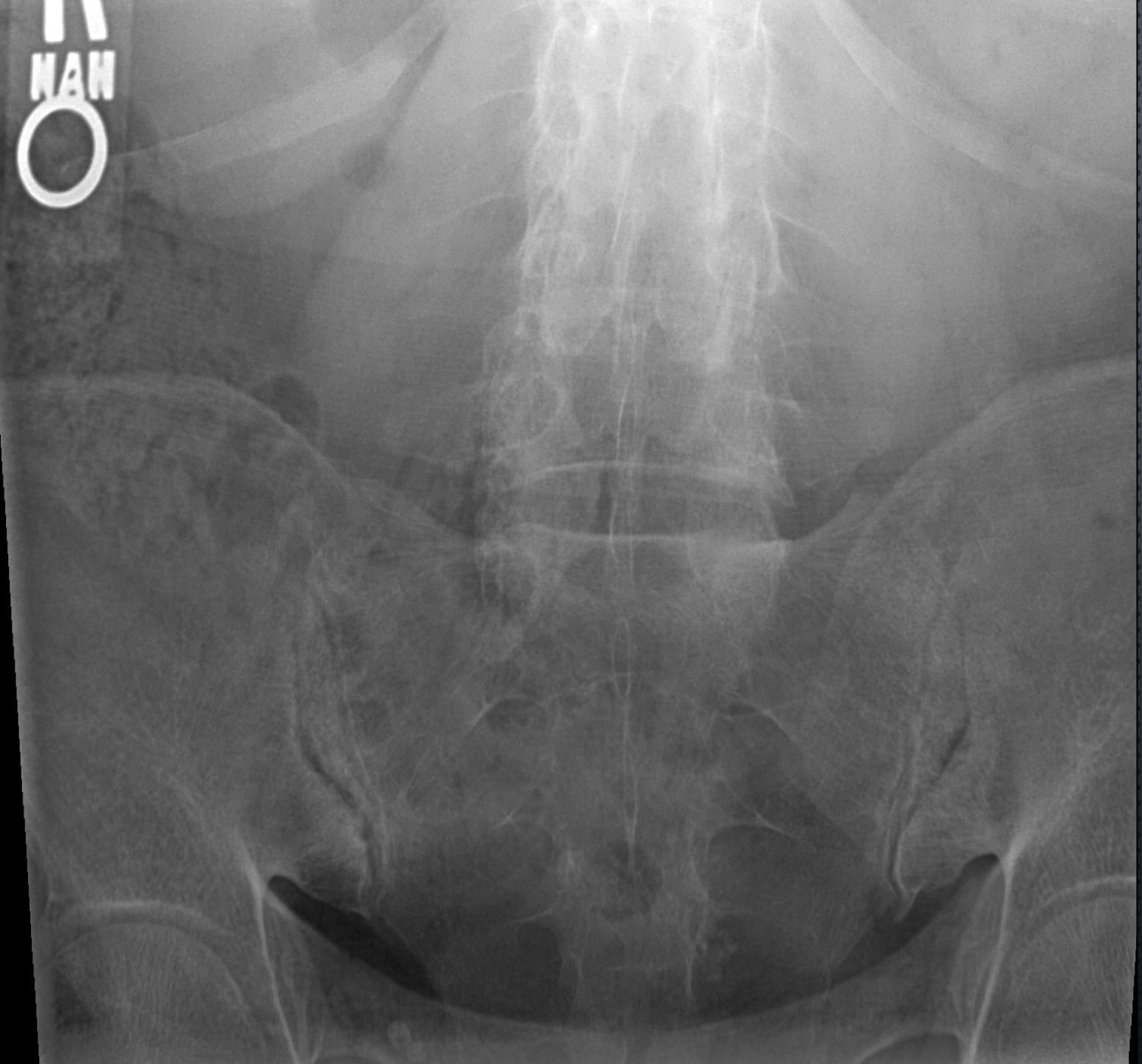
SOURCES

- Martin-Noguerol T, Casado-Verdugo OL, Beltran LS, Aguilar G, Luna A. Role of advanced MRI techniques for sacroiliitis assessment and quantification. European journal of radiology 2023; 163. https://doi.org/10.1016/j.ejrad.2023.110793
- Diekhoff T, Lambert R, Hermann KG. MRI in axial spondyloarthritis: understanding an ASAS-positive MRI and the ASAS classification criteria. Skeletal radiology 2022; 51: 1721-1730. https://doi.org/10.1007/s00256-022-04018-4
- Poddubnyy D. Classification vs diagnostic criteria: the challenge of diagnosing axial spondyloarthritis. Rheumatology 2020; 59. doi:10.1093/rheumatology/keaa250
- Wu J, Wei L, Zhong J. CT imaging features of calcium pyrophosphate dihydrate crystal deposition involving spine. Journal of radiation research and applied science 2024; 17. https://doi.org/10.1016/j.jrras.2024.100882
- Omar A, Sari I, Bedwaiwi M, Salonen D, Haroon N, Inman R. Analysis of dedicated sacroiliac joint views to improve reliability of conventional pelvic radiographs. Rheumatology 2017; 56: 1740-1745. doi:10.1093/rheumatology/kex240
- Tsoi C, Griffith JF, Lee R KL, Wong P CH, Tam LS. Imaging of sacroiliitis: current states, limitations and pitfalls. Quantitative imaging in medicine and surgery 2019; 9(2): 318-335
- Al-Mnayyis A et al. Radiological insights into sacroiliitis: a narrative review. Clinical Practice 2024; 14: 106-121. https://doi.org/10.3390/clinpract14010009
- Vleeming A, Schuenke MD, Masi AT, Carreiro JE, Danneels L, Willard FH. The sacroiliac joint: an overview of its anatomy, function and potential clinical implications. Journal of anatomy 2012; 221: 537-567. oi: 10.1111/j.1469-7580.2012.01564.x
- Roberts SL. Sacroiliac joint anatomy. Phys Med Rehabil Clin N Am 2021; 32: 703-724. https://doi.org/10.1016/j.pmr.2021.05.007
- Tuite MJ. Sacroiliac joint imaging. Seminars in musculoskeletal radiology 2008; 12(1): 72-82
- Ostergaard M. MRI of the sacroiliac jointsL what is and what is not sacroiliitis? Current opinion rheumatology 2020; 32: 357-364
- Giraudo C, Weber M, Puchner A, Grisar J, Kainberger, Schueller-Weidekamm. Which MR sequences should we use for the reliable detection and localization of bone marrow edema in spondyloarthritis? Magnetic resonance imaging 2017; 122: 752-760. DOI 10.1007/s11547-017-0778-y
- Jurik AG. Diagnostics of sacroiliac joint differentials to axial spondyloarthritis changes by magnetic resonance imaging. Journal of clinical medicine 2023; 12(3). **https://doi.org/10.3390/jcm12031039**

THANKS!

PART 2: CASES!

- 67-year-old female with a history of ankylosing spondylitis and back pain



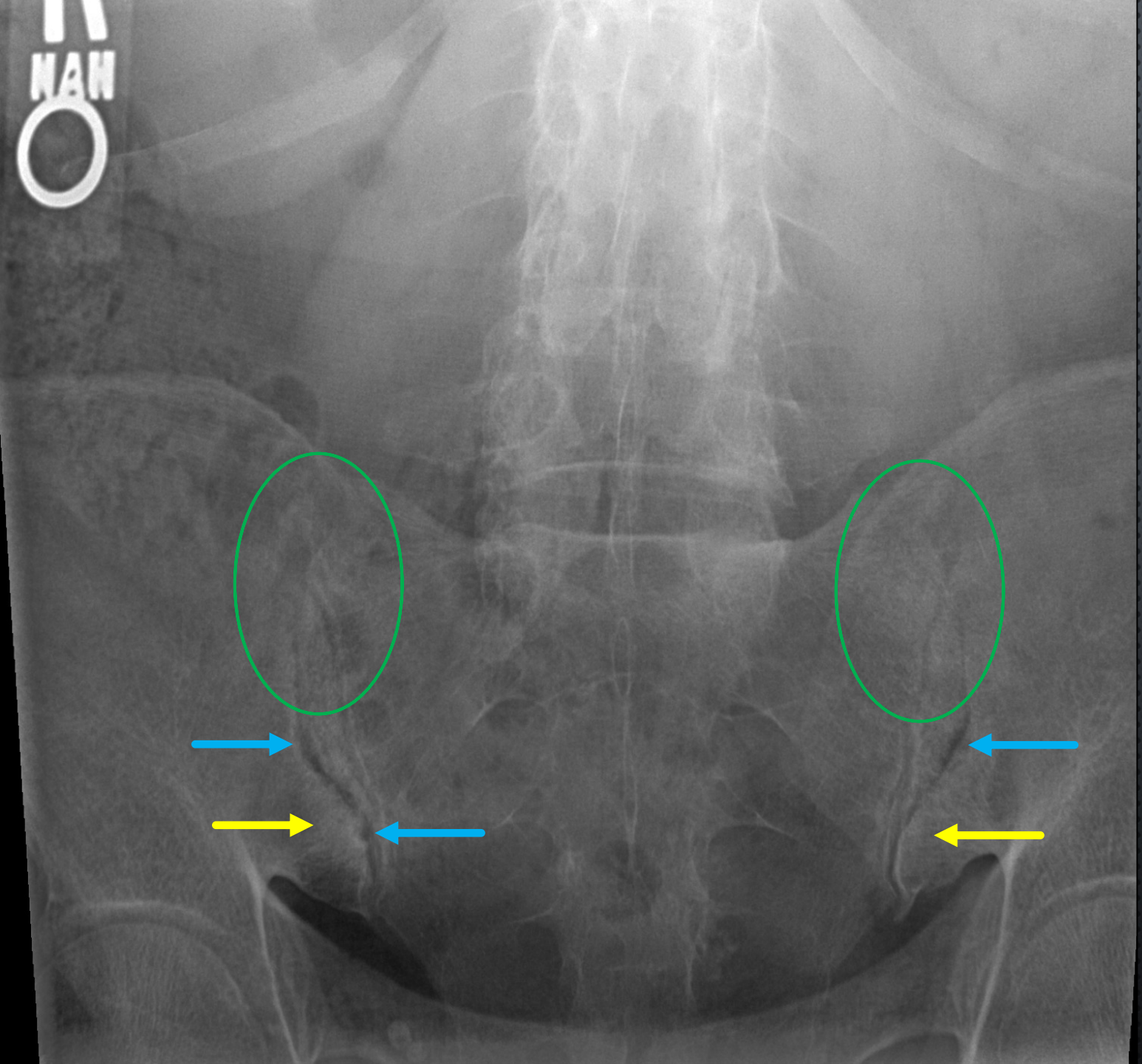
What do you see?

A. Erosions

B. Subchondral sclerosis

C. Joint space narrowing

D. Ankylosis



What do you see?

A. Erosions

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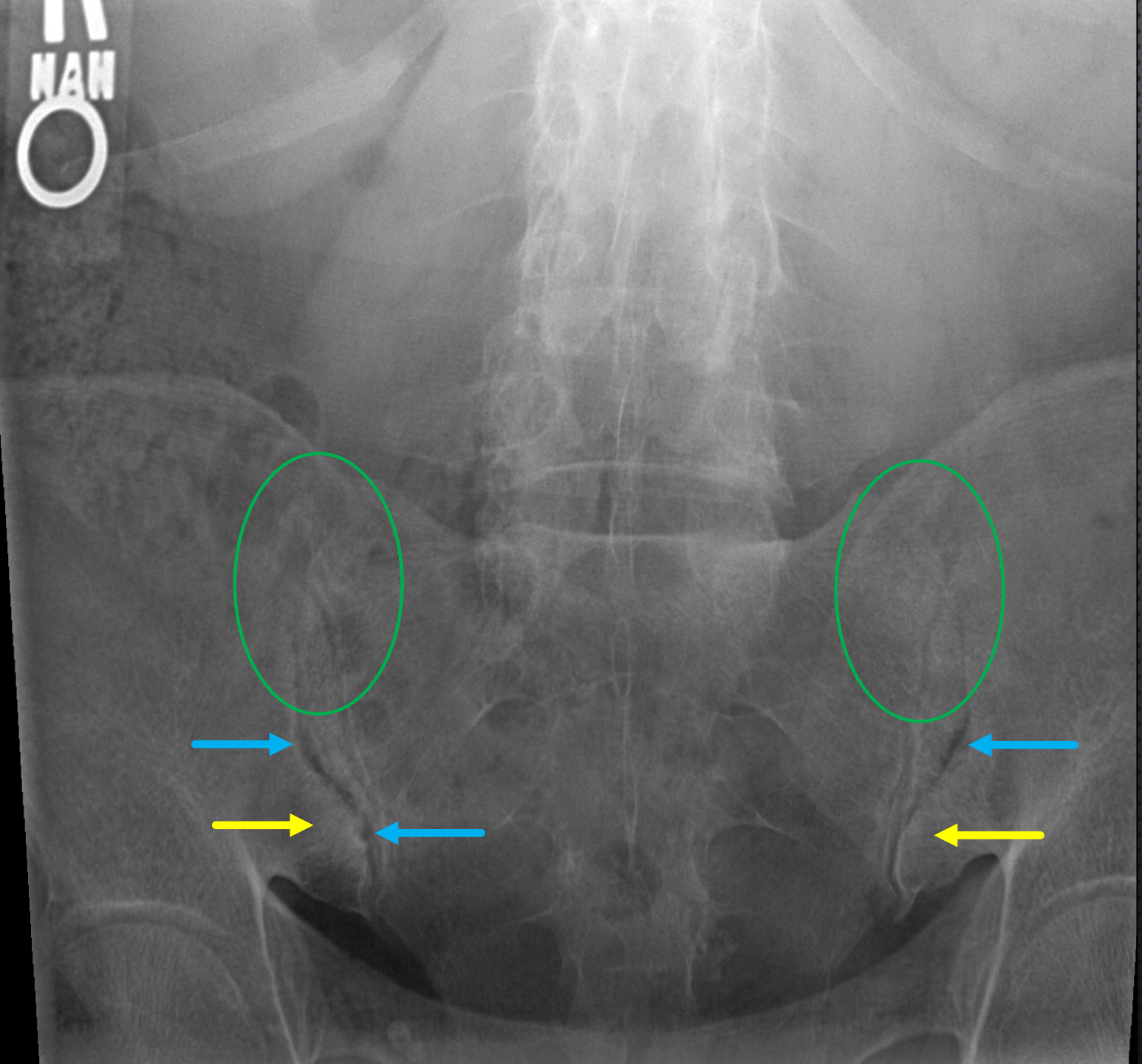
C. Joint space narrowing

D. Ankylosis



What do you see?

A. Erosions

B. Subchondral sclerosis

C. Joint space narrowing

D. Ankylosis

Diagnosis: sacroiliitis

- 38-year-old male with ankylosing spondylitis and back pain

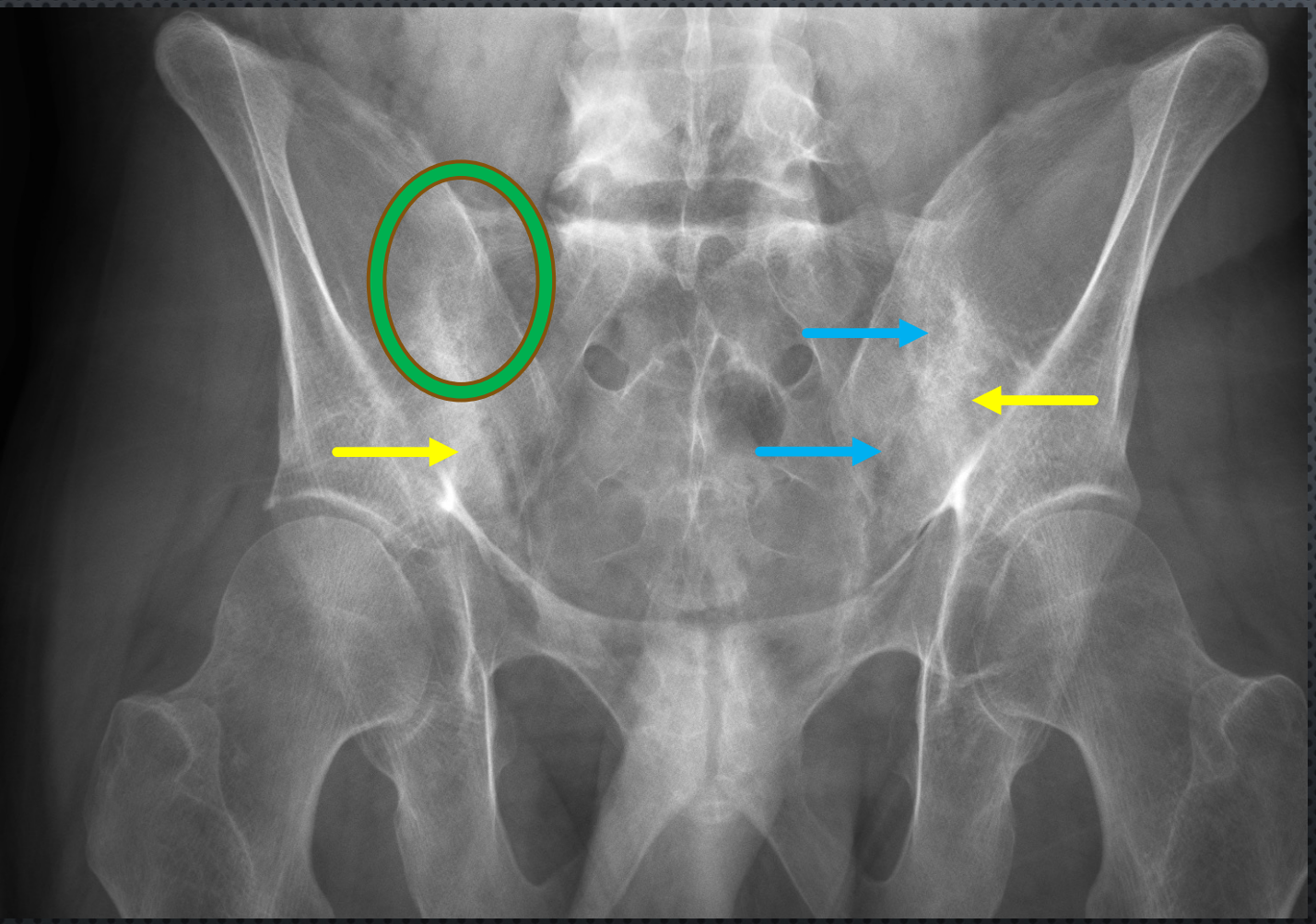
What do you see?

A. Erosions

B. Subchondral sclerosis

C. Joint space narrowing

D. Ankylosis



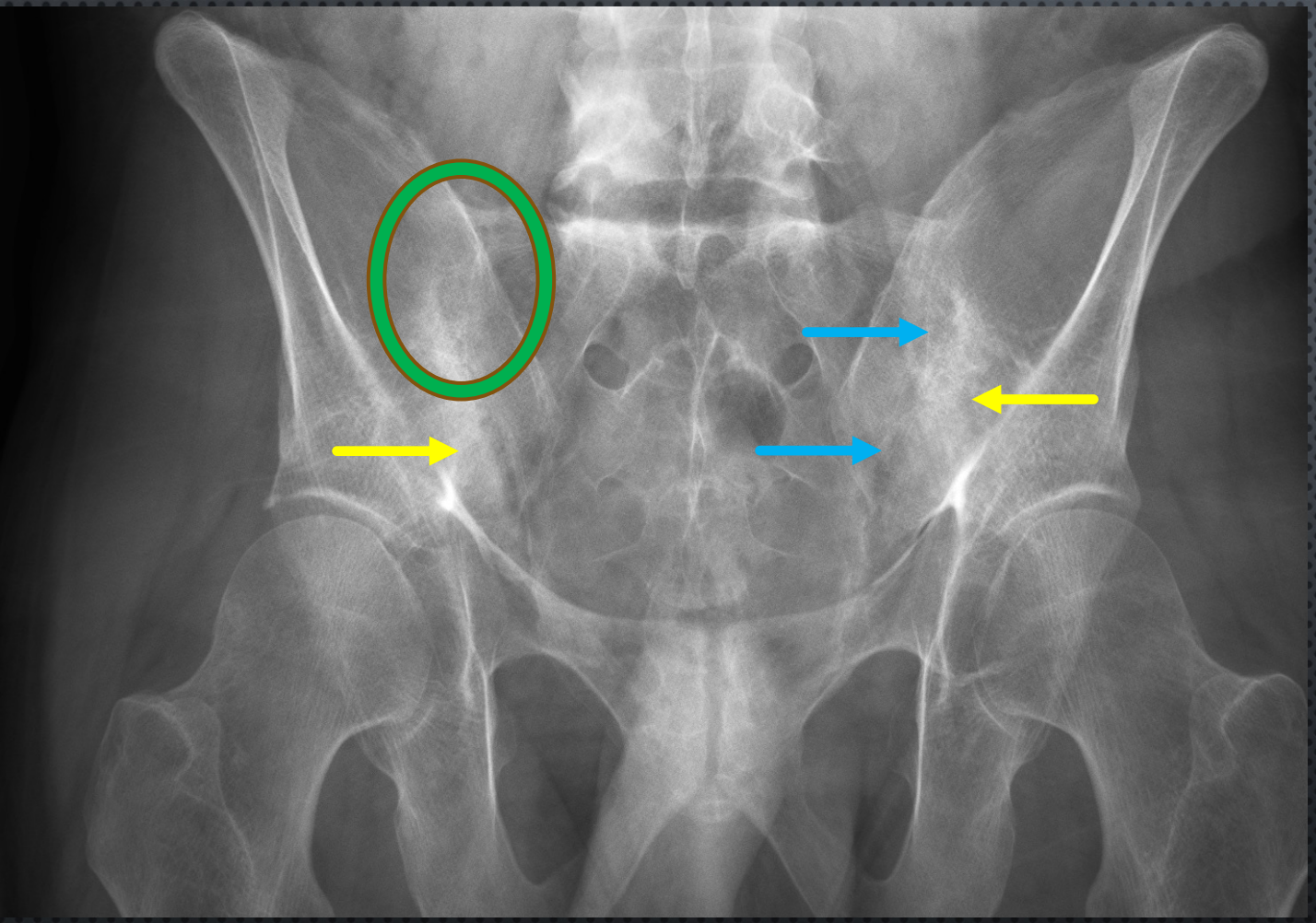
What do you see?

A. Erosions

B. Subchondral sclerosis

C. Joint space narrowing

D. Ankylosis



What do you see?

A. Erosions

B. Subchondral sclerosis

C. Joint space narrowing

D. Ankylosis

Diagnosis: sacroiliitis

- 43-year-old male with Crohn's disease ankylosing spondylitis and back pain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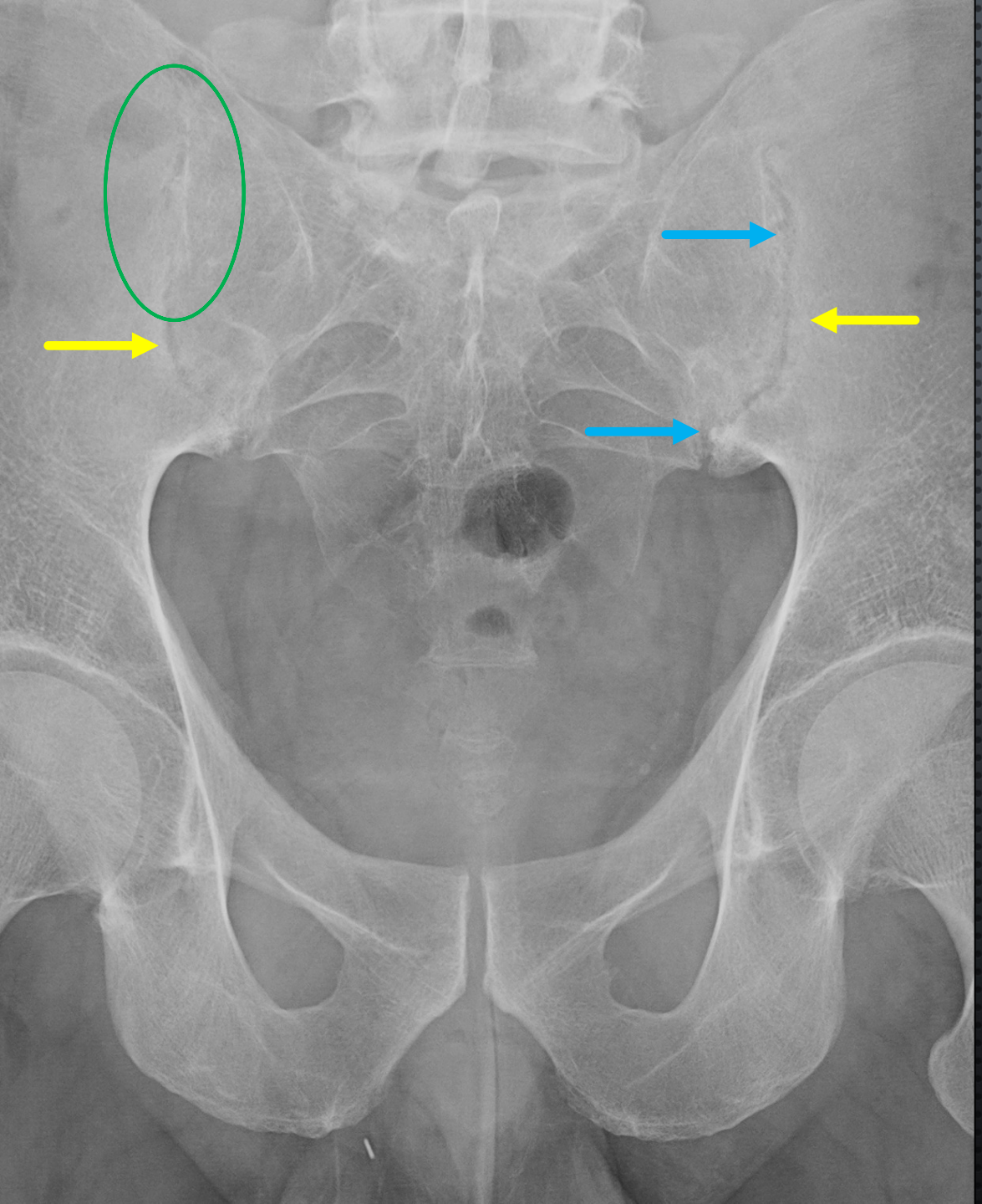
What do you see?

A. Erosions

B. Subchondral sclerosis

C. Joint space narrowing

D. Ankylosis



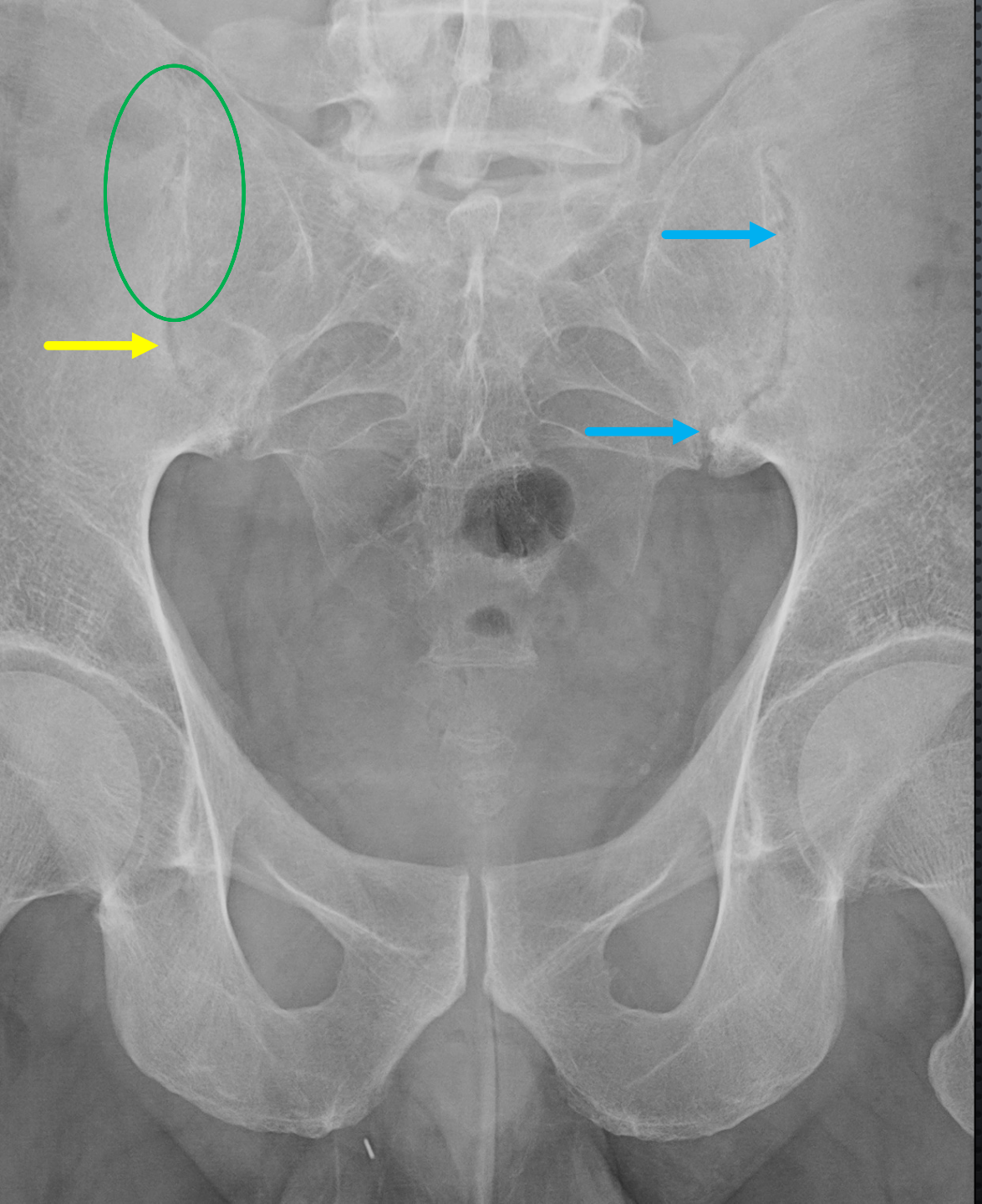
What do you see?

