# HIP MRI

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- Technique
- Anatomy
- DDH
- LCP/AVN
- SCFE
- Dermatomyositis
- Infection
    - Arthritis vs Myositis vs Osteo
- Femoroacetabular Impingement
- Labral Tears

TECHNIQUE

T1 AND T2 CORONAL/AXIAL

T1 CONVENTIONAL SPIN ECHO
T2 FAST SPIN ECHO FAT SAT (Min Time)
FSEIR MAXIMIZES CONTRAST
AND RED/YELLOW MARROW

FAST GRE FOR CARTILAGE

OBLIQUE AX THROUGH FEM NECK
I.E. IMPINGEMENT

SAG HELPFUL IN LABRAL TEARS AND AVN

TO GAD OR NOT TO GAD

DIRECT VS. IV (INDIRECT) 5-10 MIN POST/EXERCISE)
DIRECT VIA FLUORO VS CT