A. Erosions

B. Subchondral sclerosis

C. Joint space narrowing

D. Ankylosis



What do you see?

A. Erosions

B. Subchondral sclerosis

C. Joint space narrowing

D. Ankylosis

Diagnosis: sacroiliitis

- 41-year-old male with ankylosing spondylitis

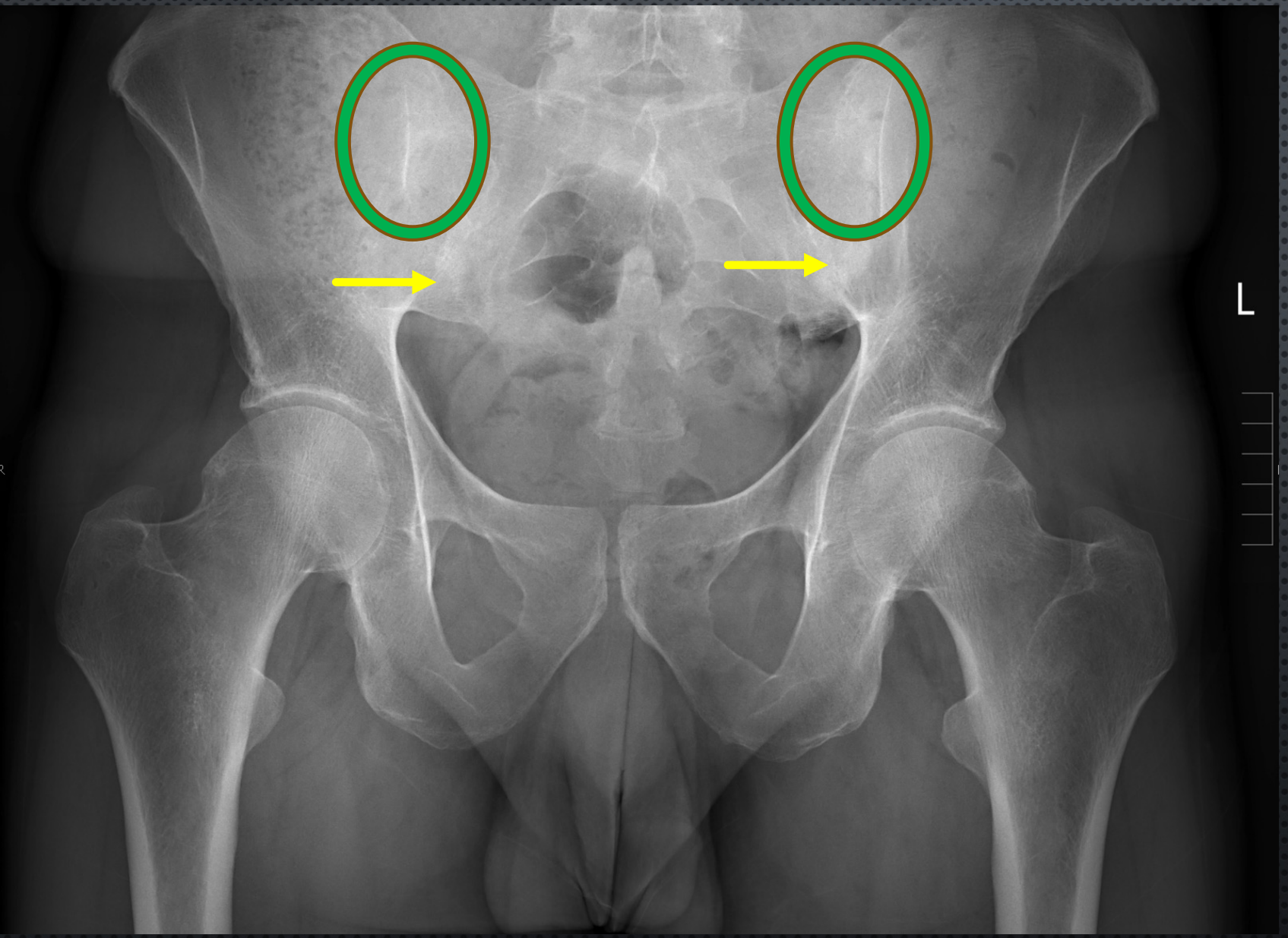
What do you see?

A. Erosions

B. Subchondral sclerosis

C. Joint space narrowing

D. Ankylosis



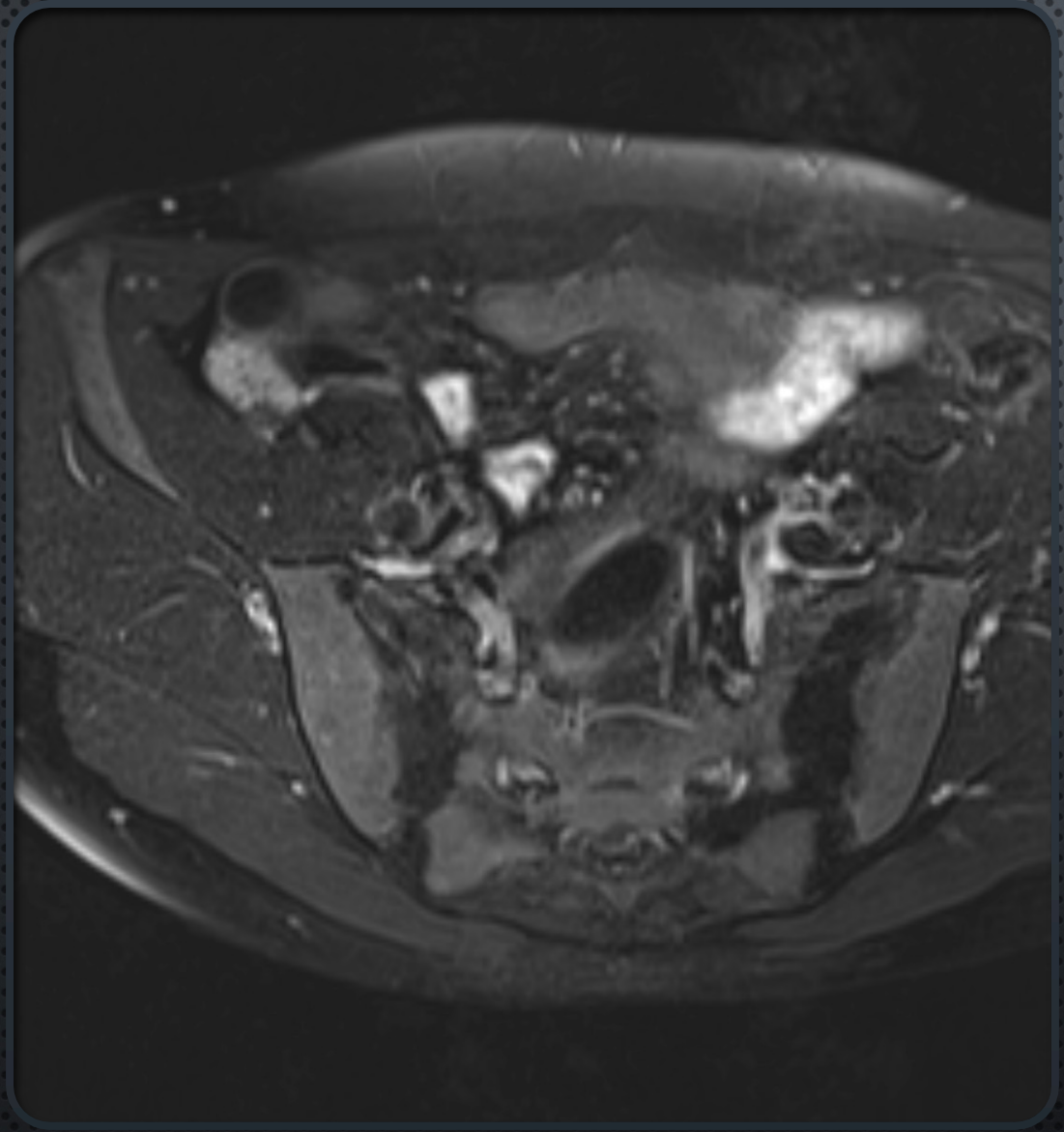
What do you see?

A. Erosions

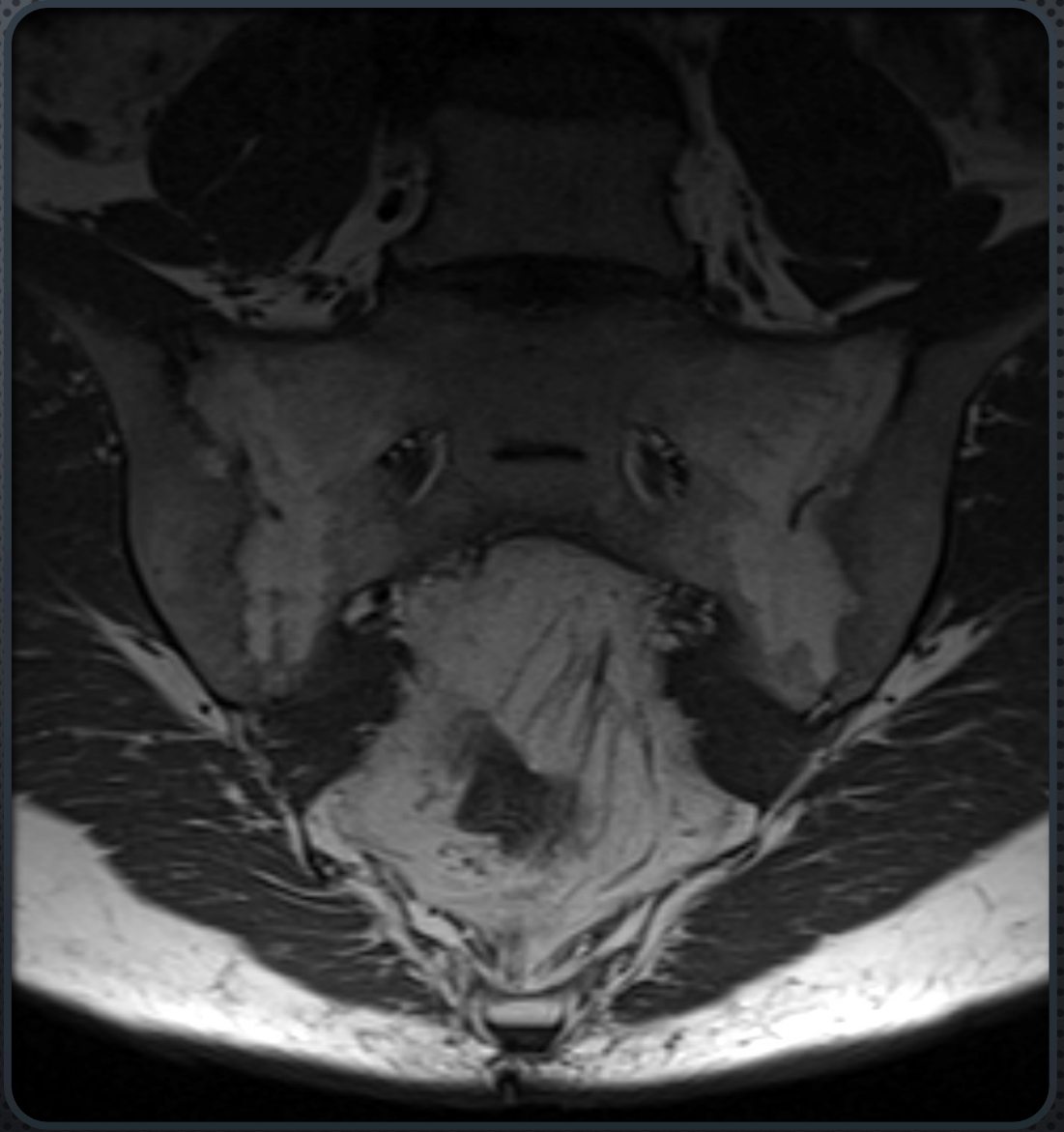
B. *Subchondral sclerosis*

C. *Joint space narrowing*

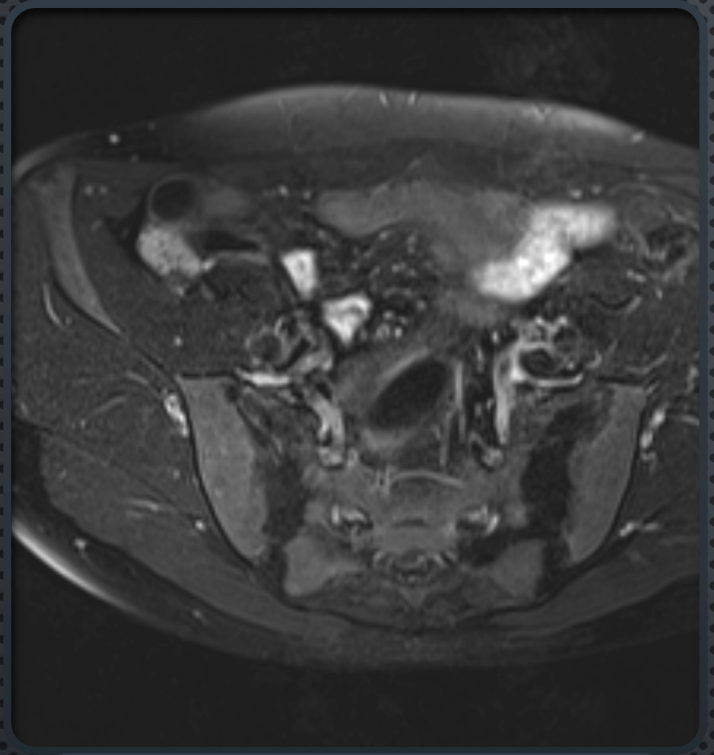
D. *Ankylosis*

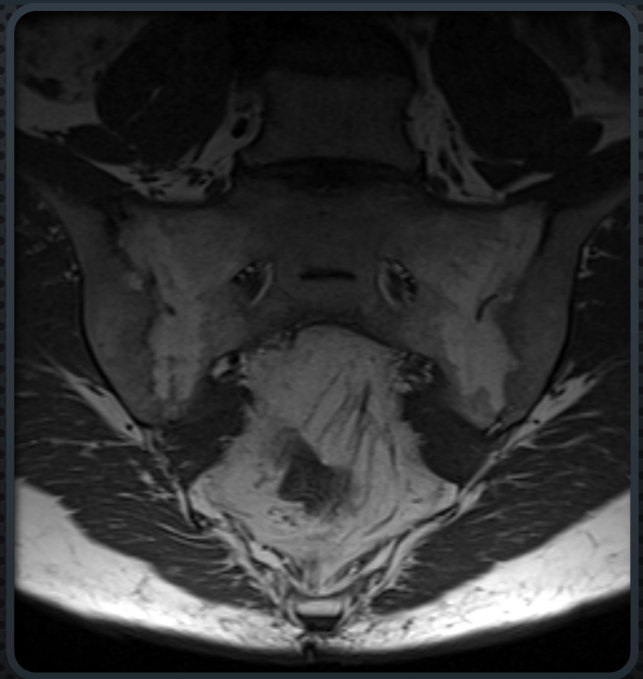


Oblique axial T2FS



Oblique coronal T1





What do you see?

A. Bone marrow edema

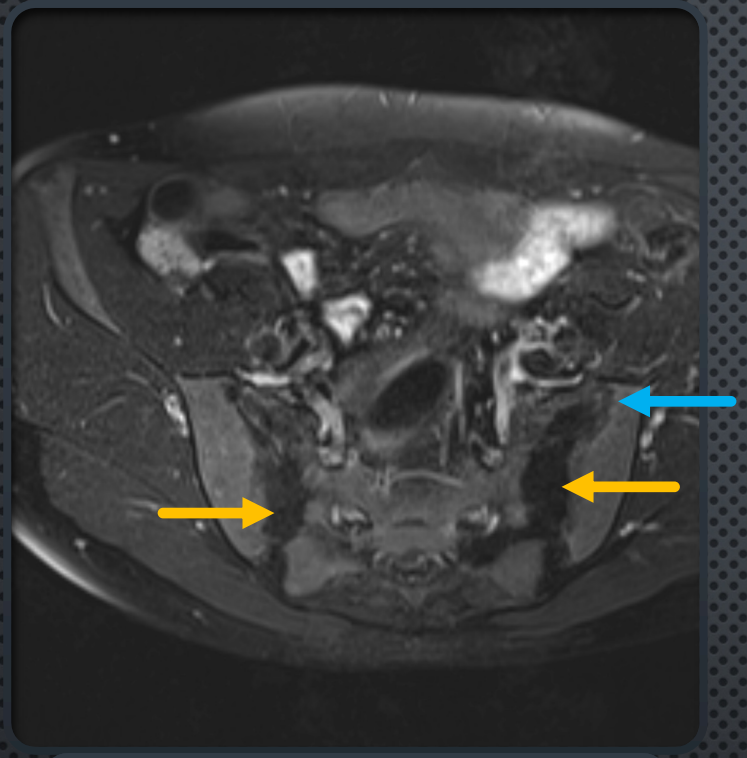
B. Subchondral sclerosis

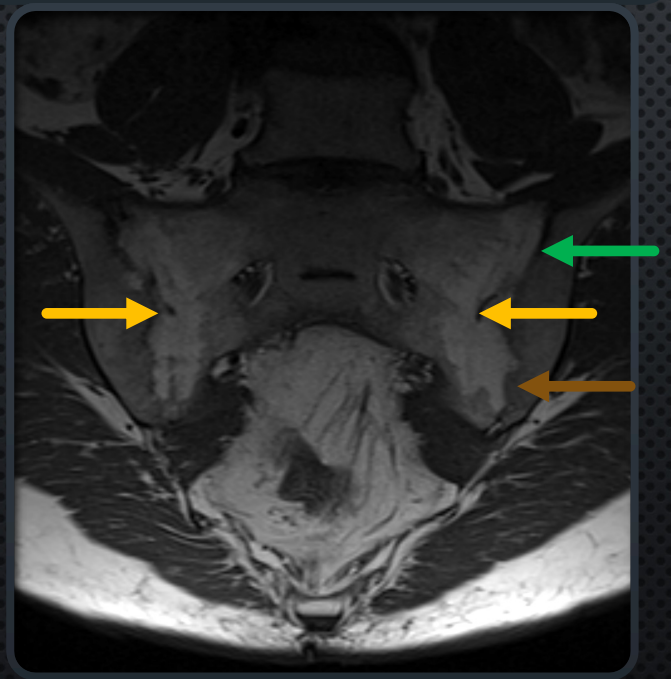
C. Erosions

D. Fatty metaplasia

E. Joint space narrowing

F. Ankylosis





What do you see?

A. Bone marrow edema

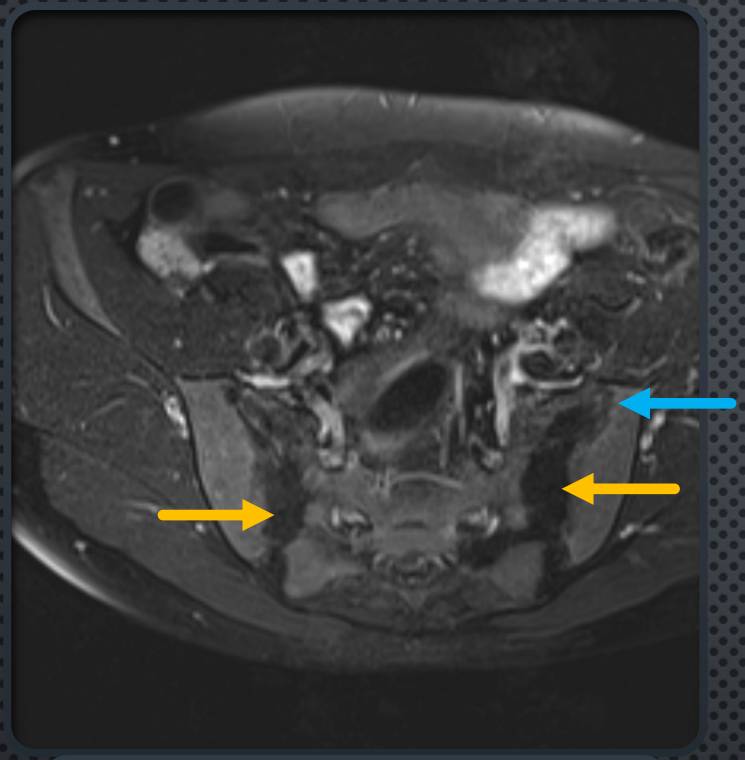
B. Subchondral sclerosis

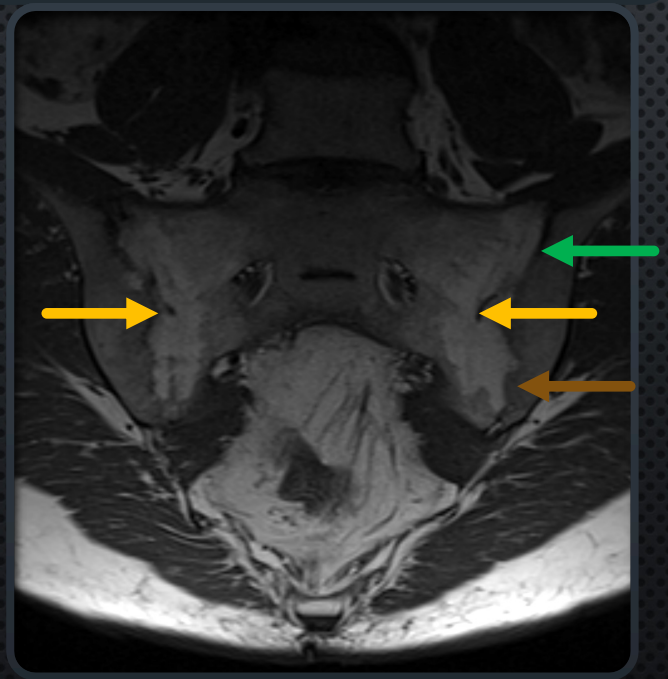
C. Erosions

D. *Fatty metaplasia*

E. Joint space narrowing

F. *Ankylosis*





What do you see?

A. Bone marrow edema

B. Subchondral sclerosis

C. Erosions

D. Fatty metaplasia

E. Joint space narrowing

F. Ankylosis

Diagnosis: chronic sacroiliitis

- 29-year-old female with fibromyalgia and chronic low back pain

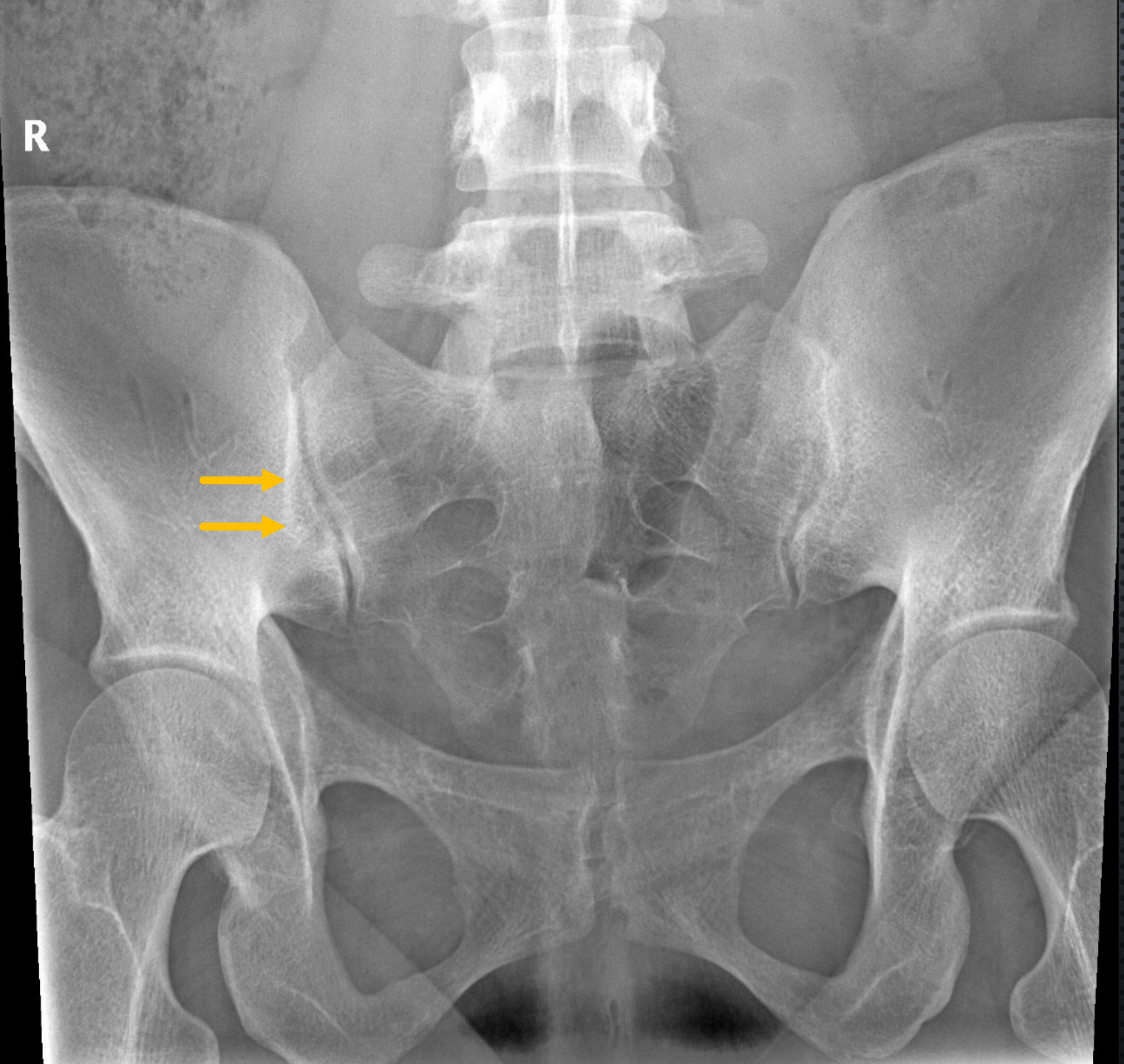
What do you see?

A. Erosions

B. Subchondral sclerosis

C. Joint space narrowing

D. Ankylosis



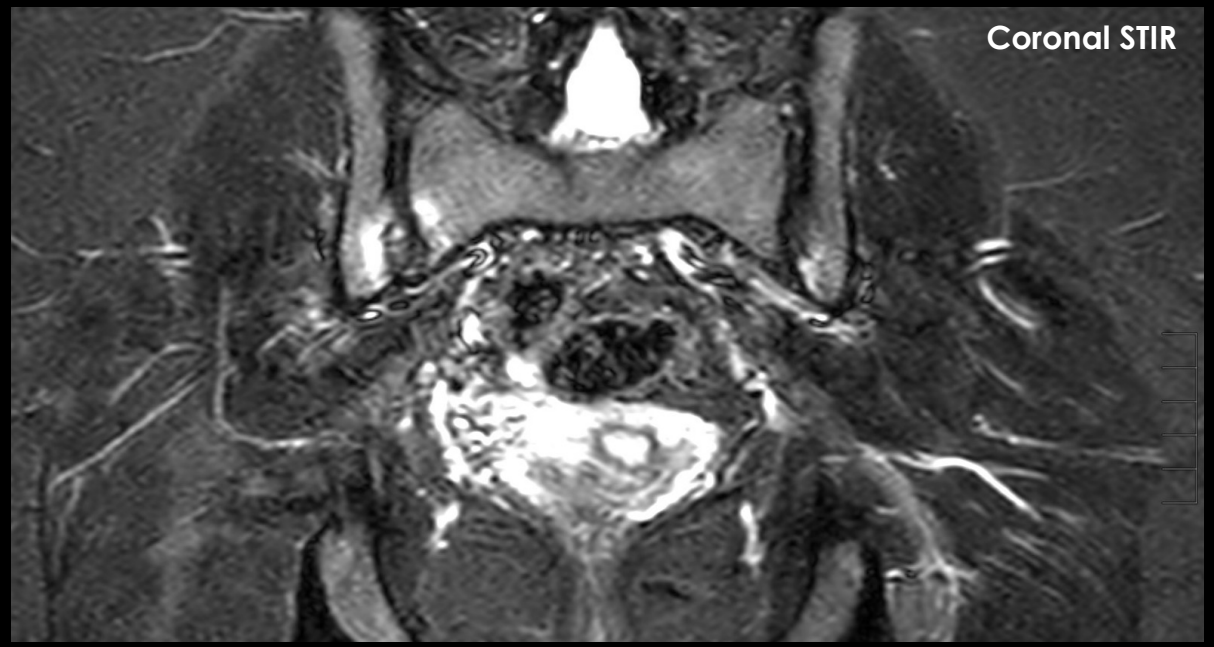
What do you see?

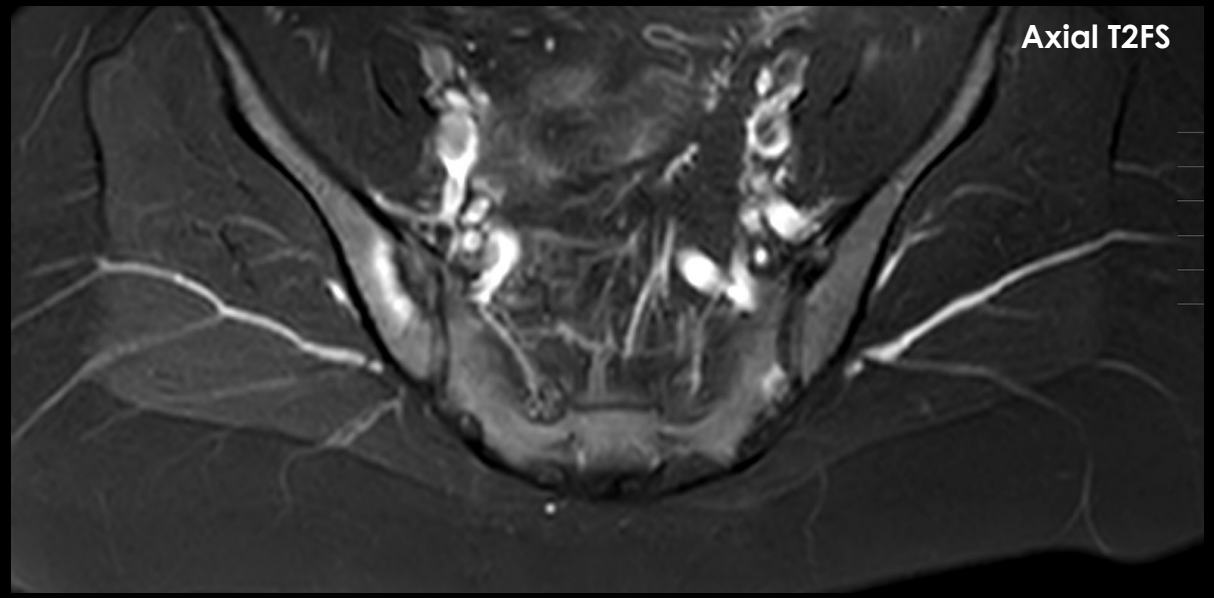
A. Erosions

B. *Subchondral sclerosis?*

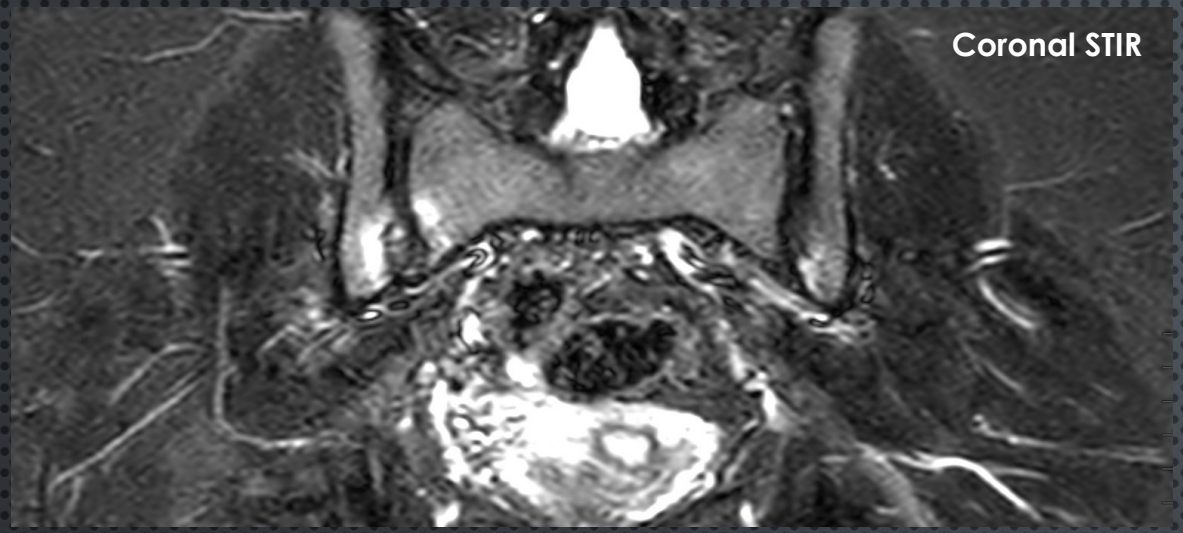
C. Joint space narrowing

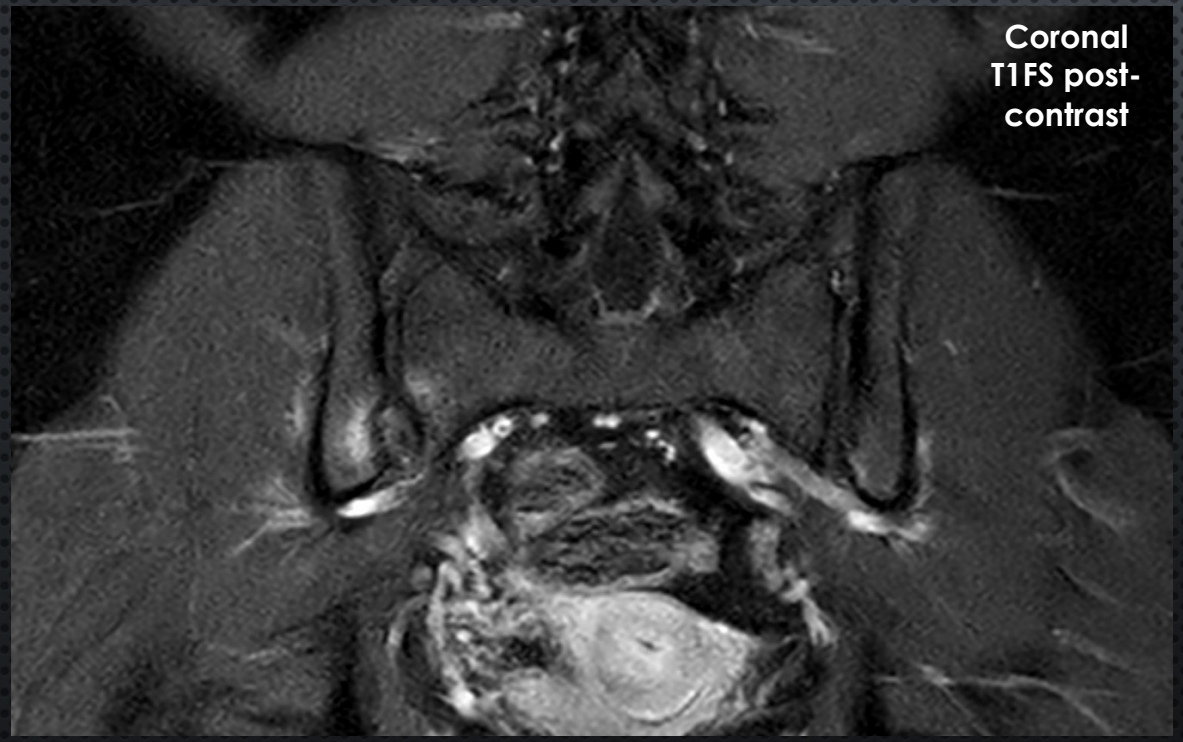
D. Ankylosis


Coronal STIR


Axial T2FS


Coronal
T1FS post-
contrast





What do you see?

A. Bone marrow edema

B. Subchondral sclerosis

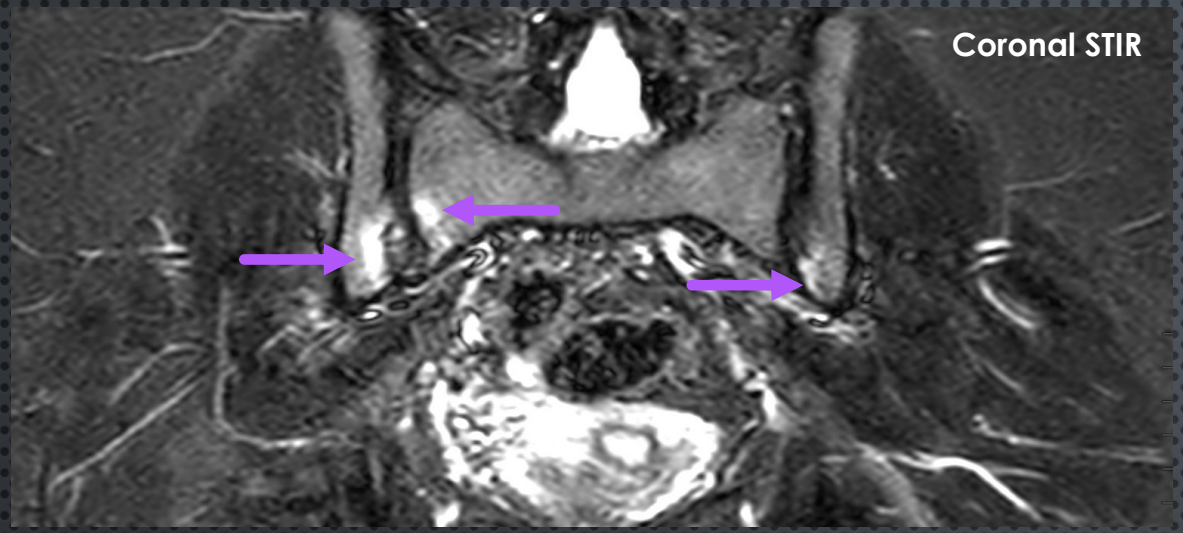
C. Erosions

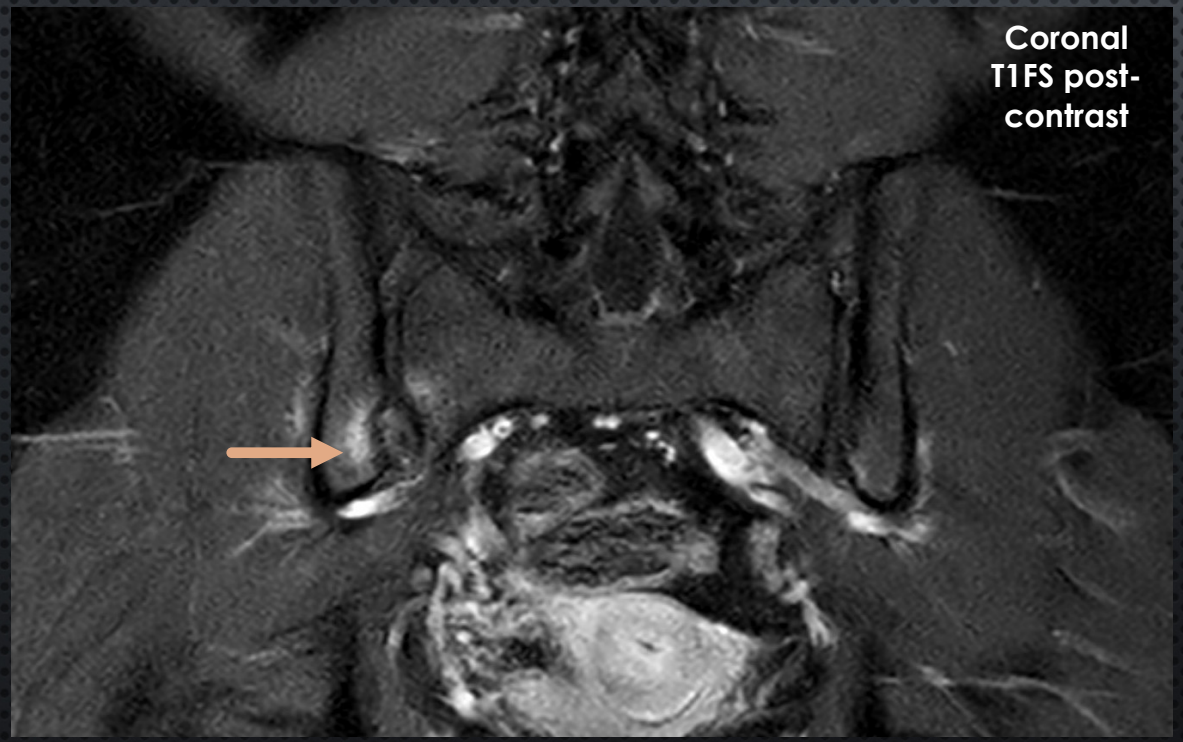
D. Fatty metaplasia

E. Joint space narrowing

F. Ankylosis

G. Enhancement





What do you see?

A. Bone marrow edema

B. Subchondral sclerosis

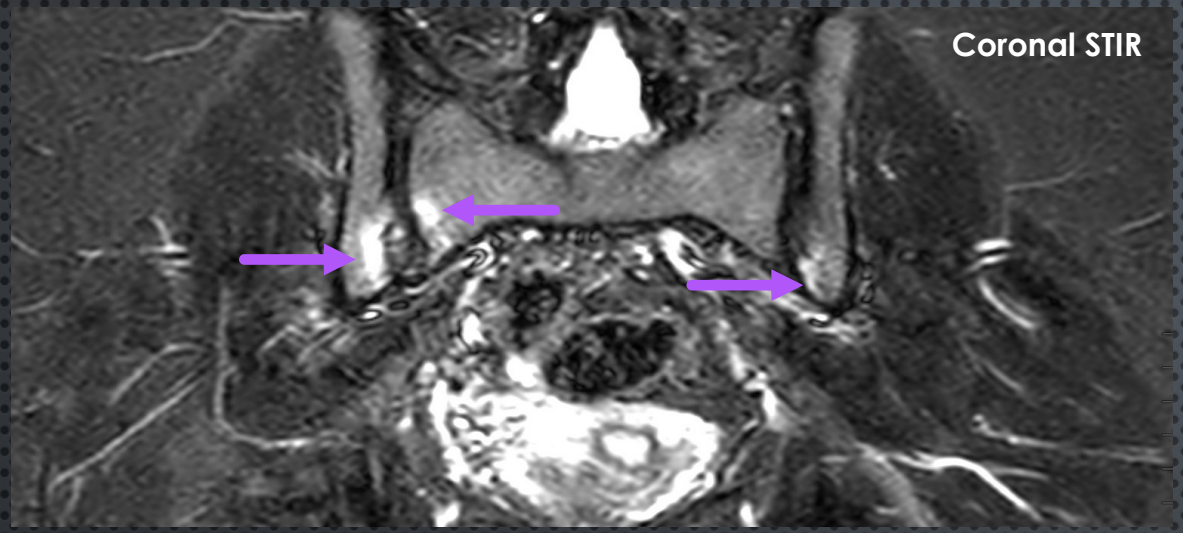
C. Erosions

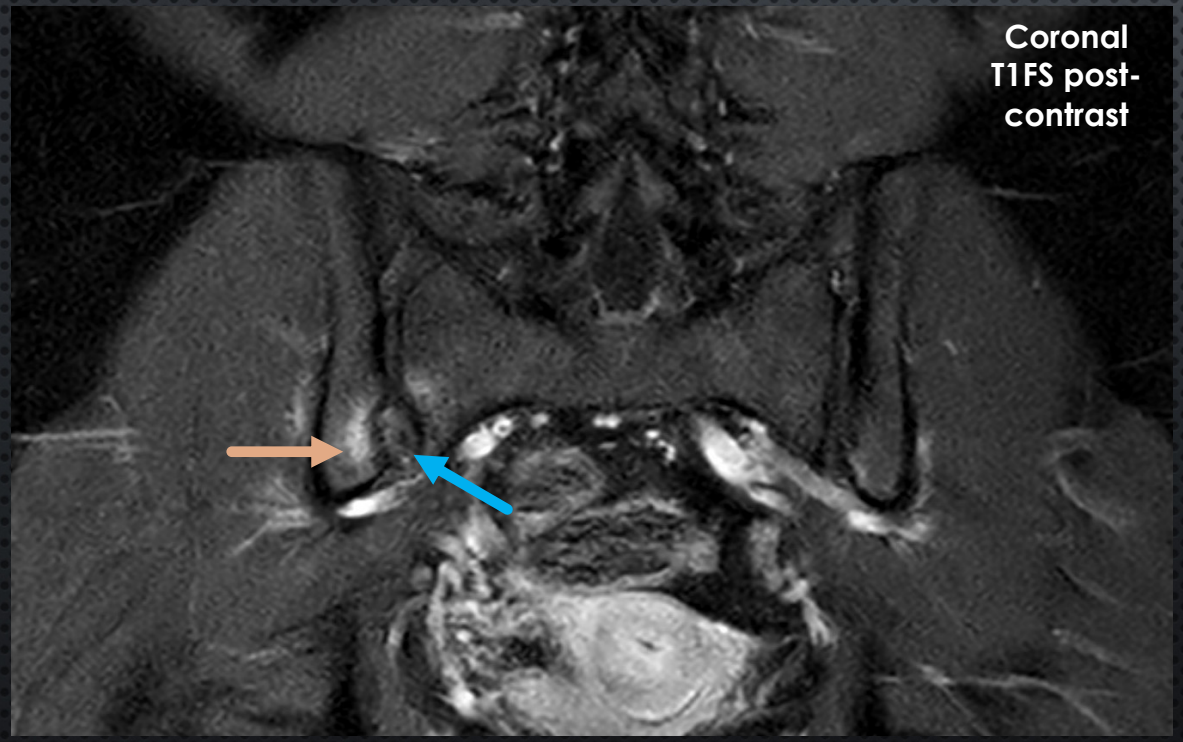
D. Fatty metaplasia

E. Joint space narrowing

F. Ankylosis

G. Enhancement





What do you see?

- *Bone marrow edema*
- *Enhancement*

Diagnosis: ?sacroiliitis ?SIJ dysfunction related to fibromyalgia

- 35-year-old female with no PMHx and low back pain

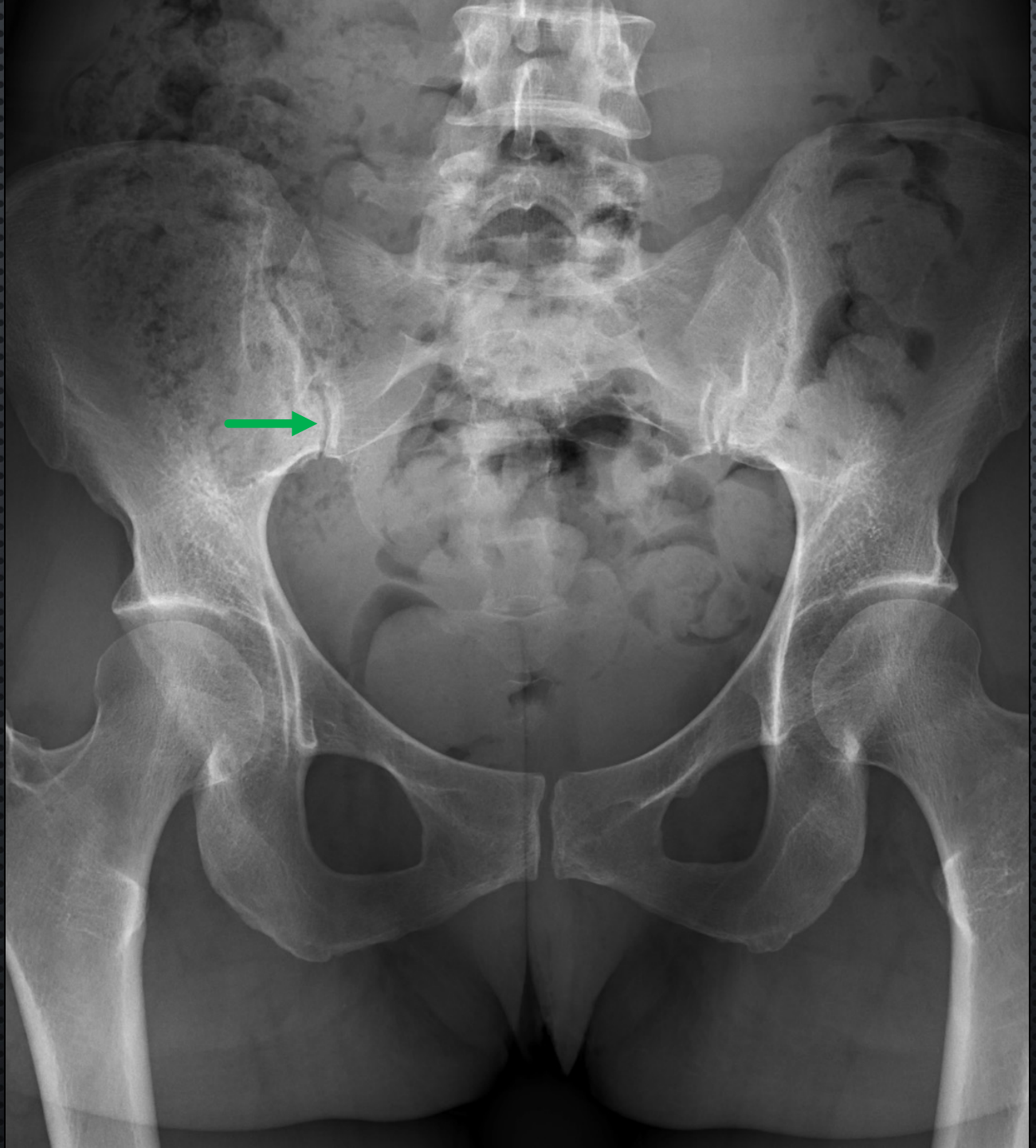
What do you see?

A. Erosions

B. Subchondral sclerosis

C. Joint space narrowing

D. Ankylosis



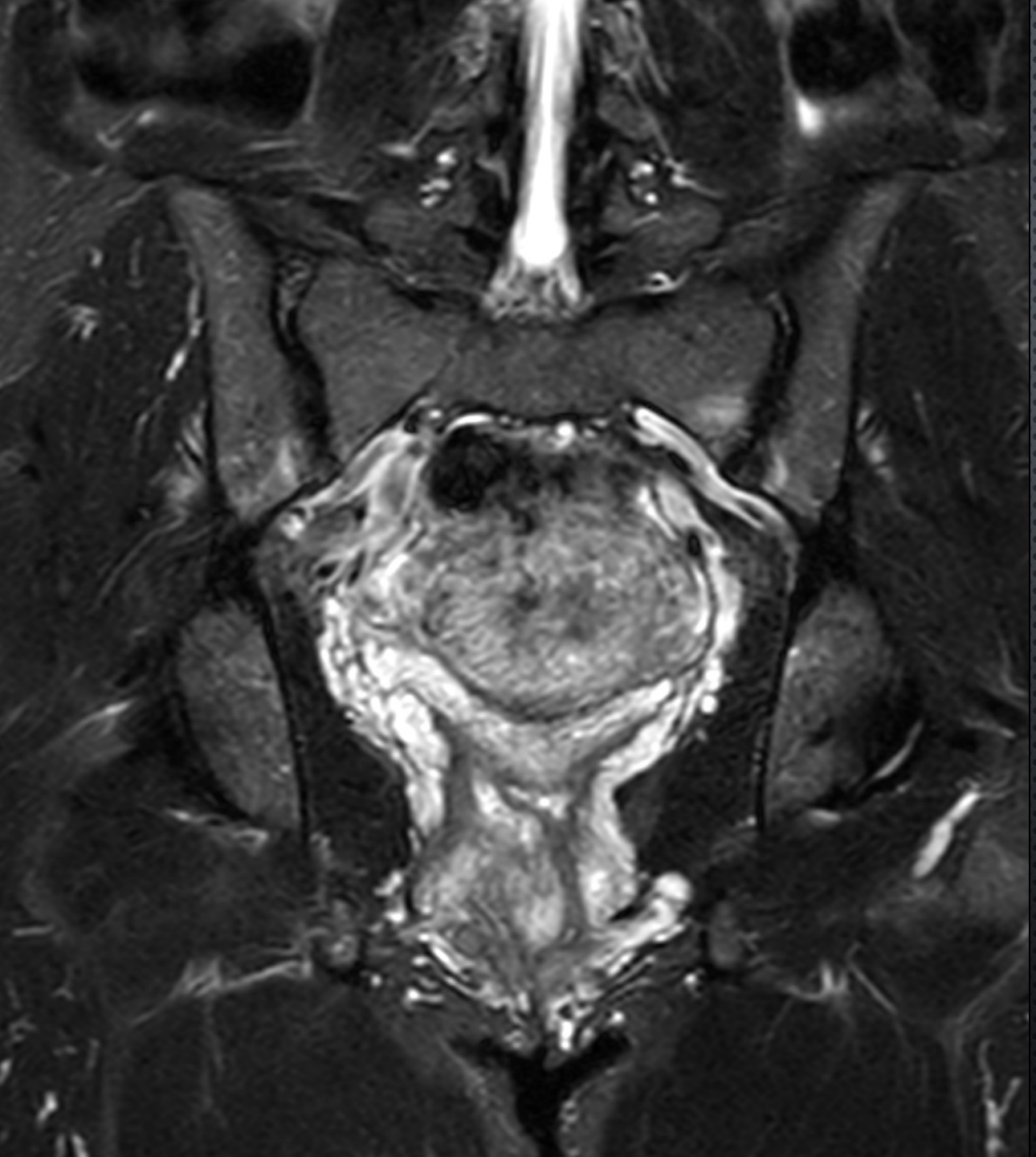
What do you see?

A. Erosions

B. Subchondral sclerosis

C. ?Joint space narrowing

D. Ankylosis



What do you see?

A. Bone marrow edema

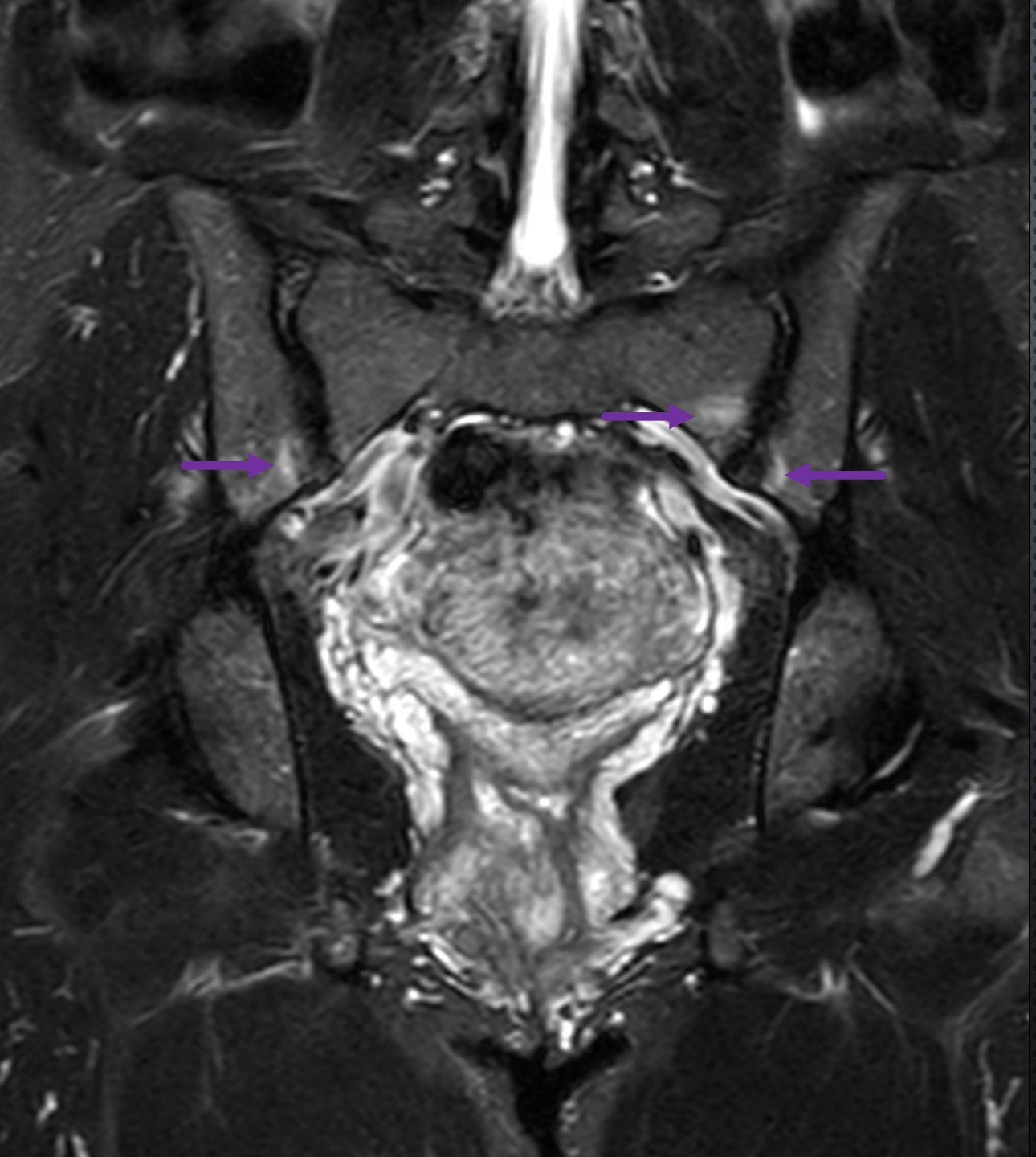
B. Subchondral sclerosis

C. Erosions

D. Fatty metaplasia

E. Joint space narrowing

F. Ankylosis



What do you see?

A. Bone marrow edema

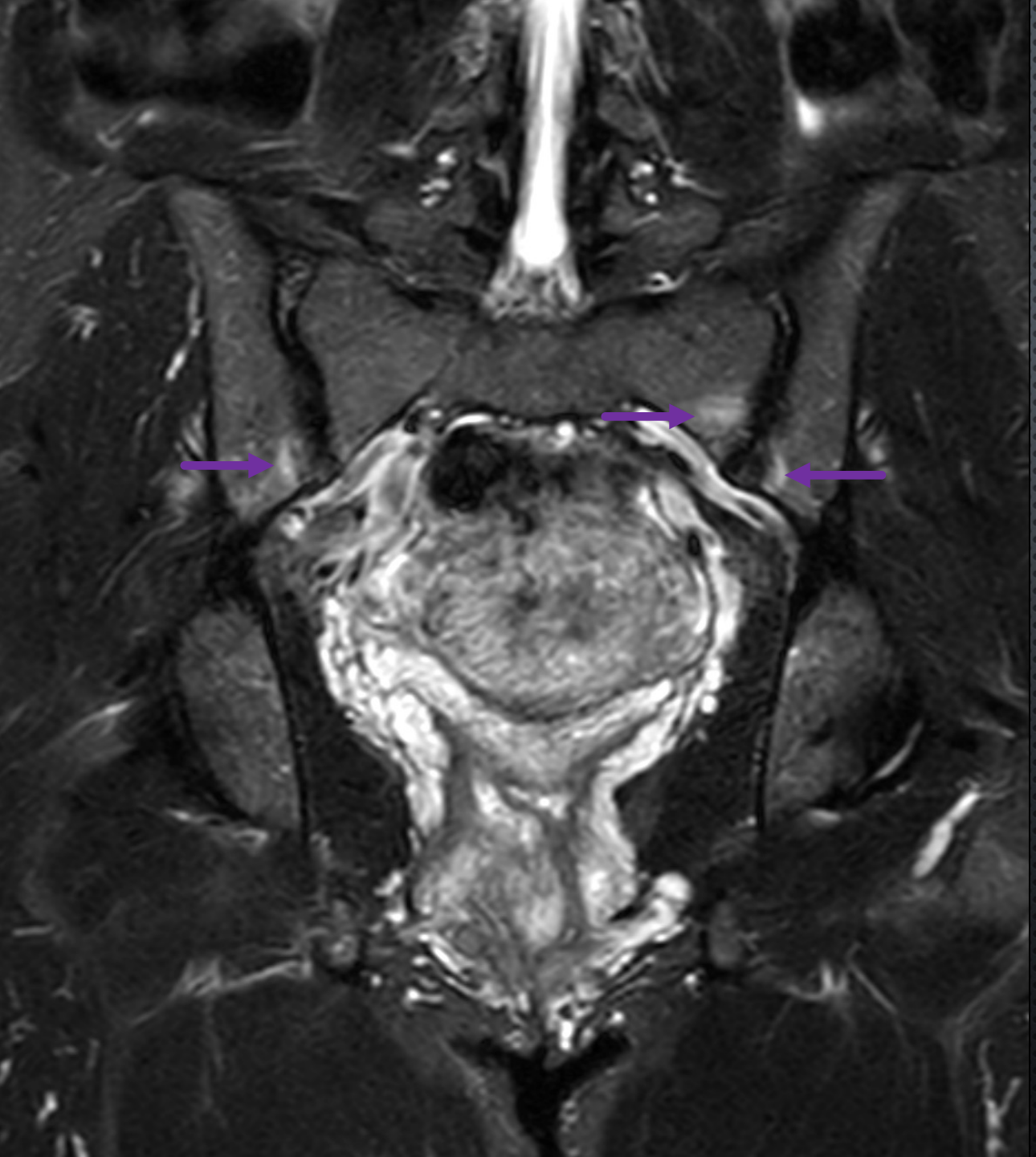
B. Subchondral sclerosis

C. Erosions

D. Fatty metaplasia

E. Joint space narrowing

F. Ankylosis



What do you see?

A. Bone marrow edema

B. Subchondral sclerosis

C. Erosions

D. Fatty metaplasia

E. Joint space narrowing

F. Ankylosis

Diagnosis: ??early OA

- 20-year-old female with no PMHx and low back pain

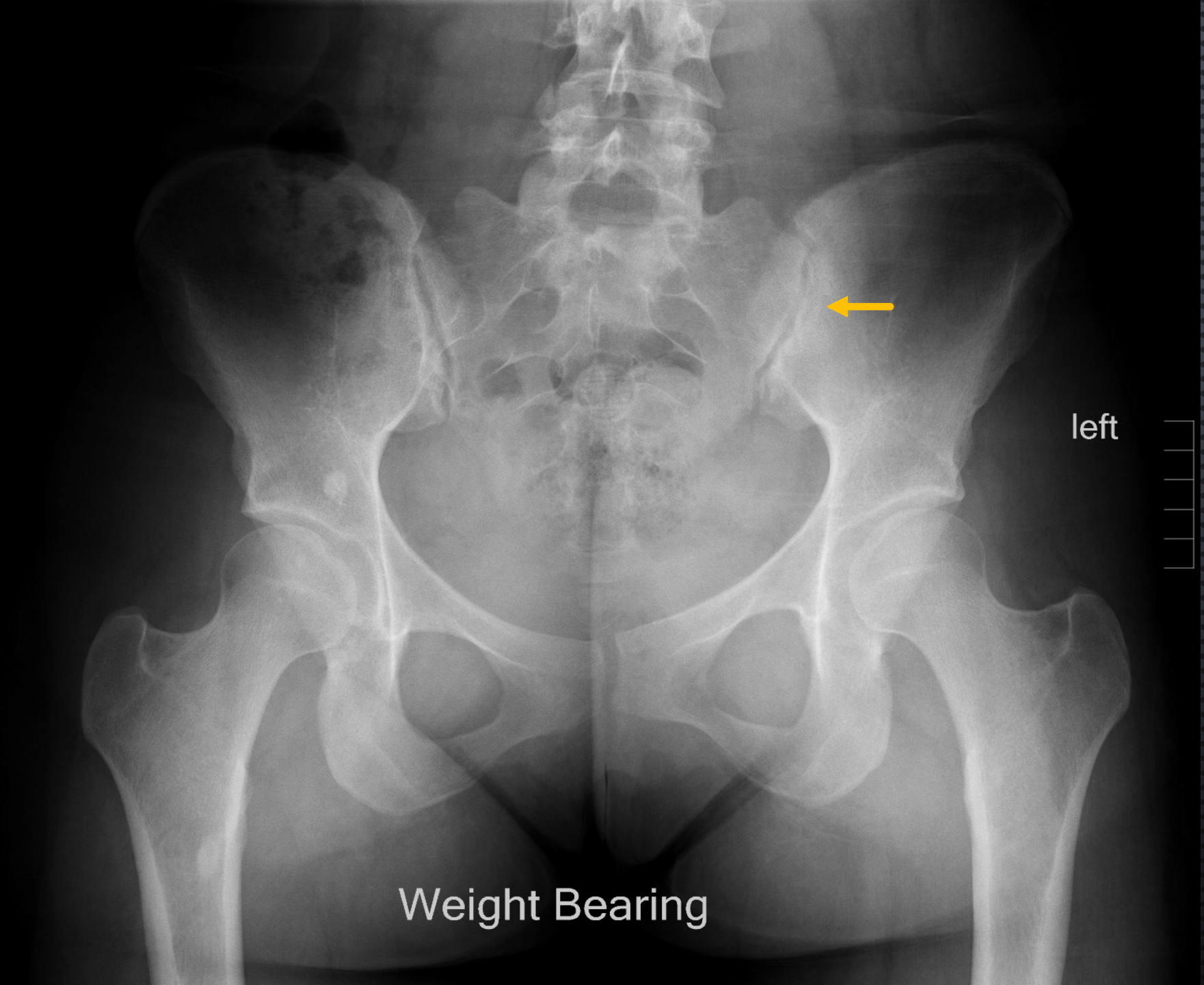
What do you see?

A. Erosions

B. Subchondral sclerosis

C. Joint space narrowing

D. Ankylosis



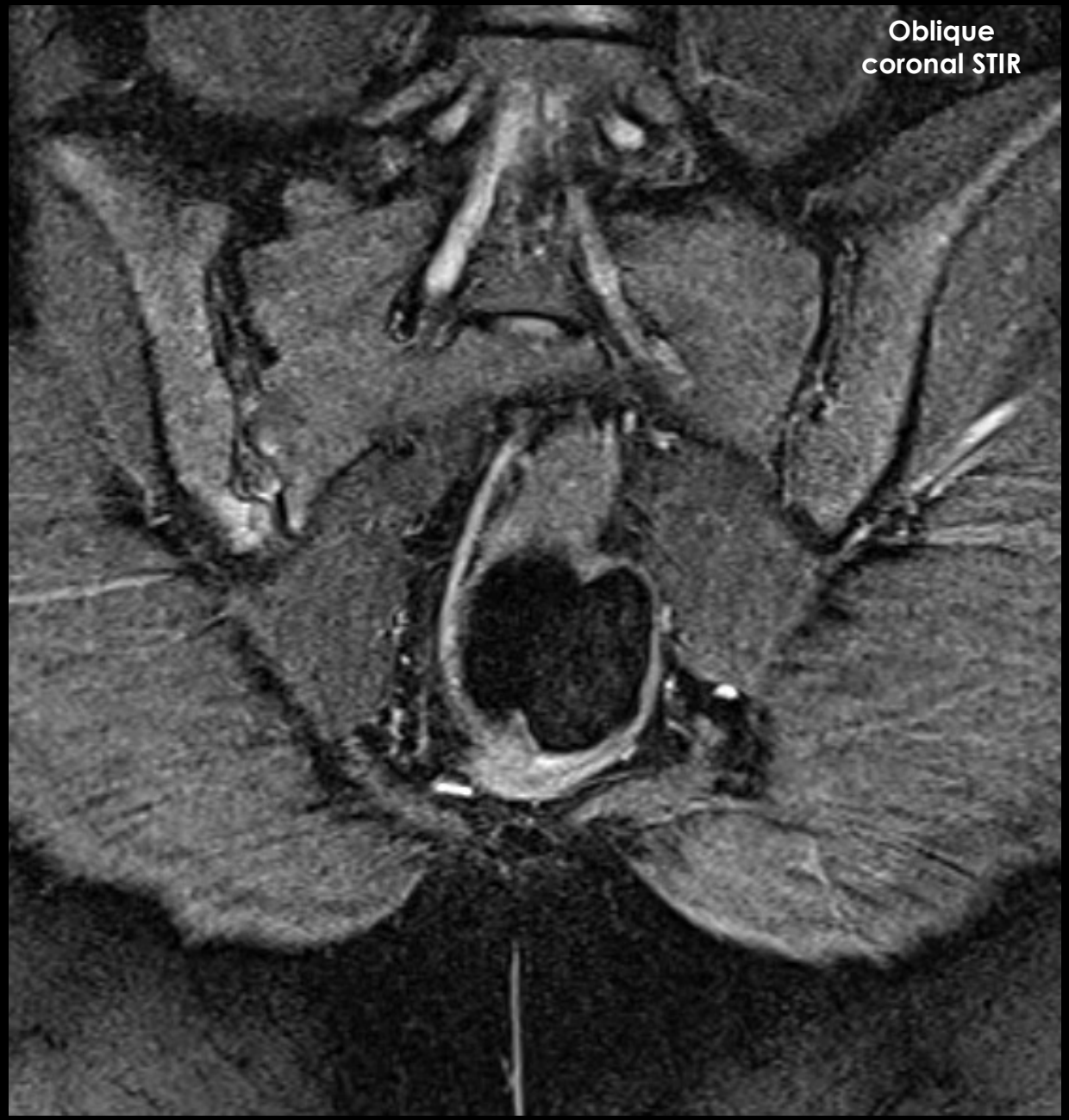
What do you see?

A. Erosions

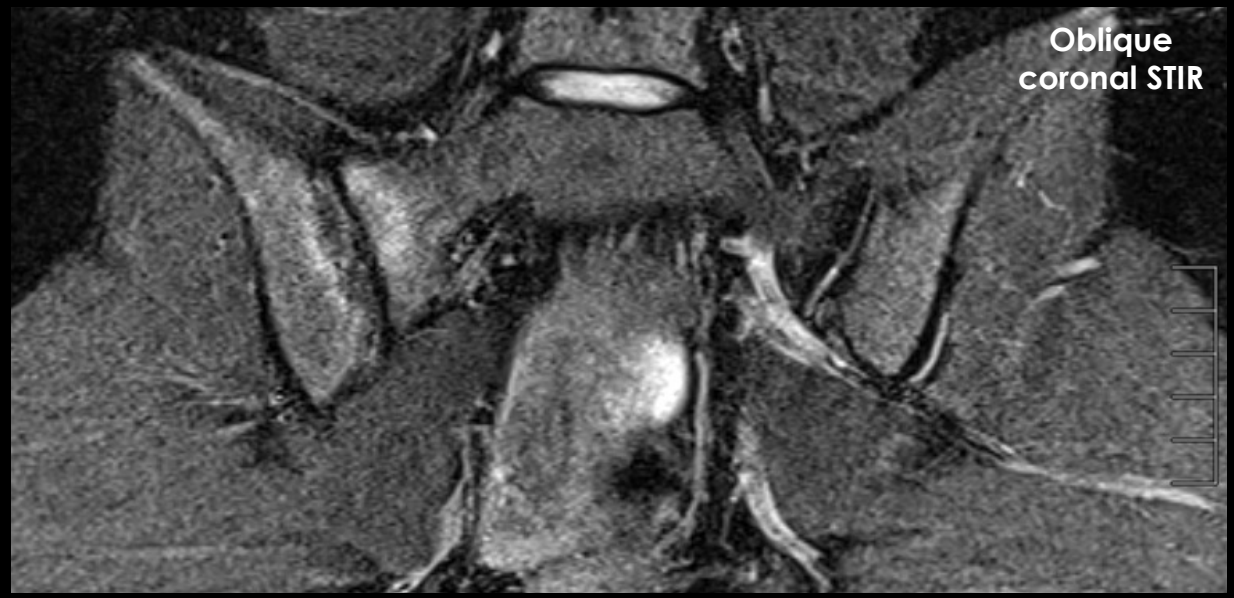
B. *Subchondral sclerosis*

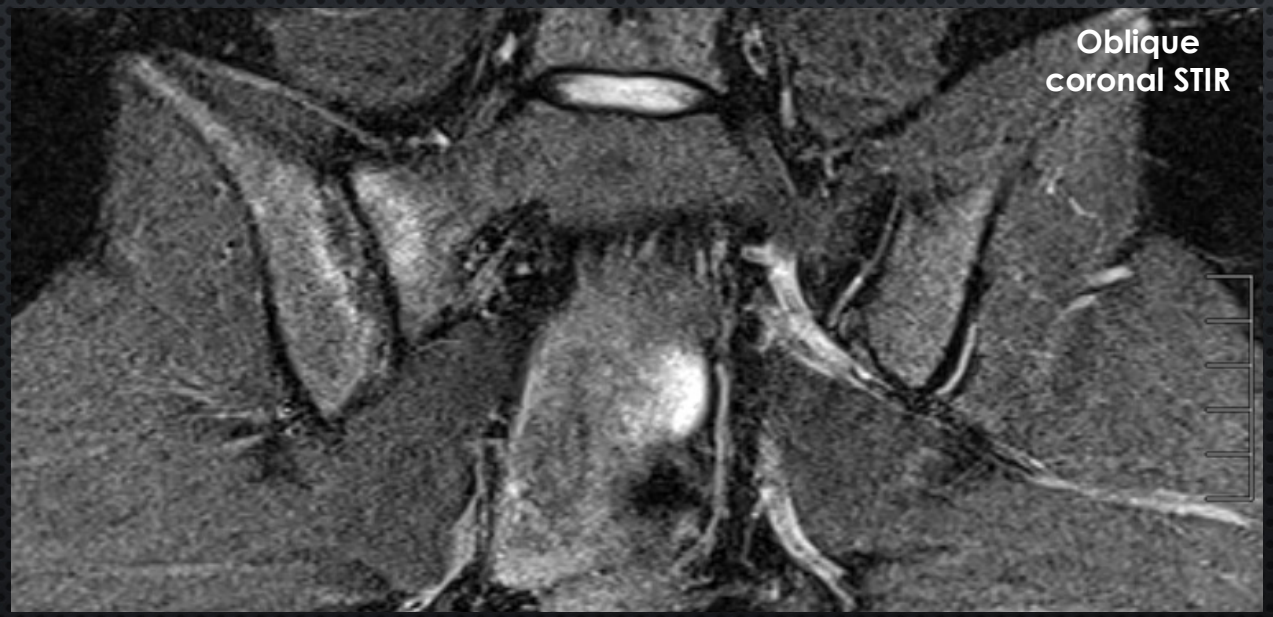
C. Joint space narrowing

D. Ankylosis


Oblique
coronal STIR


Oblique
coronal STIR


Oblique
coronal STIR



What do you see?

A. Bone marrow edema

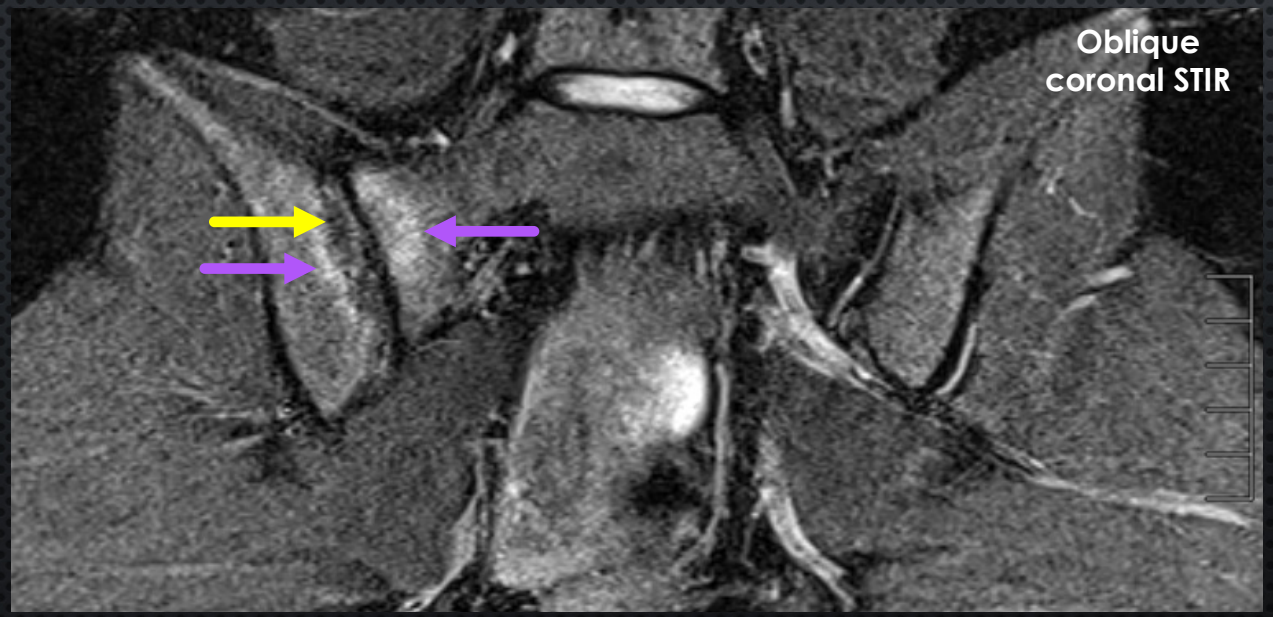
B. Subchondral sclerosis

C. Erosions

D. Fatty metaplasia

E. Joint space narrowing

F. Ankylosis



What do you see?

A. Bone marrow edema

B. Subchondral sclerosis

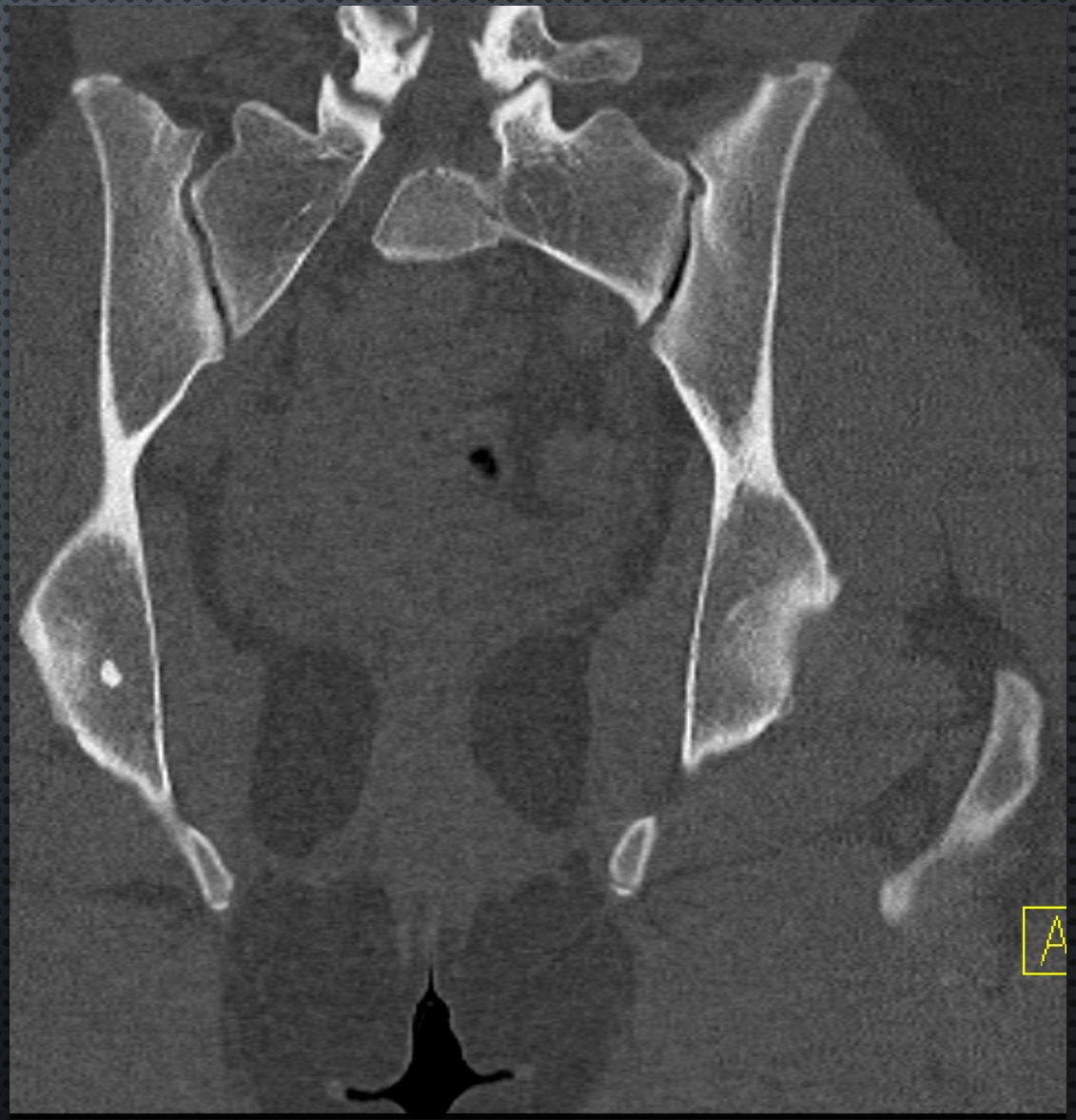
C. Erosions

D. Fatty metaplasia

E. Joint space narrowing

F. Ankylosis

Axial



Coronal

What do you see?

A. Subchondral sclerosis

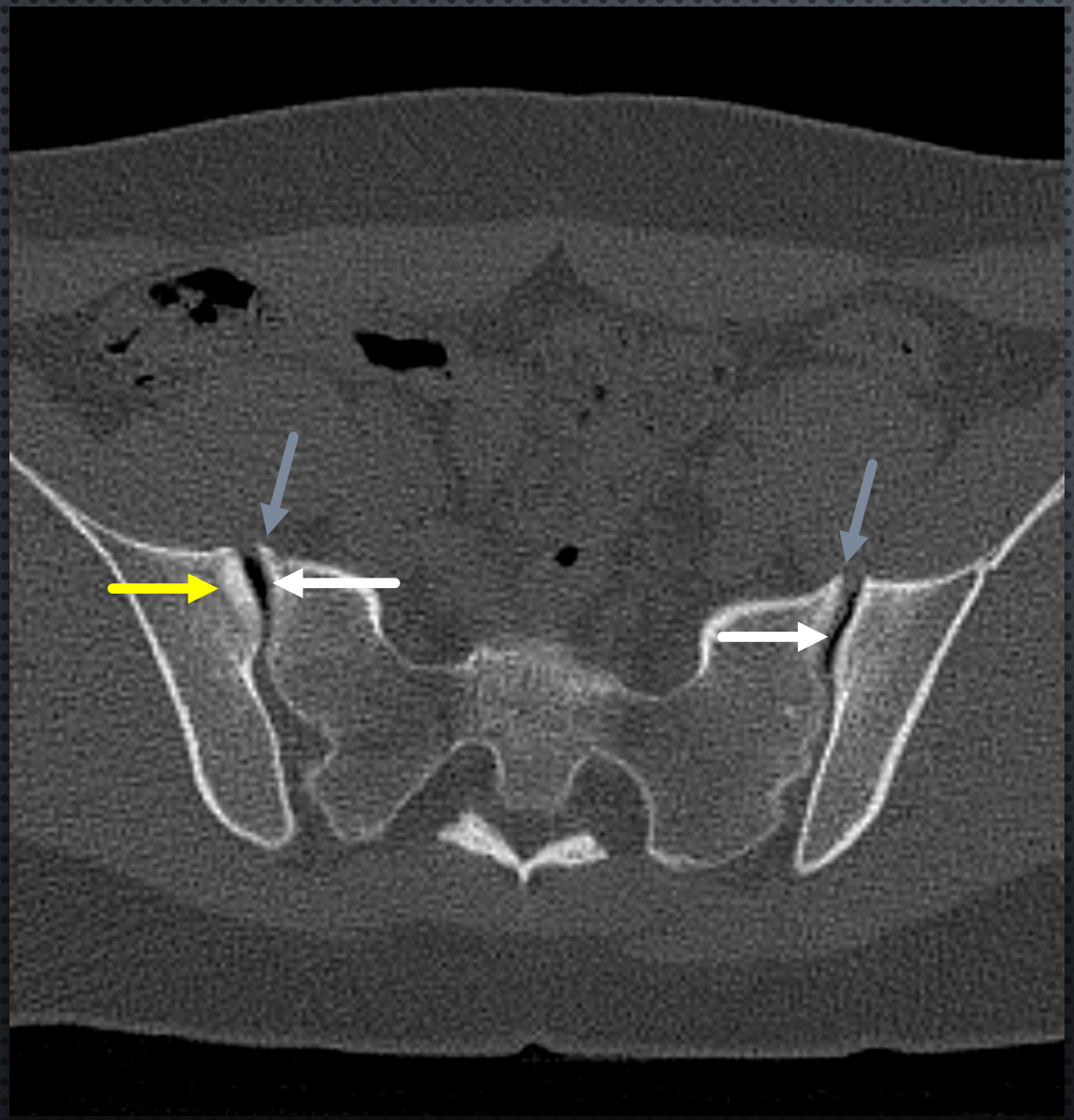
B. Erosions

C. Joint space narrowing

D. Osteophytes

E. Joint vacuum phenomenon

F. Ankylosis



What do you see?

A. *Subchondral sclerosis*

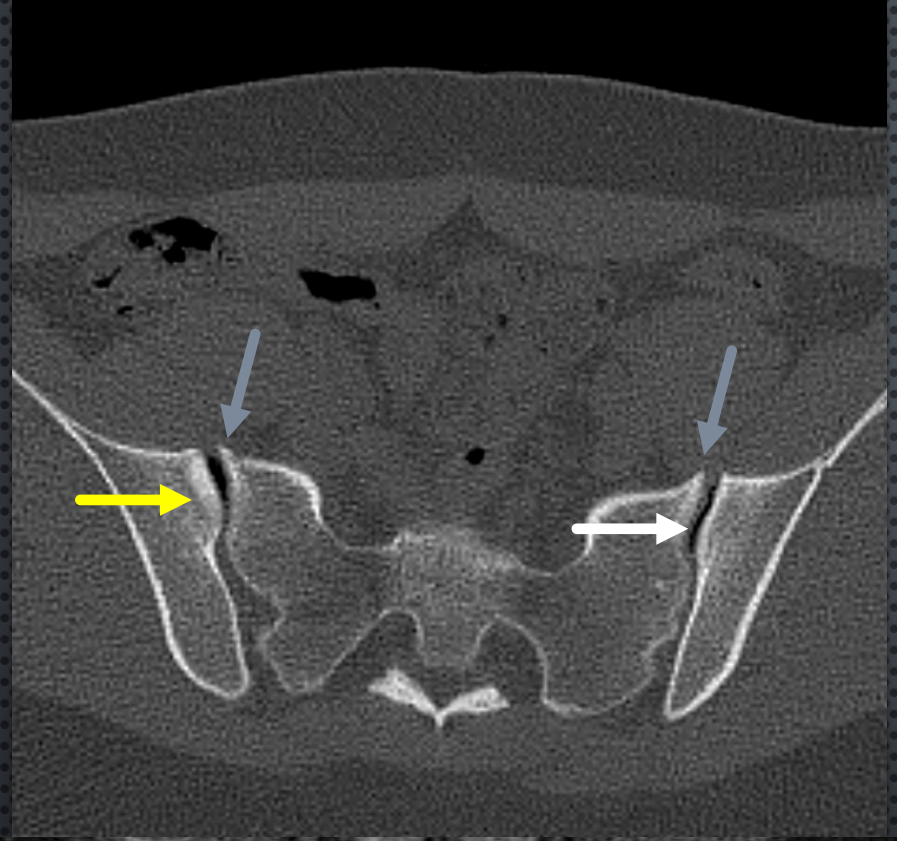
B. Erosions

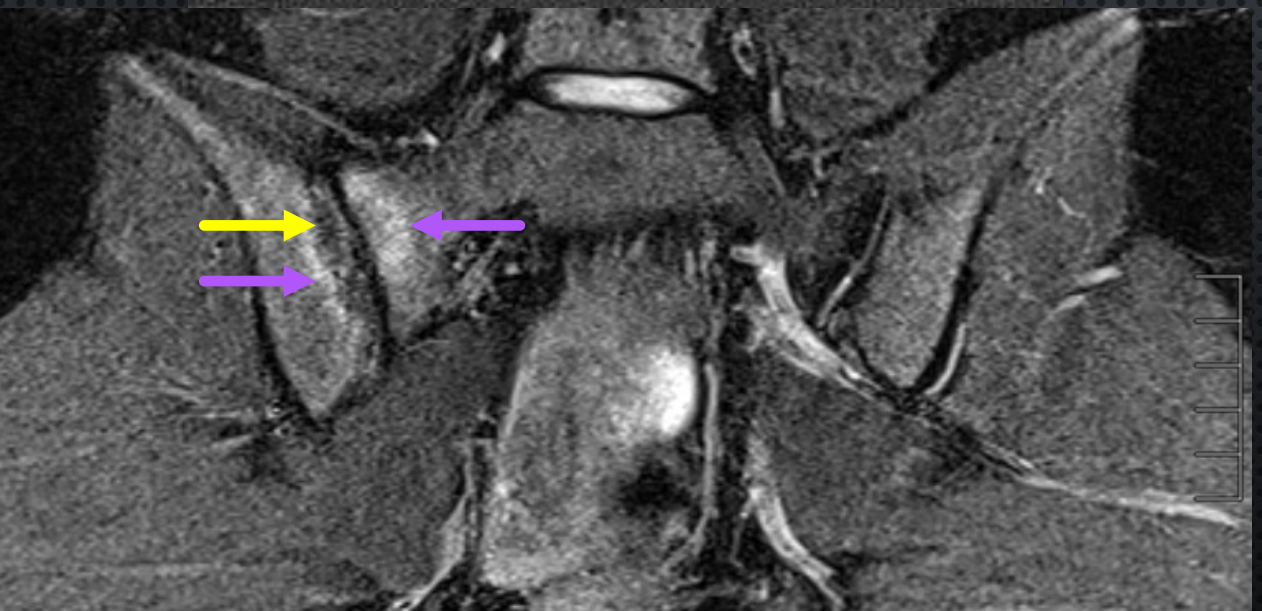
C. Joint space narrowing

D. *Osteophytes*

E. *Joint vacuum phenomenon*

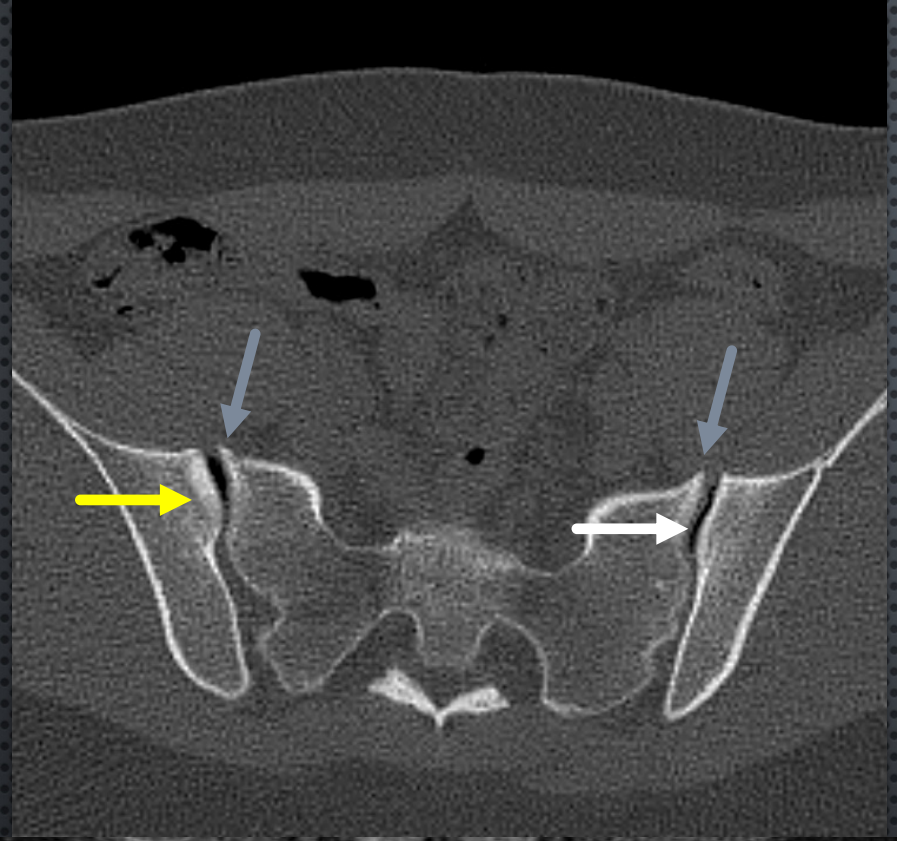
F. Ankylosis

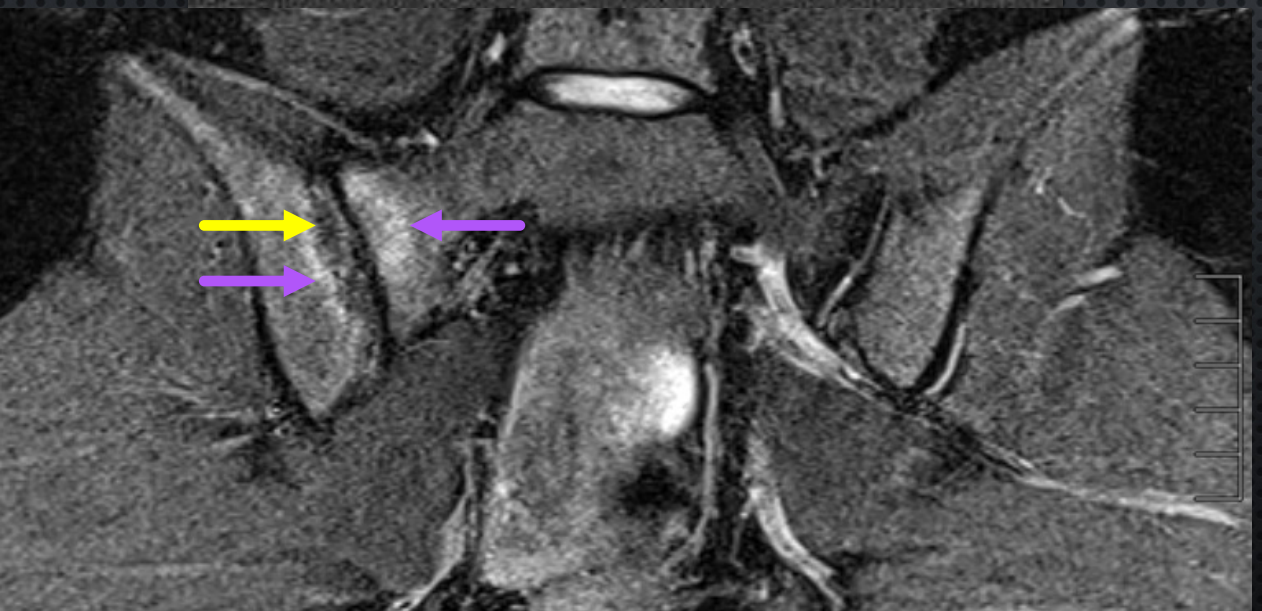




What do you see?

- *Subchondral sclerosis*
- *Osteophytes*
- *Joint vacuum phenomenon*
- *Bone marrow edema*





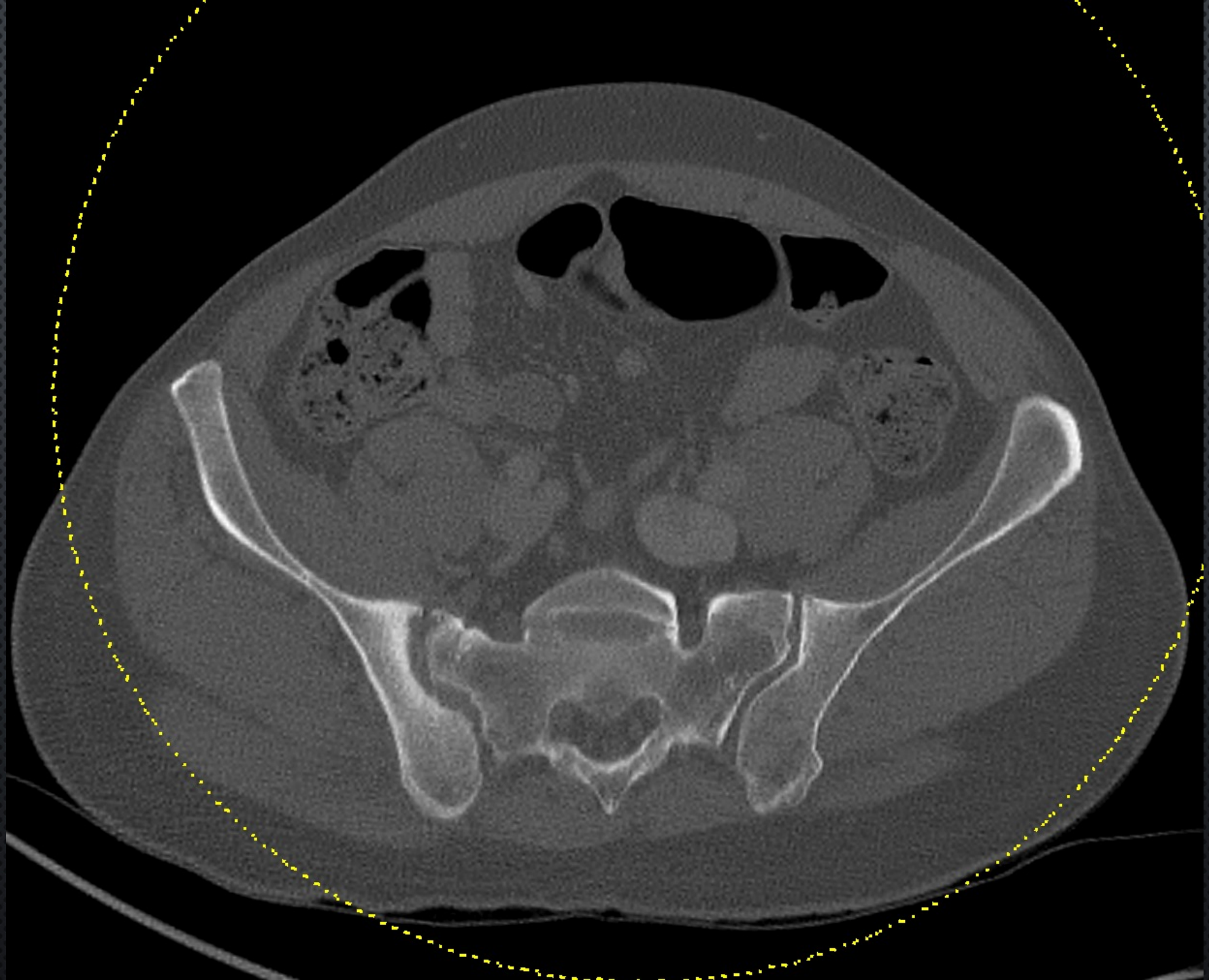
What do you see?

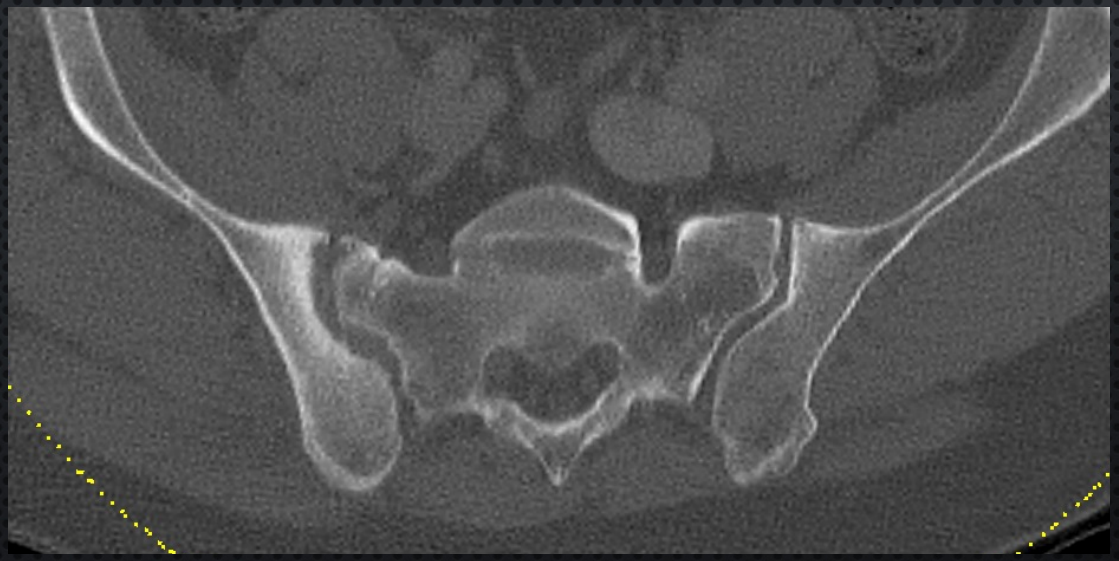
- *Subchondral sclerosis*
- *Osteophytes*
- *Joint vacuum phenomenon*
- *Bone marrow edema*

Diagnosis: osteoarthritis

- 44-year-old male with Hx IVDU presenting with right hip pain


R
ANA





What do you see?

A. Subchondral sclerosis

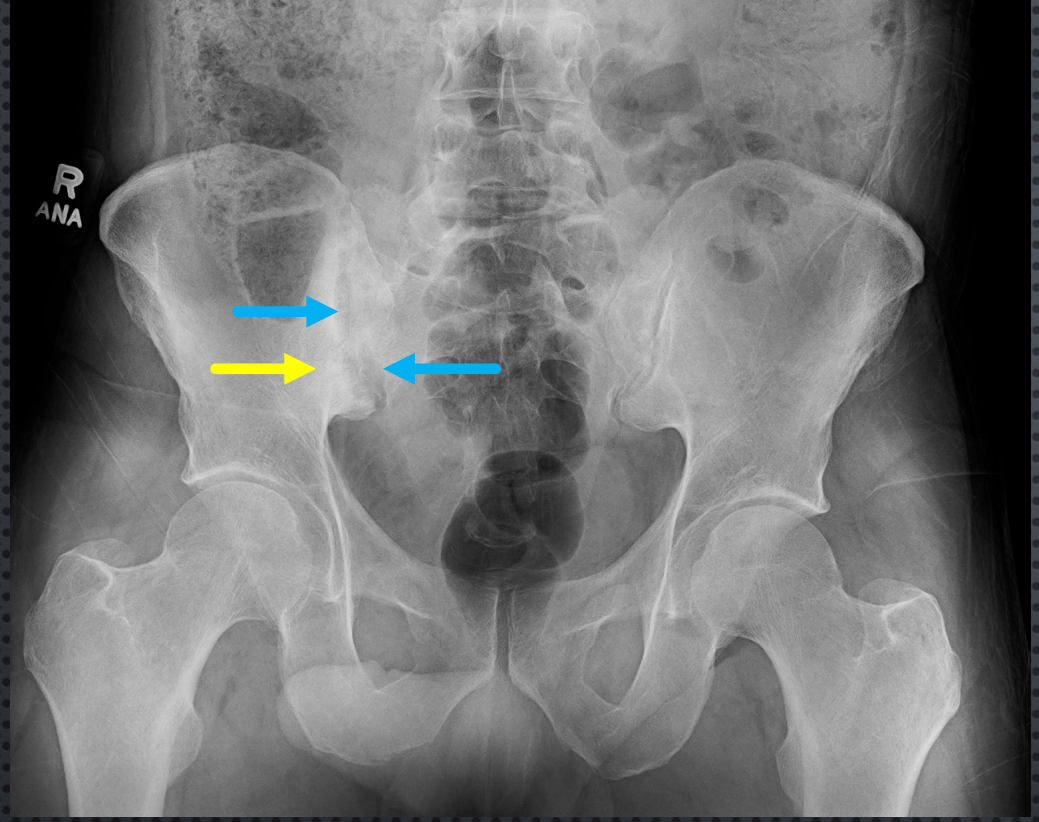
B. Erosions

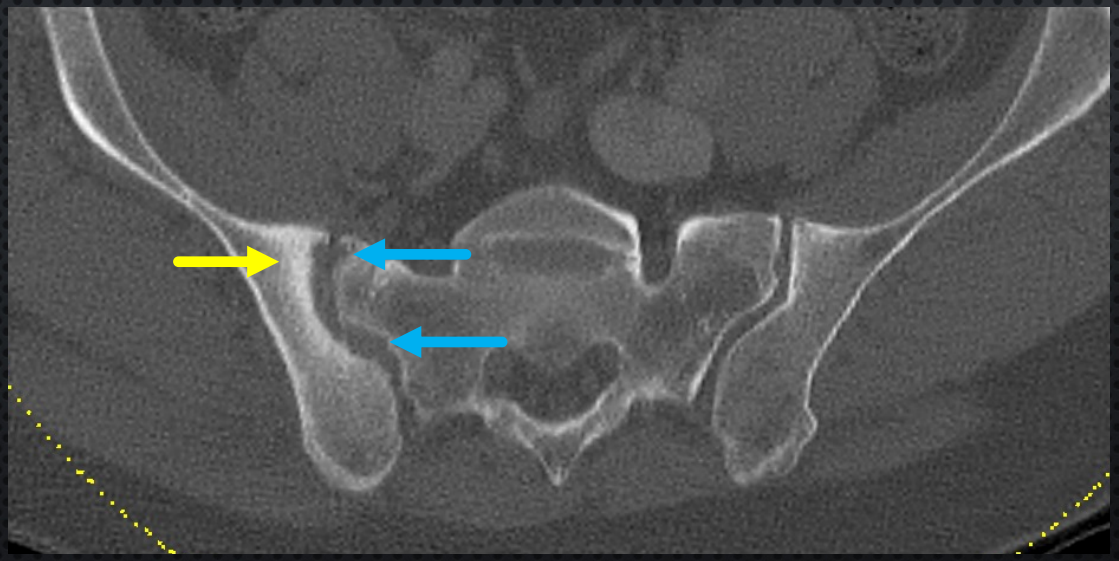
C. Joint space narrowing

D. Osteophytes

E. Joint vacuum phenomenon

F. Ankylosis





What do you see?

A. *Subchondral sclerosis*

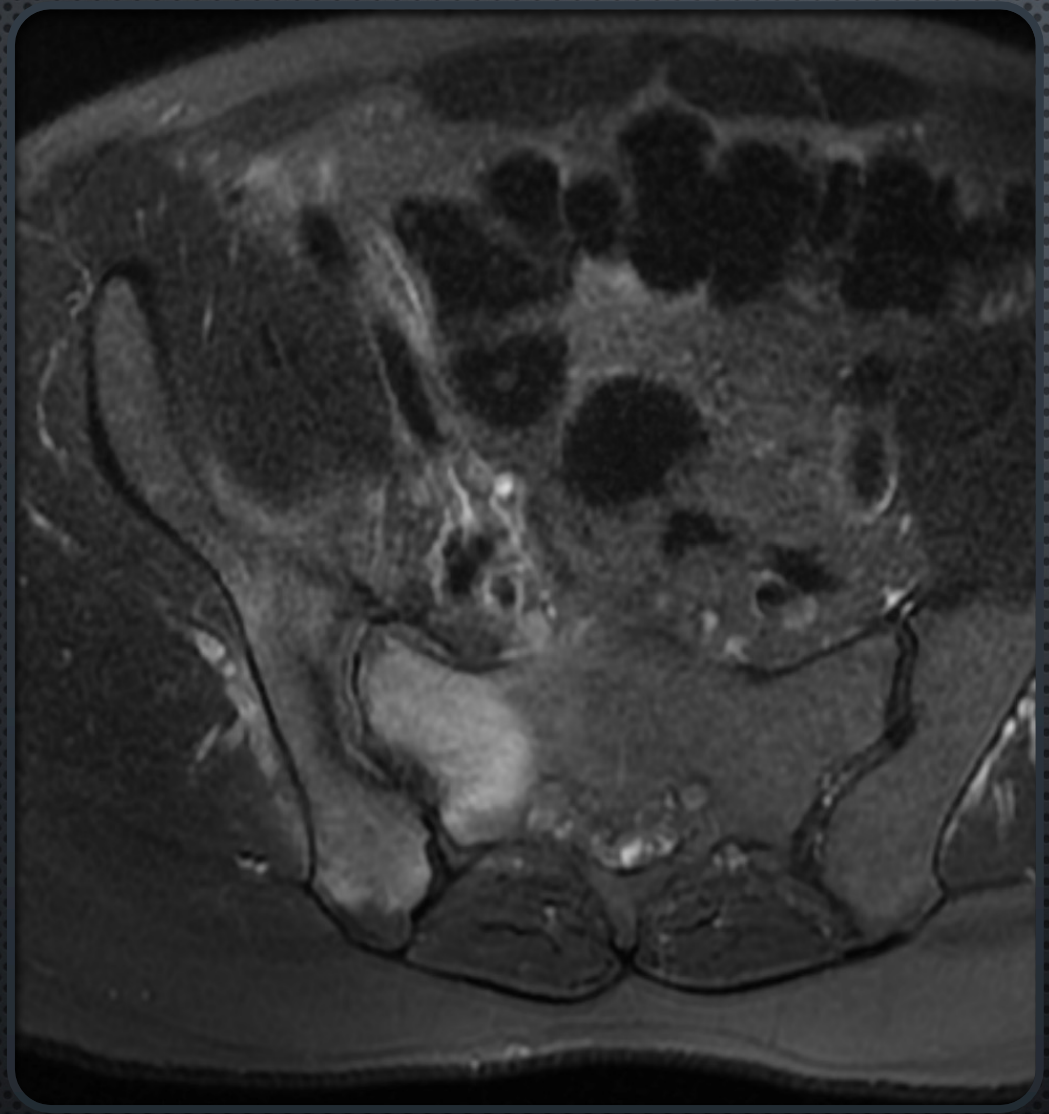
B. *Erosions*

C. Joint space narrowing

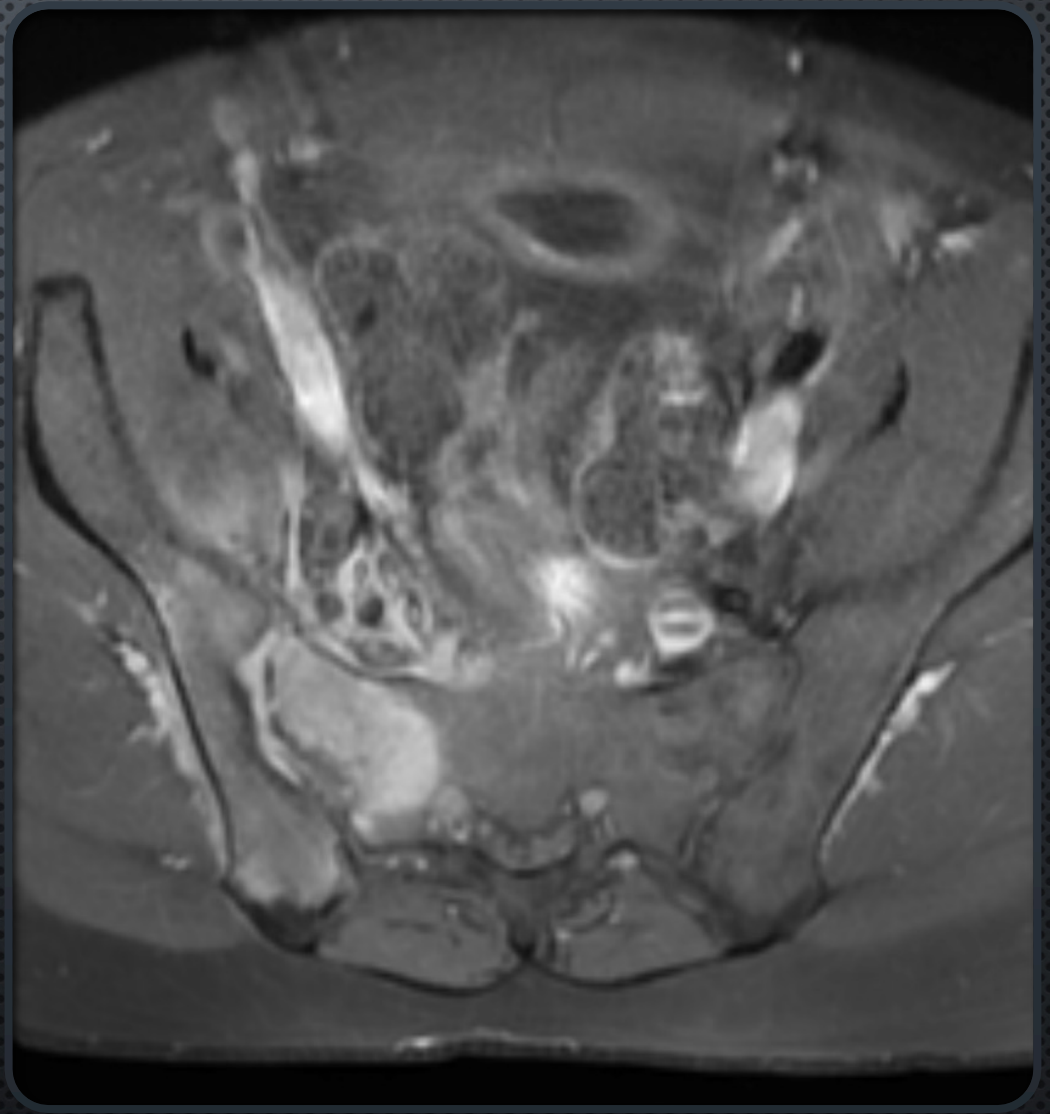
D. Osteophytes

E. Joint vacuum phenomenon

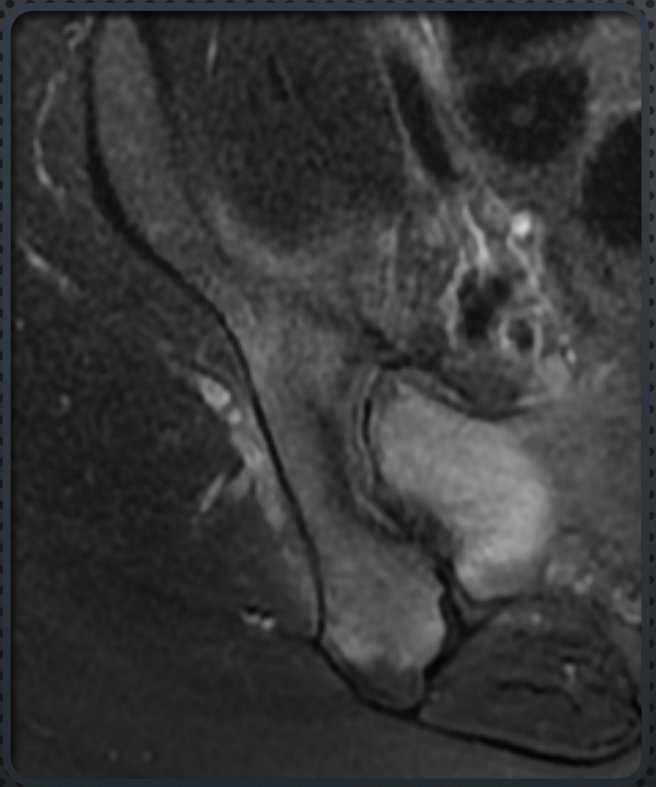
F. Ankylosis



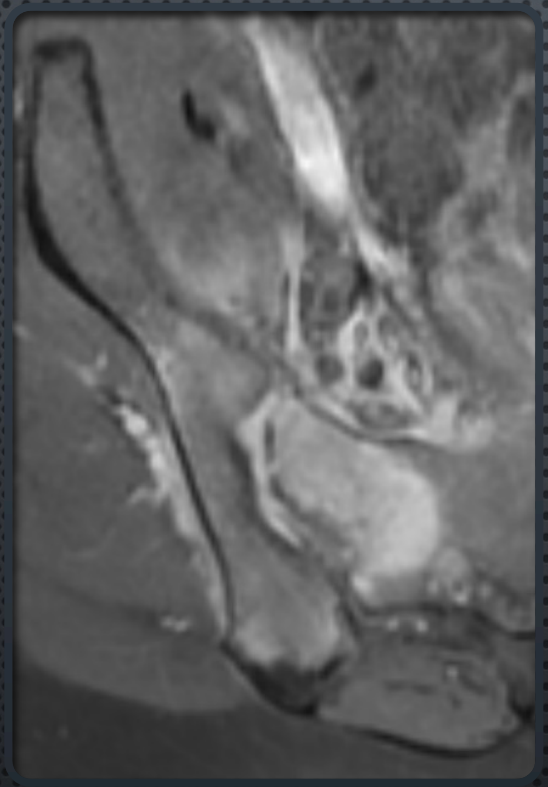
Axial T2FS



Axial T1FS post-contrast



Axial T2FS



Axial T1FS post-contrast

What do you see?

A. Bone marrow edema

B. Subchondral sclerosis

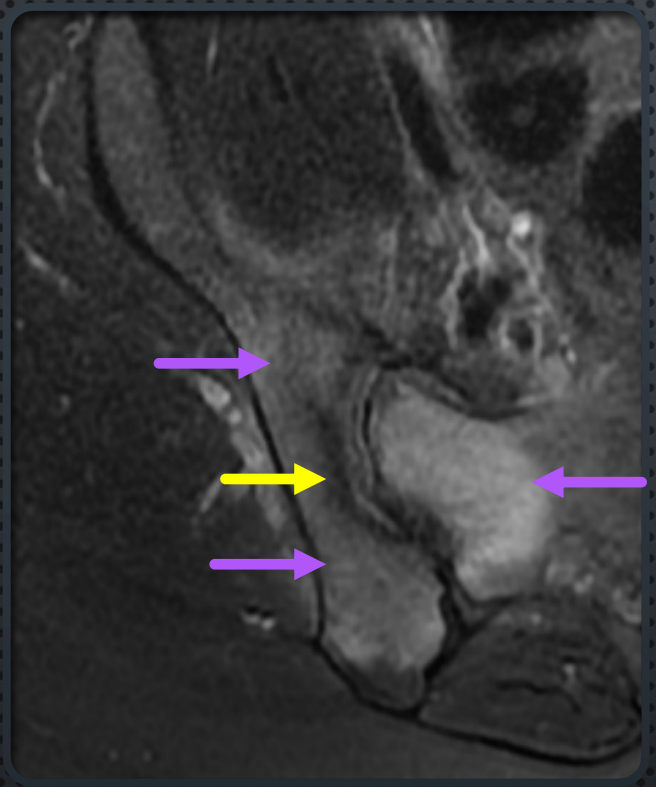
C. Erosions

D. Fatty metaplasia

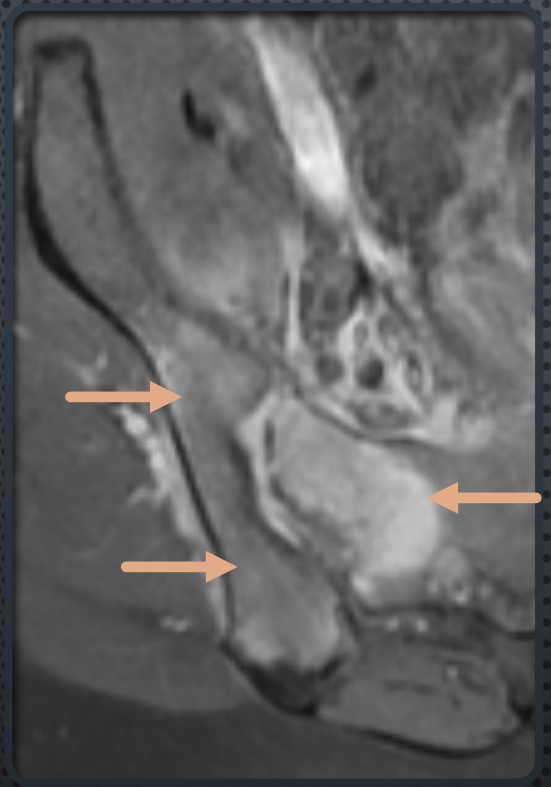
E. Joint space narrowing

F. Ankylosis

G. Enhancement



Axial T2FS



Axial T1FS post-contrast

What do you see?

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C. Erosions

D. Fatty metaplasia

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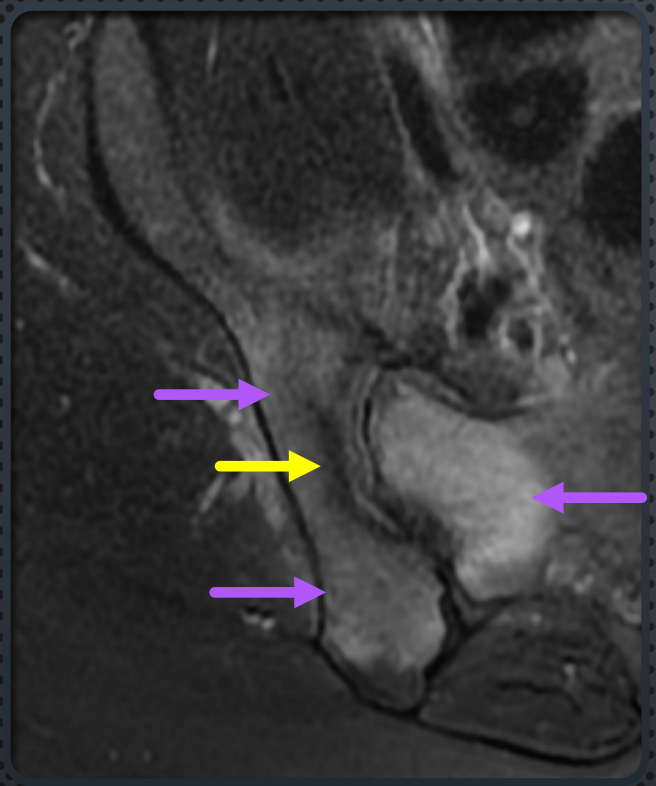
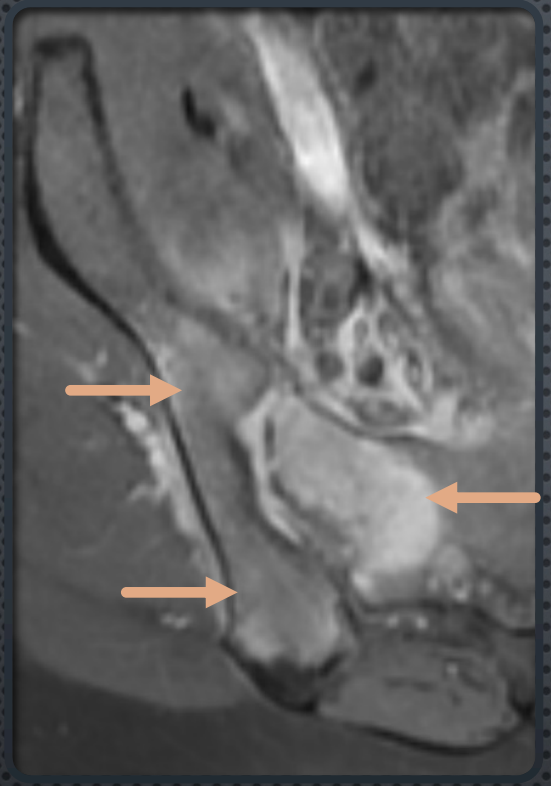
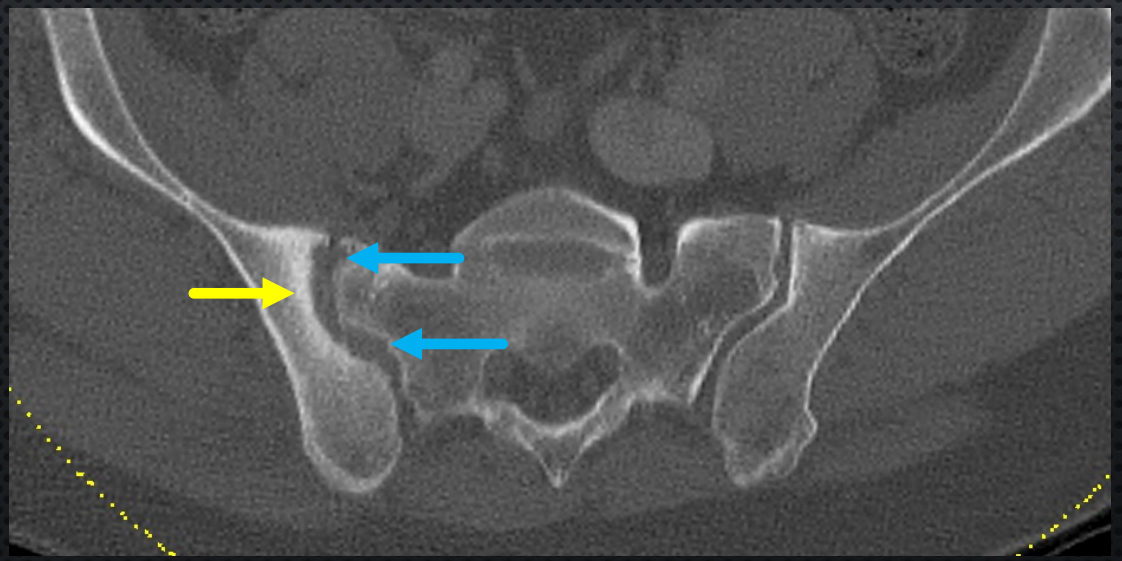
F. Ankylosis

G. Enhancement





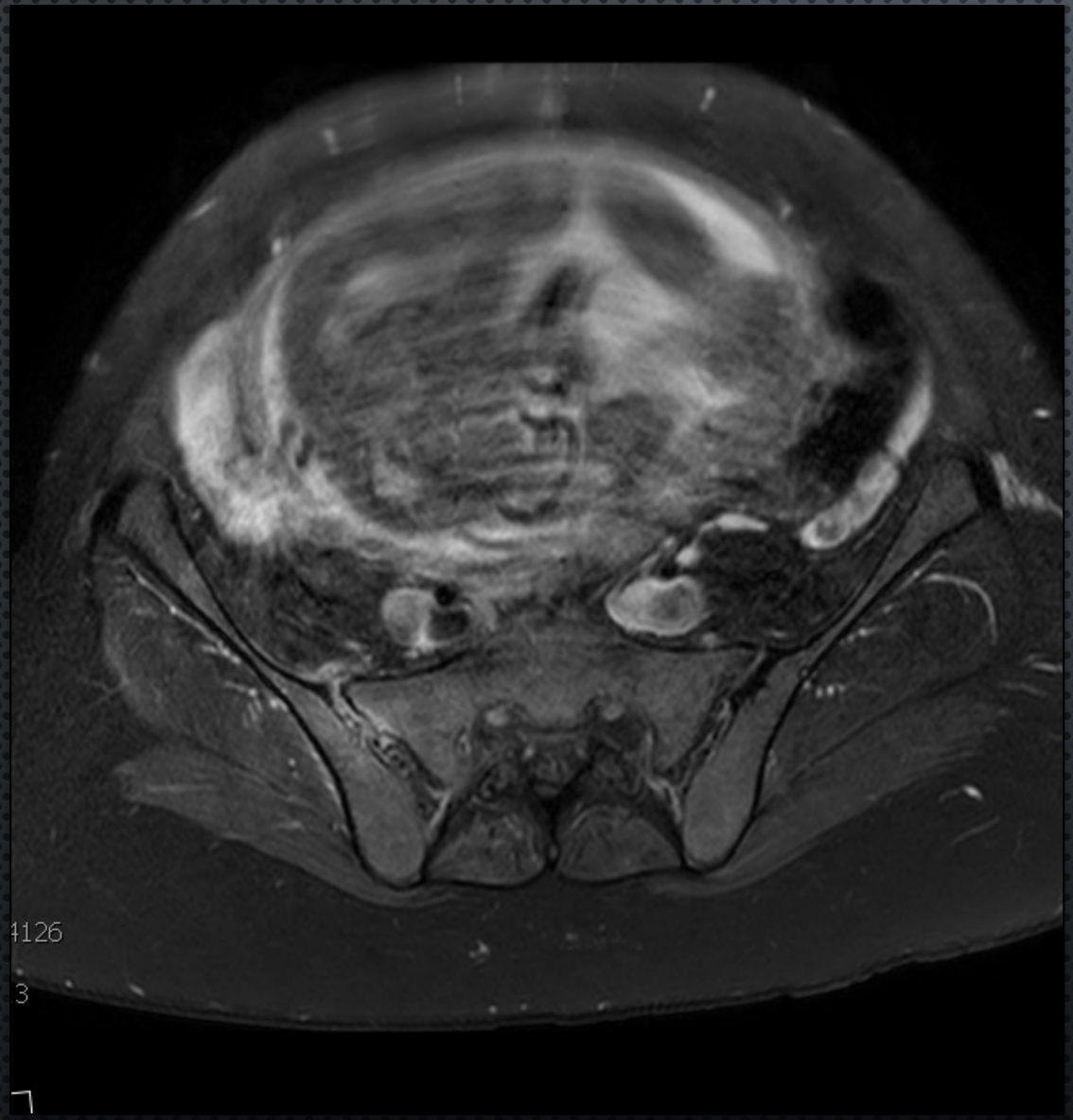


What do you see?

- *Bone marrow edema*
- *Subchondral sclerosis*
- *Erosions*
- *Enhancement*

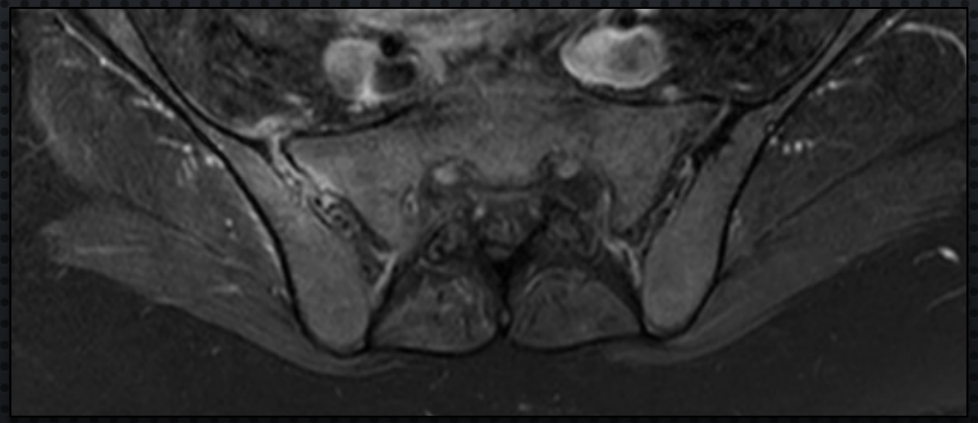
Diagnosis: septic sacroiliitis

- 23-year-old female with Hx IVDU admitted with MRSA endocarditis with complaints of right hip pain



Axial T2FS

Oblique coronal STIR



What do you see?

A. Bone marrow edema

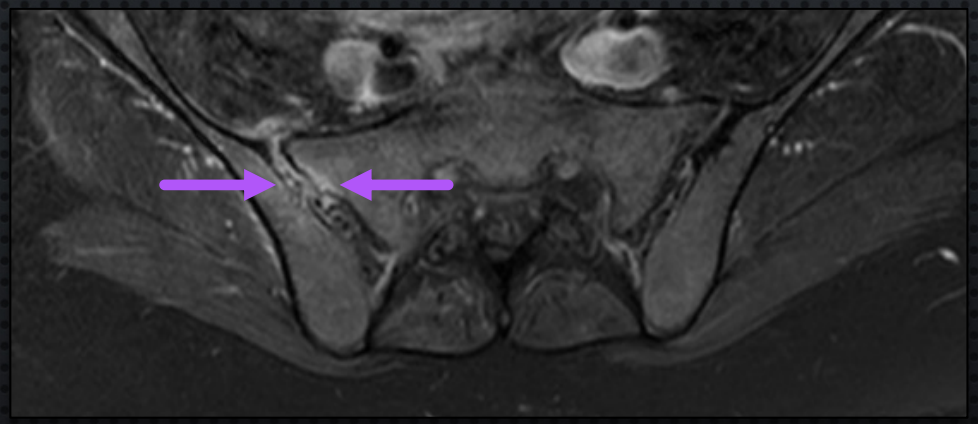
B. Subchondral sclerosis

C. Erosions

D. Fatty metaplasia

E. Joint space narrowing

F. Ankylosis



What do you see?

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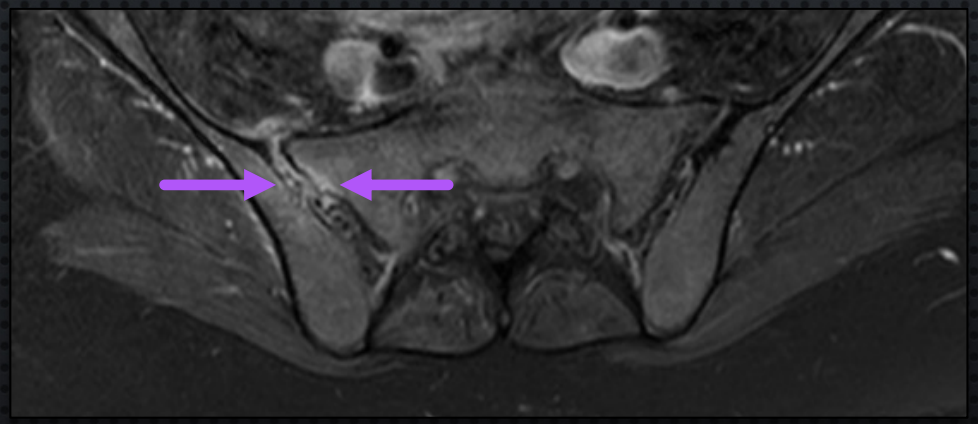
B. Subchondral sclerosis

C. Erosions

D. Fatty metaplasia

E. Joint space narrowing

F. Ankylosis



What do you see?

A. Bone marrow edema

B. Subchondral sclerosis

C. Erosions

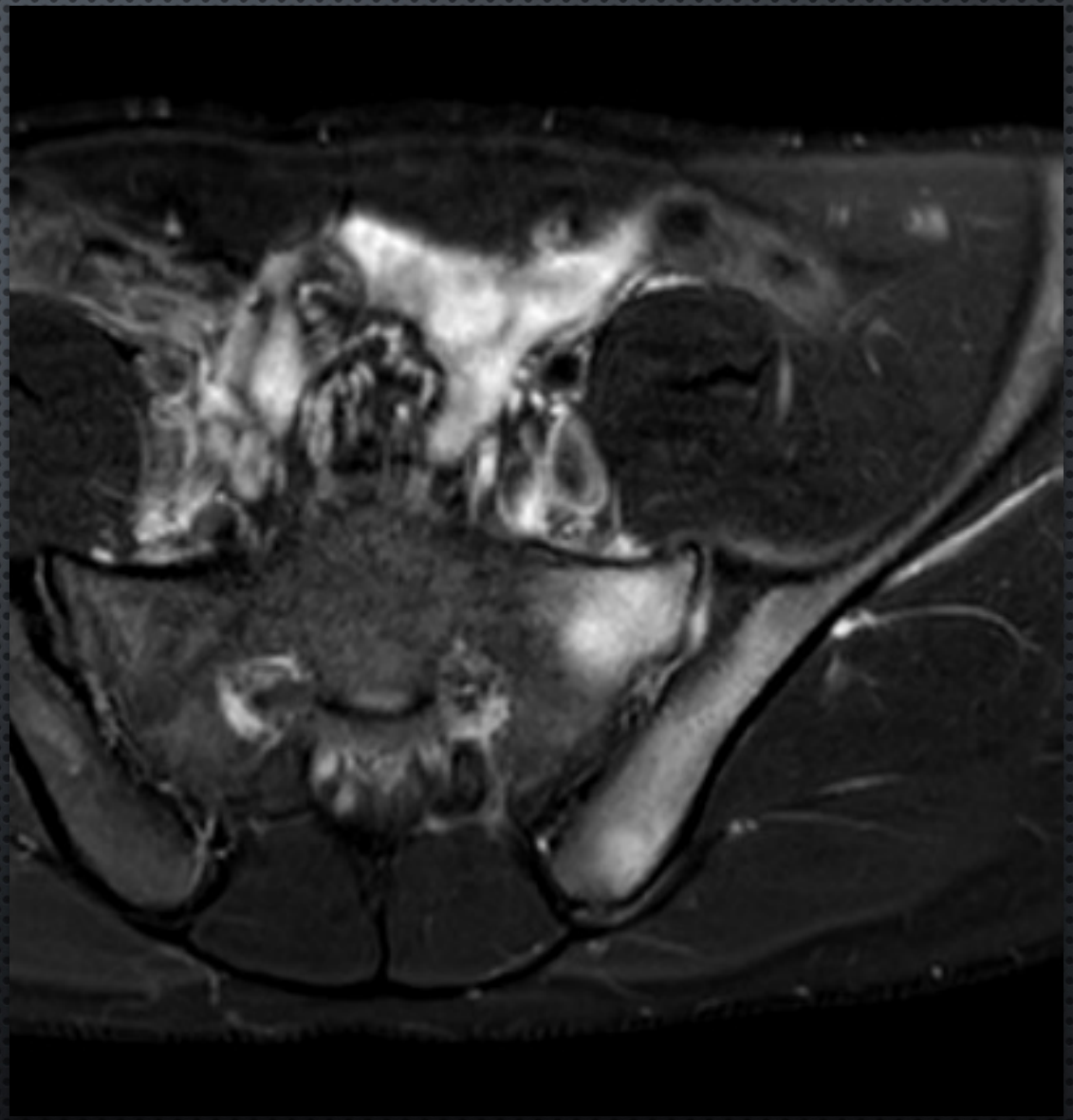
D. Fatty metaplasia

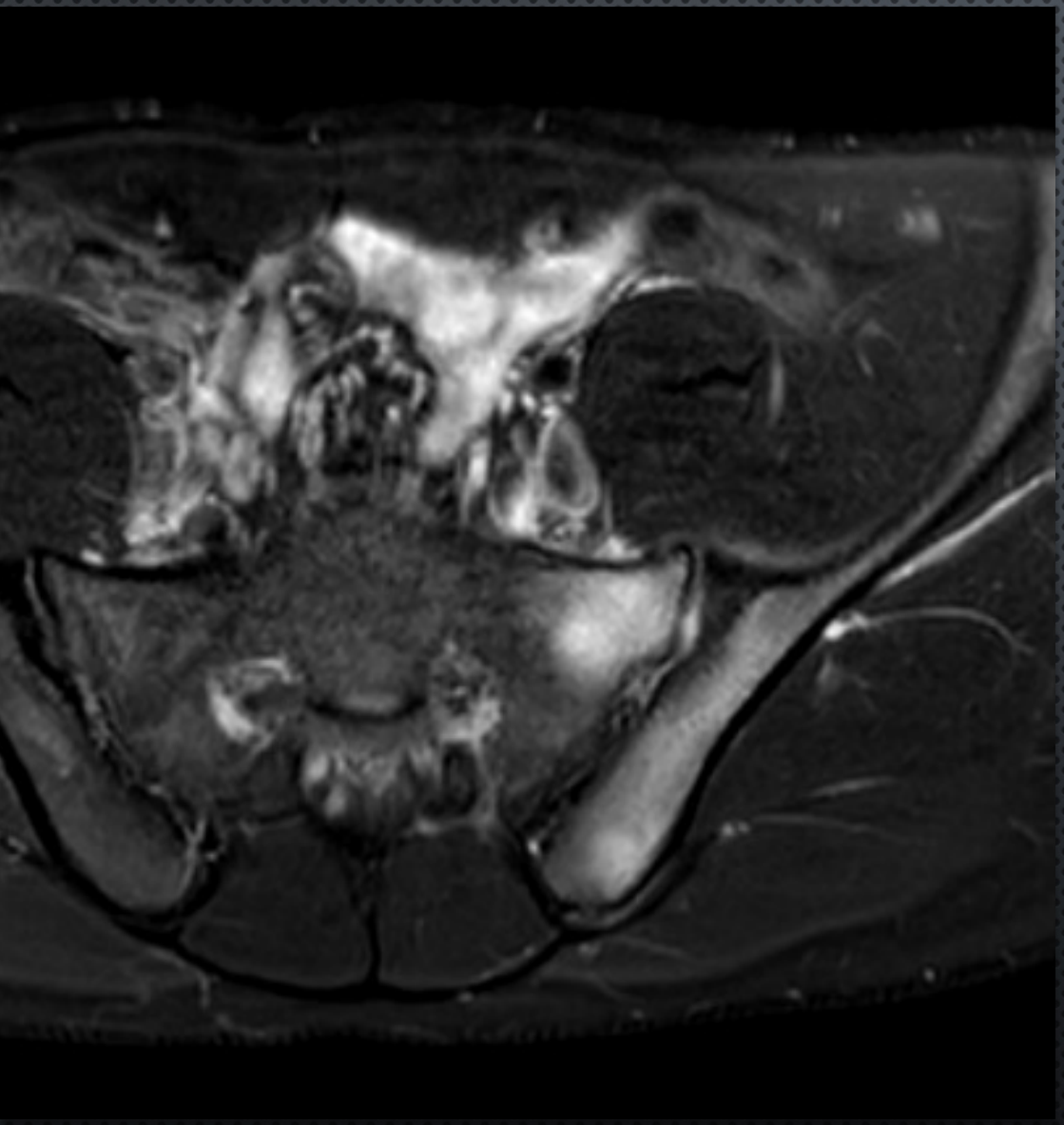
E. Joint space narrowing

F. Ankylosis

Diagnosis: septic sacroiliitis

- 16-year-old female with no significant PMHx with left hip pain





What do you see?

A. Bone marrow edema

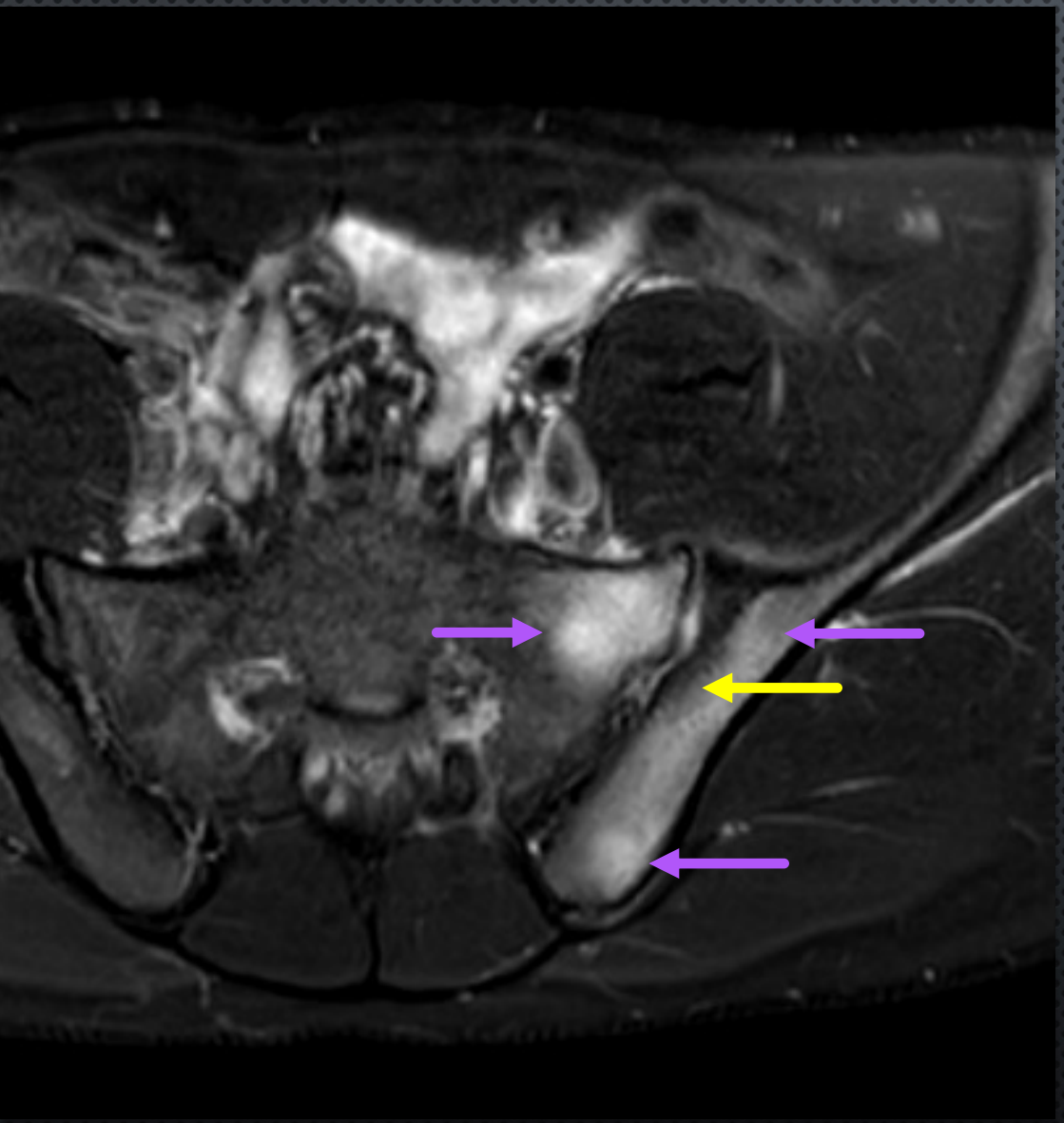
B. Subchondral sclerosis

C. Erosions

D. Fatty metaplasia

E. Joint space narrowing

F. Ankylosis



What do you see?

A. *Bone marrow edema*

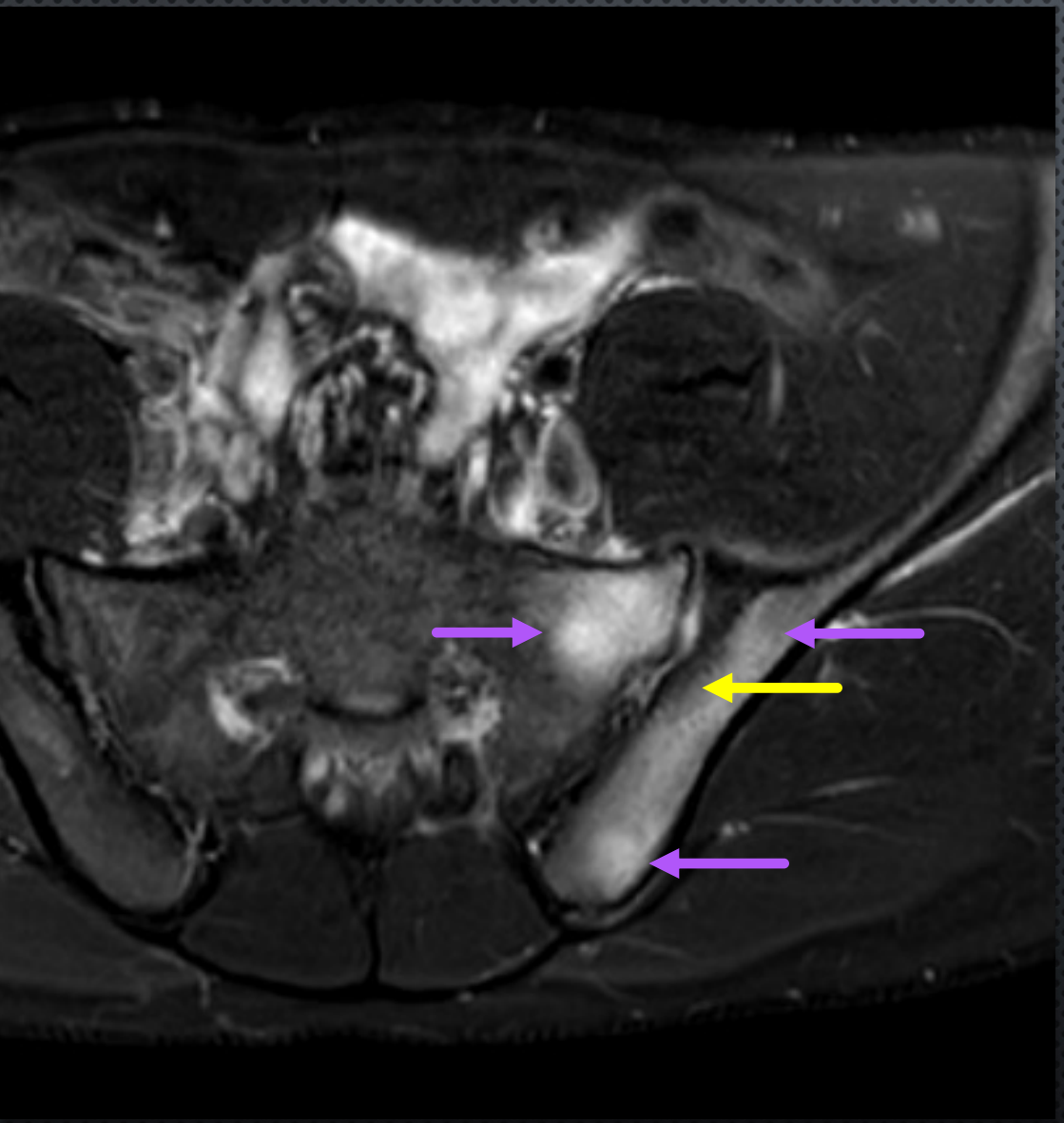
B. *Subchondral sclerosis*

C. Erosions

D. Fatty metaplasia

E. Joint space narrowing

F. Ankylosis



What do you see?

A. Bone marrow edema

B. Subchondral sclerosis

C. Erosions

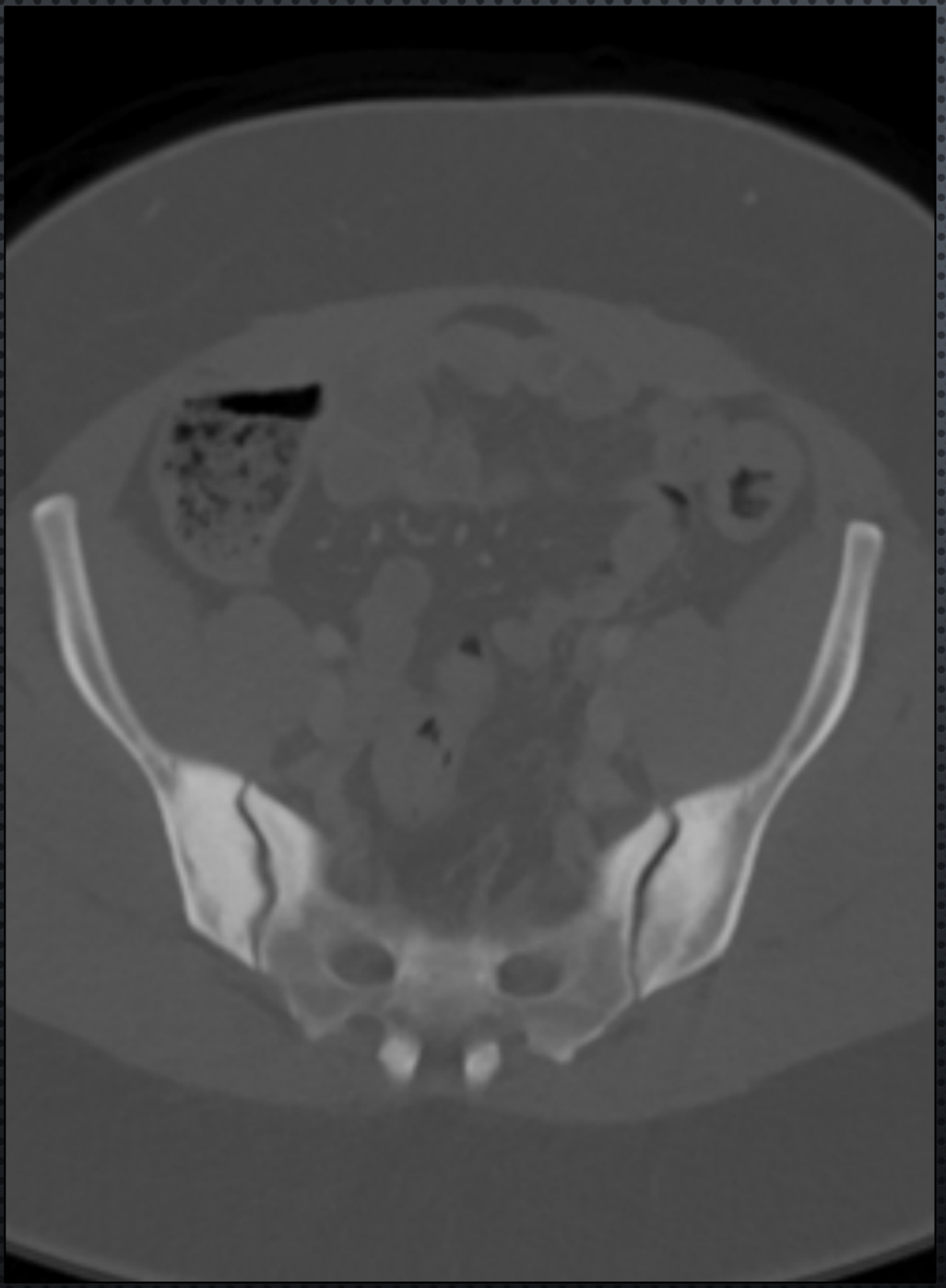
D. Fatty metaplasia

E. Joint space narrowing

F. Ankylosis

Diagnosis: sacroiliitis

- 33-year-old female with no significant PMHx with low back pain



What do you see?

A. Subchondral sclerosis

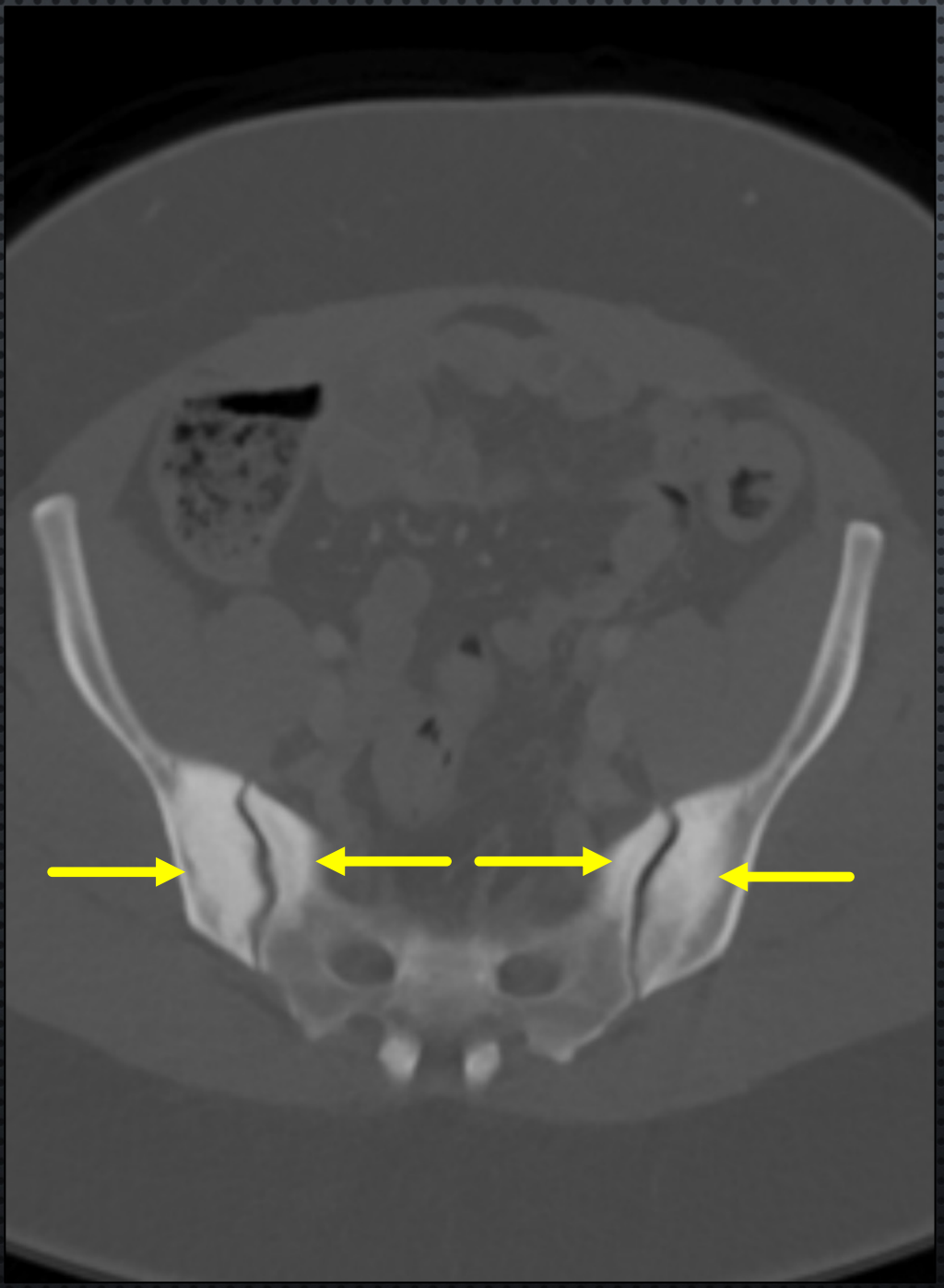
B. Erosions

C. Joint space narrowing

D. Osteophytes

E. Joint vacuum phenomenon

F. Ankylosis



What do you see?

A. *Subchondral sclerosis*

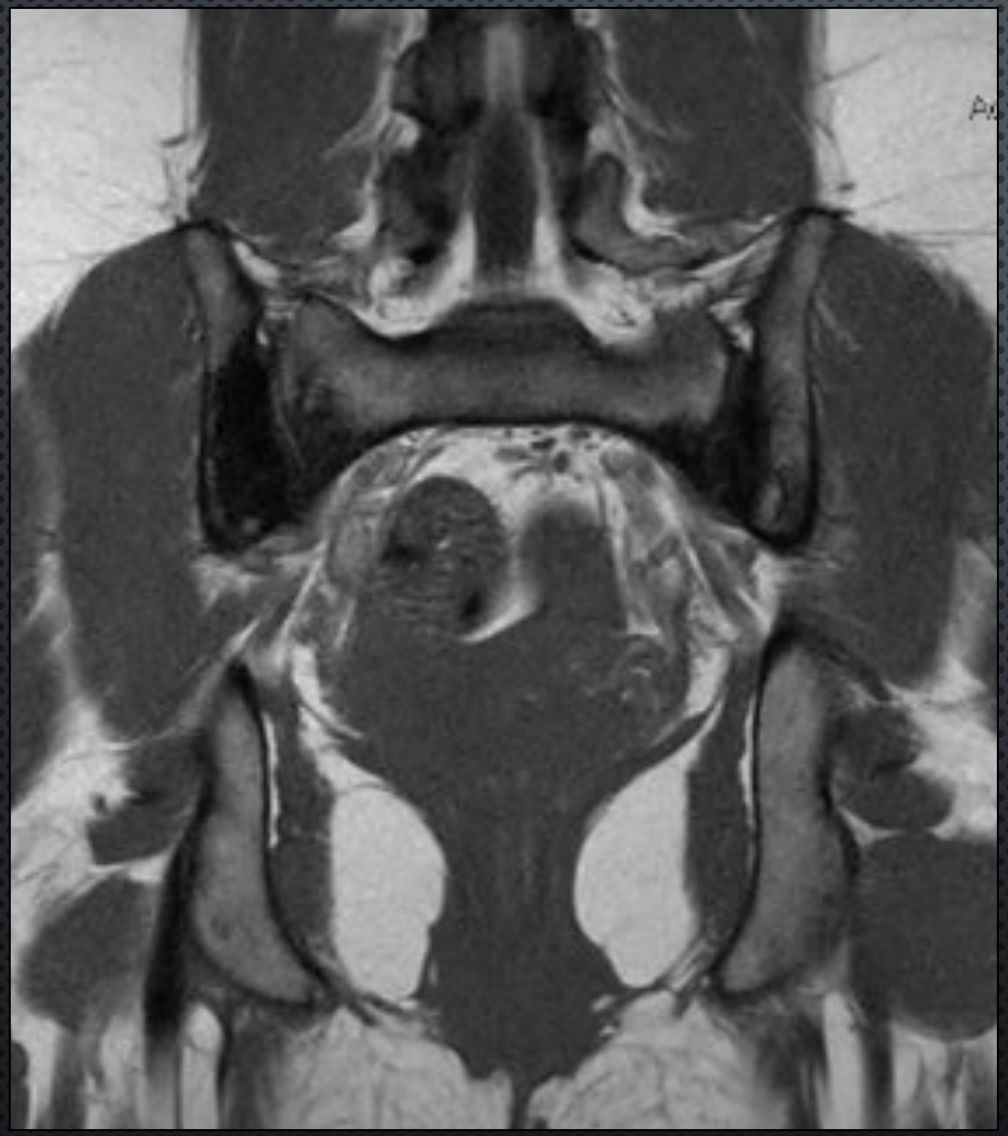
B. Erosions

C. Joint space narrowing

D. Osteophytes

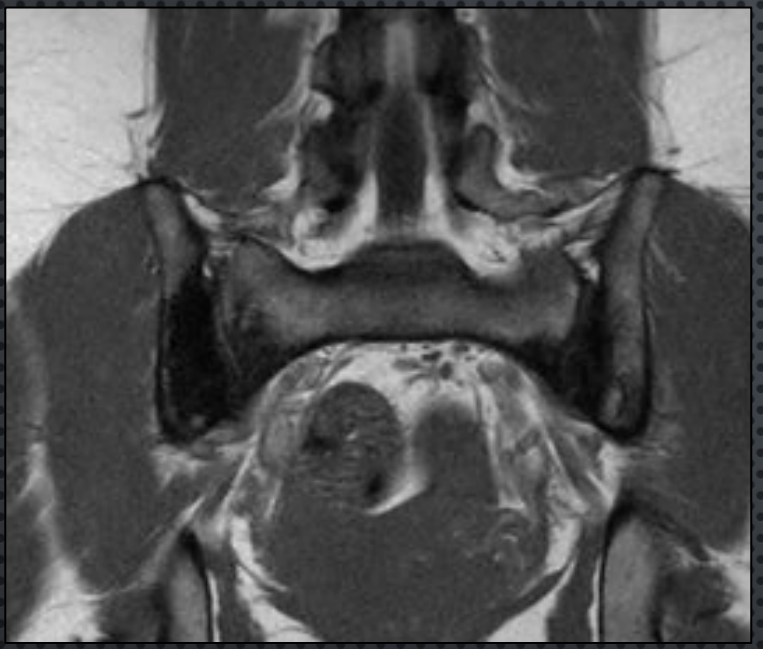
E. Joint vacuum phenomenon

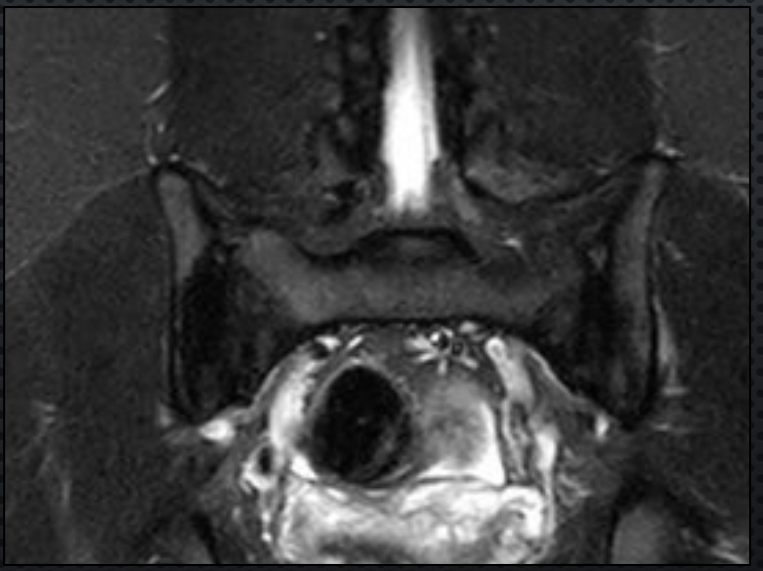
F. Ankylosis



Coronal T1

Coronal STIR





What do you see?

A. Bone marrow edema

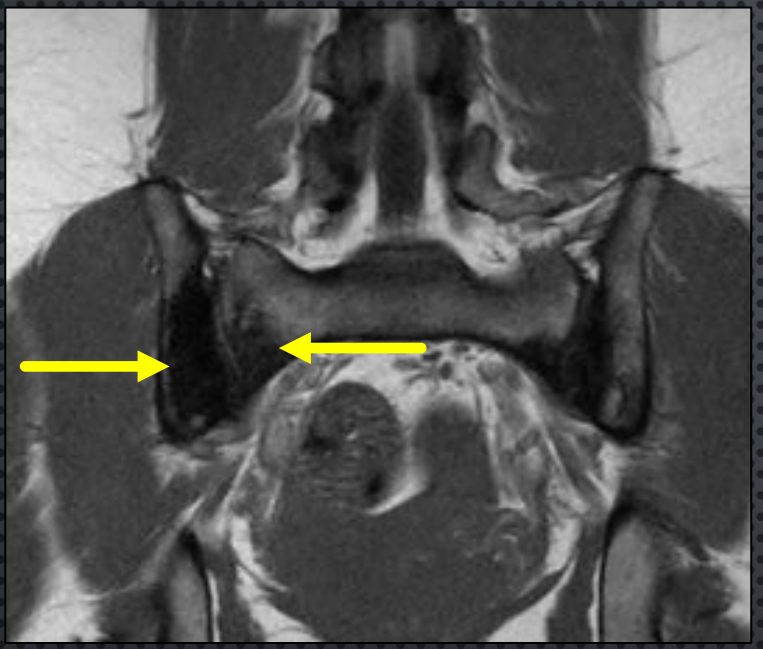
B. Subchondral sclerosis

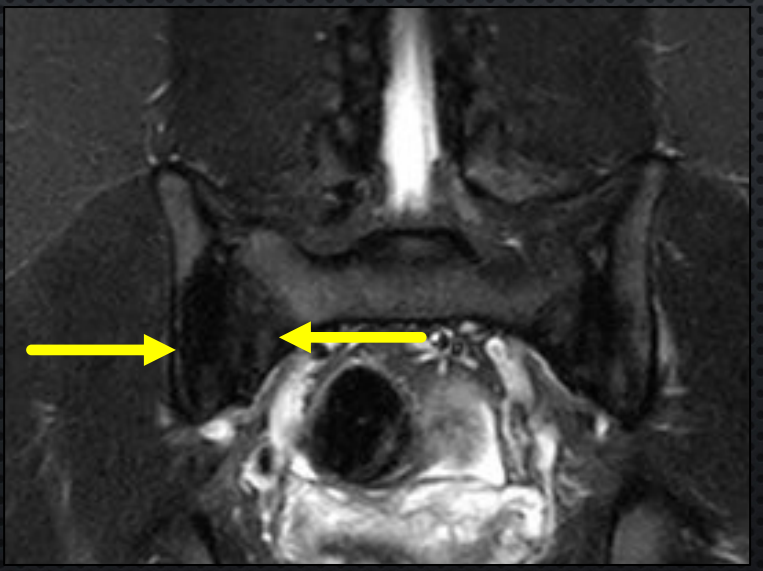
C. Erosions

D. Fatty metaplasia

E. Joint space narrowing

F. Ankylosis





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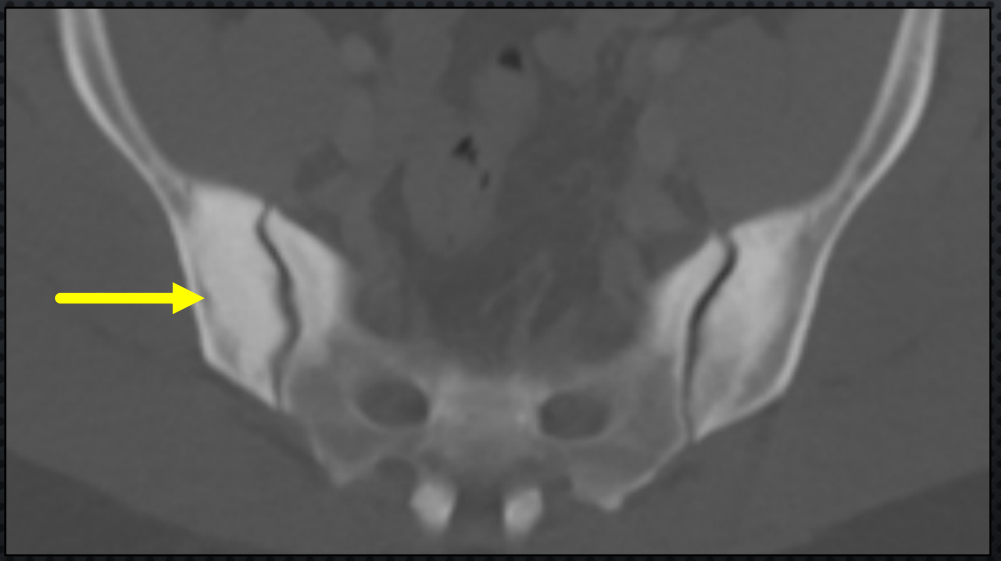
What do you see?

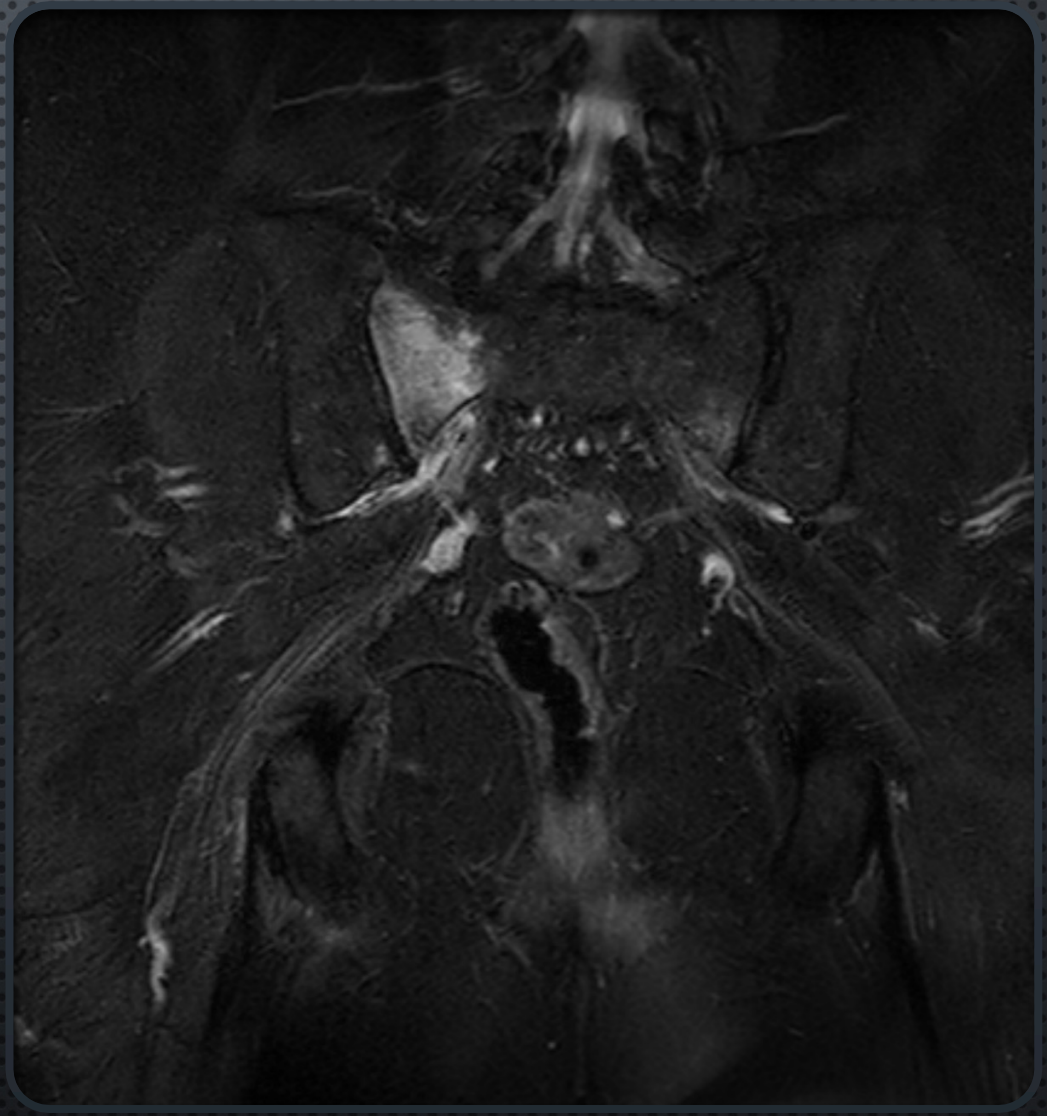
- *Subchondral sclerosis*



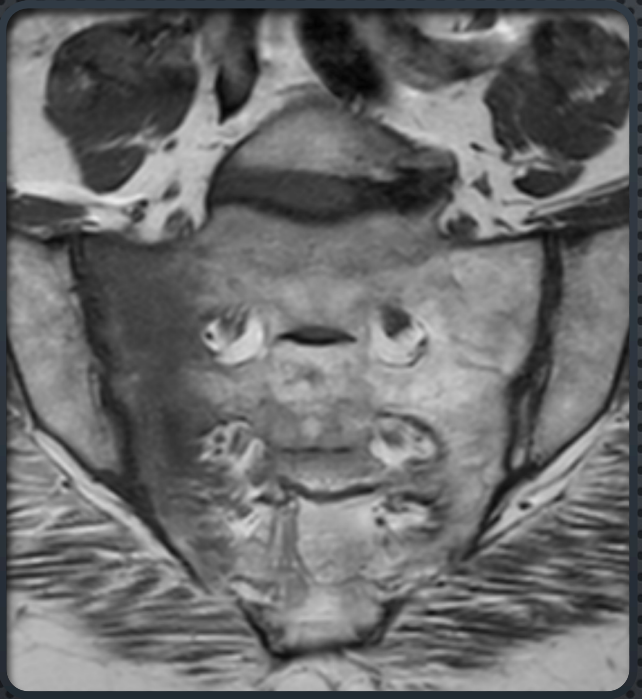
Diagnosis: osteitis condensans ilii

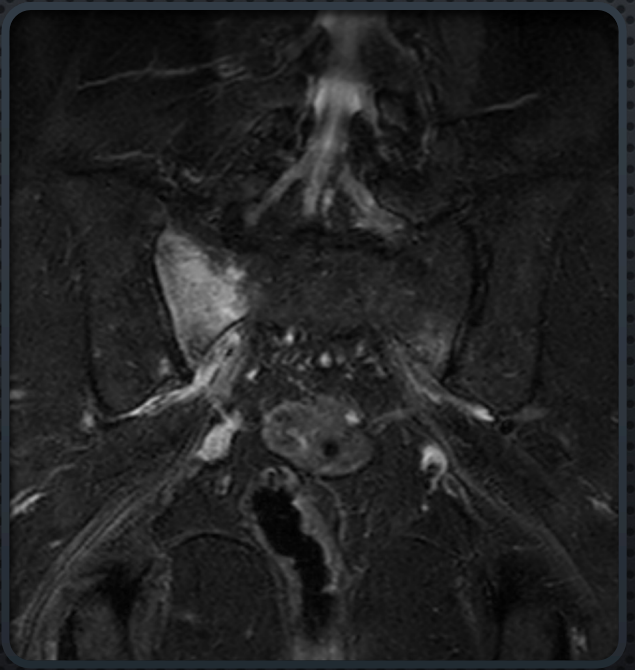
- 75-year-old female with lower back and buttock pain

Coronal T1



Coronal STIR





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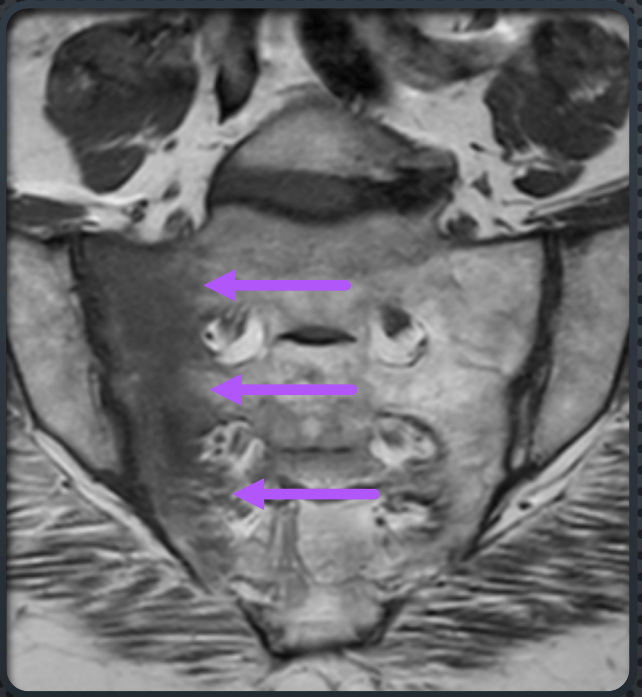

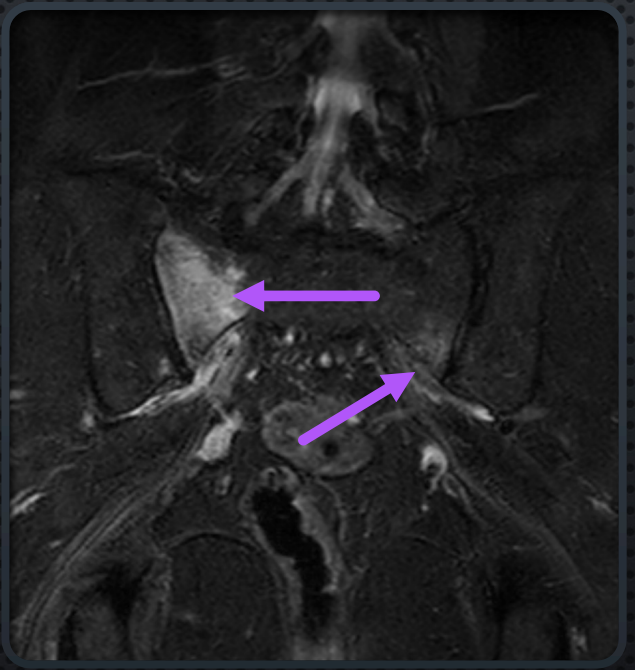

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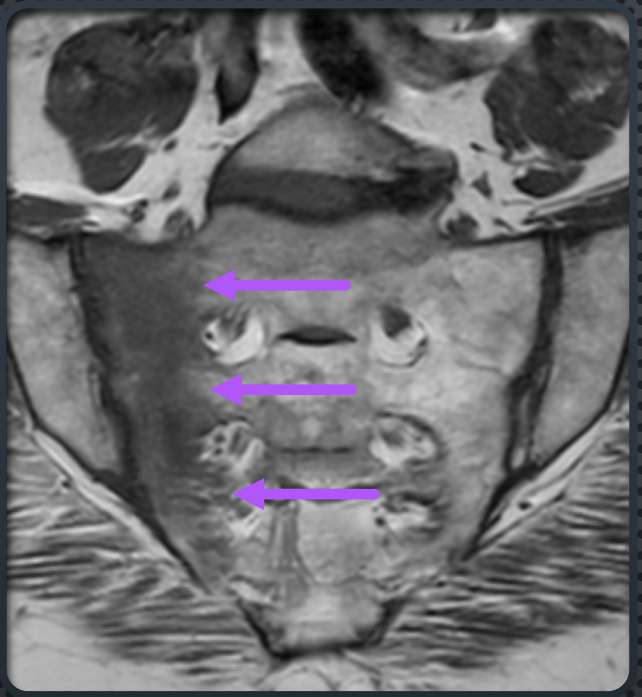

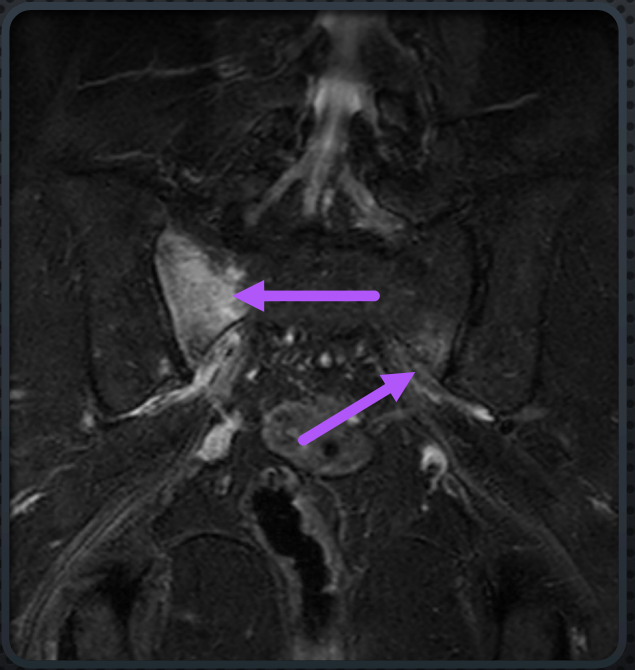

What do you see?

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C. Erosions

D. Fatty metaplasia

E. Joint space narrowing

F. Ankylosis

Diagnosis: sacral insufficiency fracture

- 44-year-old male with diabetes and end stage renal disease on hemodialysis

What do you see?

A. Subchondral sclerosis

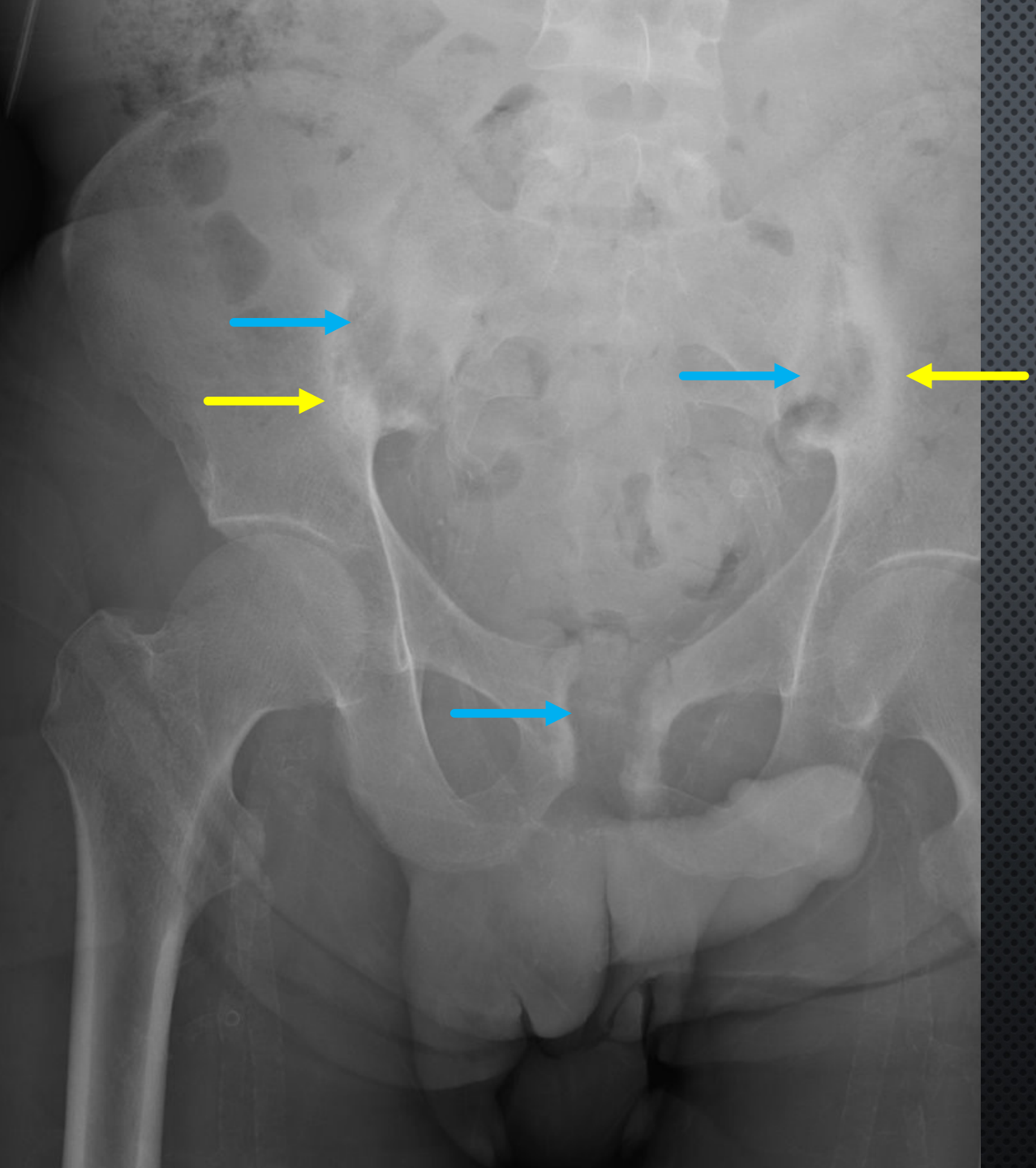
B. Erosions

C. Joint space narrowing

D. Osteophytes

E. Joint vacuum phenomenon

F. Ankylosis



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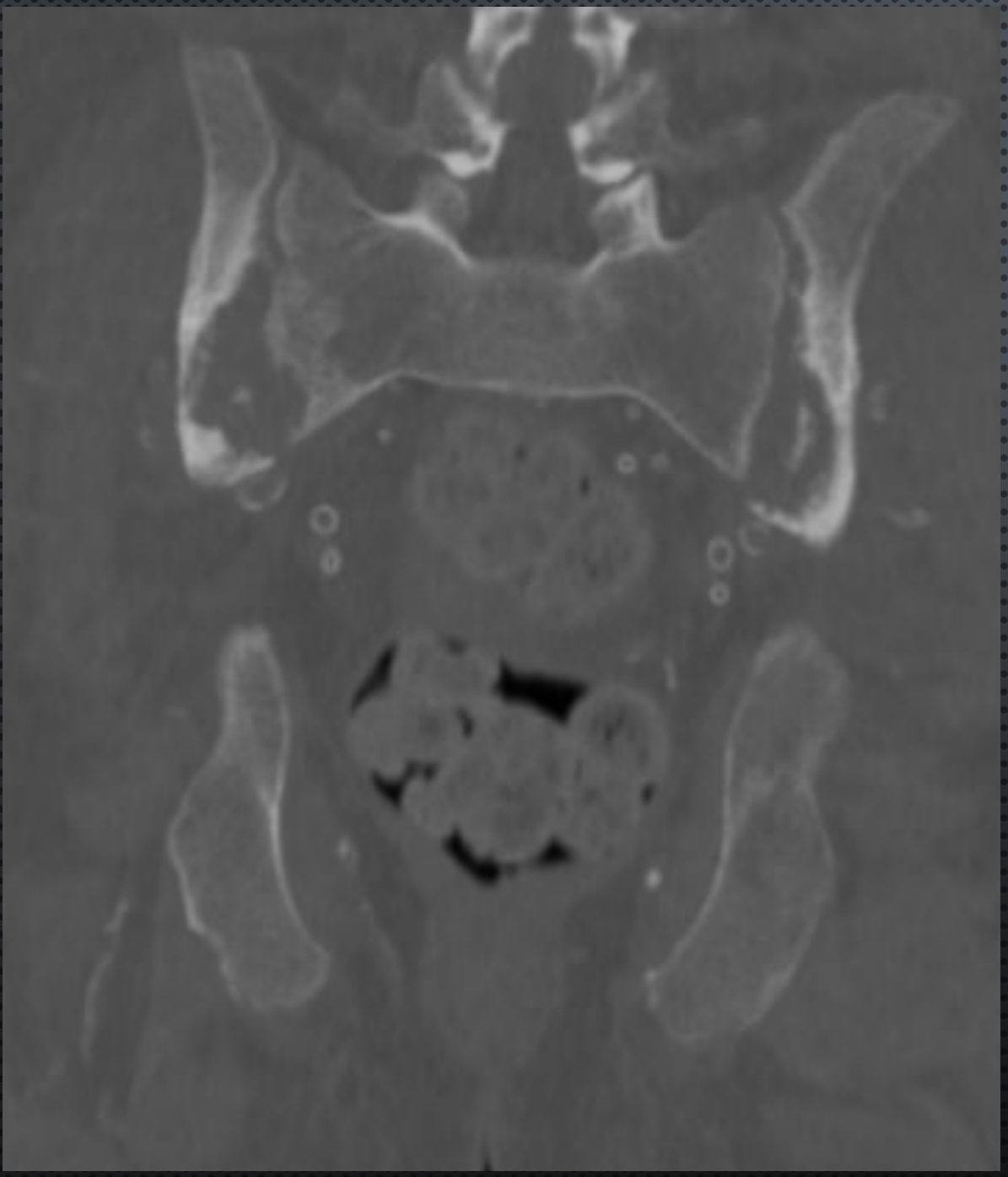

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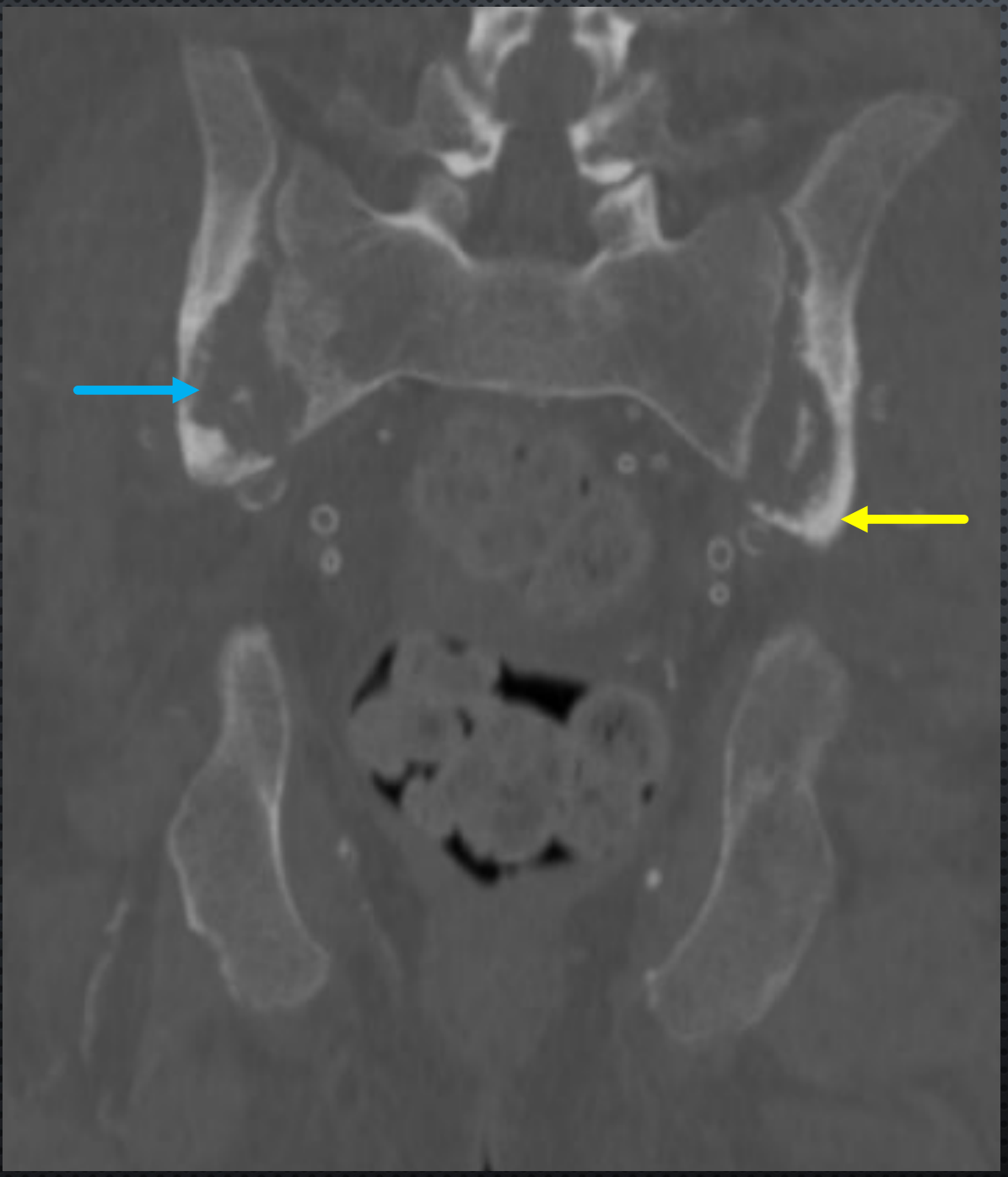

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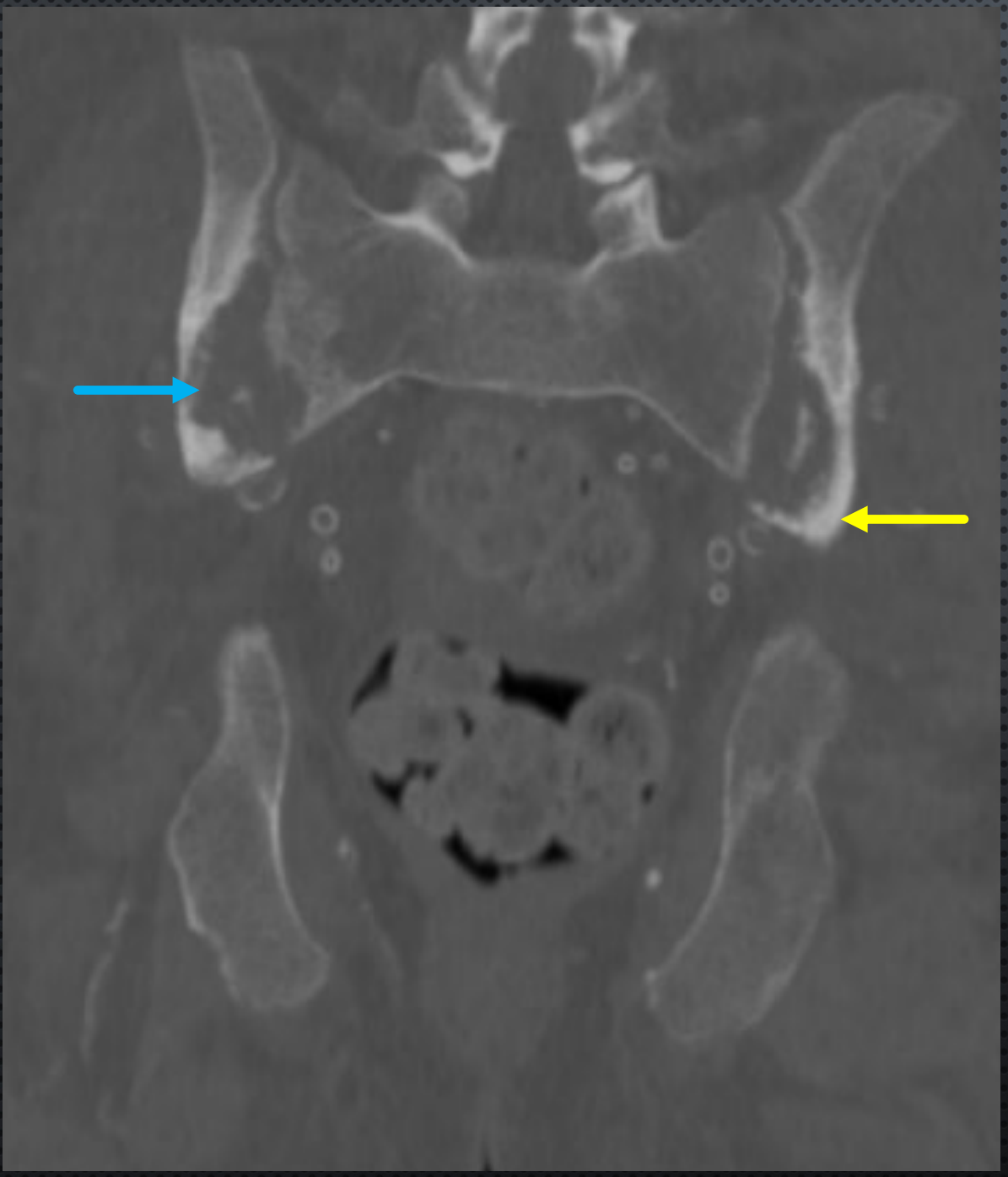

What do you see?

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C. Joint space narrowing

D. Osteophytes

E. Joint vacuum phenomenon

F. Ankylosis

Diagnosis: secondary hyperparathyroidism/renal osteodystrophy

SACROILIITIS CASE SUMMARY

- Different imaging modalities can be useful in the evaluation of sacroiliitis
  - Radiographs: should be done first → look for subtle erosion, subchondral sclerosis, joint space narrowing or widening, ankylosis
  - MRI: often done for negative or equivocal radiographs → can show early disease, look for bone marrow edema!
  - CT: not routinely done but can be useful to troubleshoot
- Not all bone marrow edema is sacroiliitis!
  - Clinical context is key!

THANKS!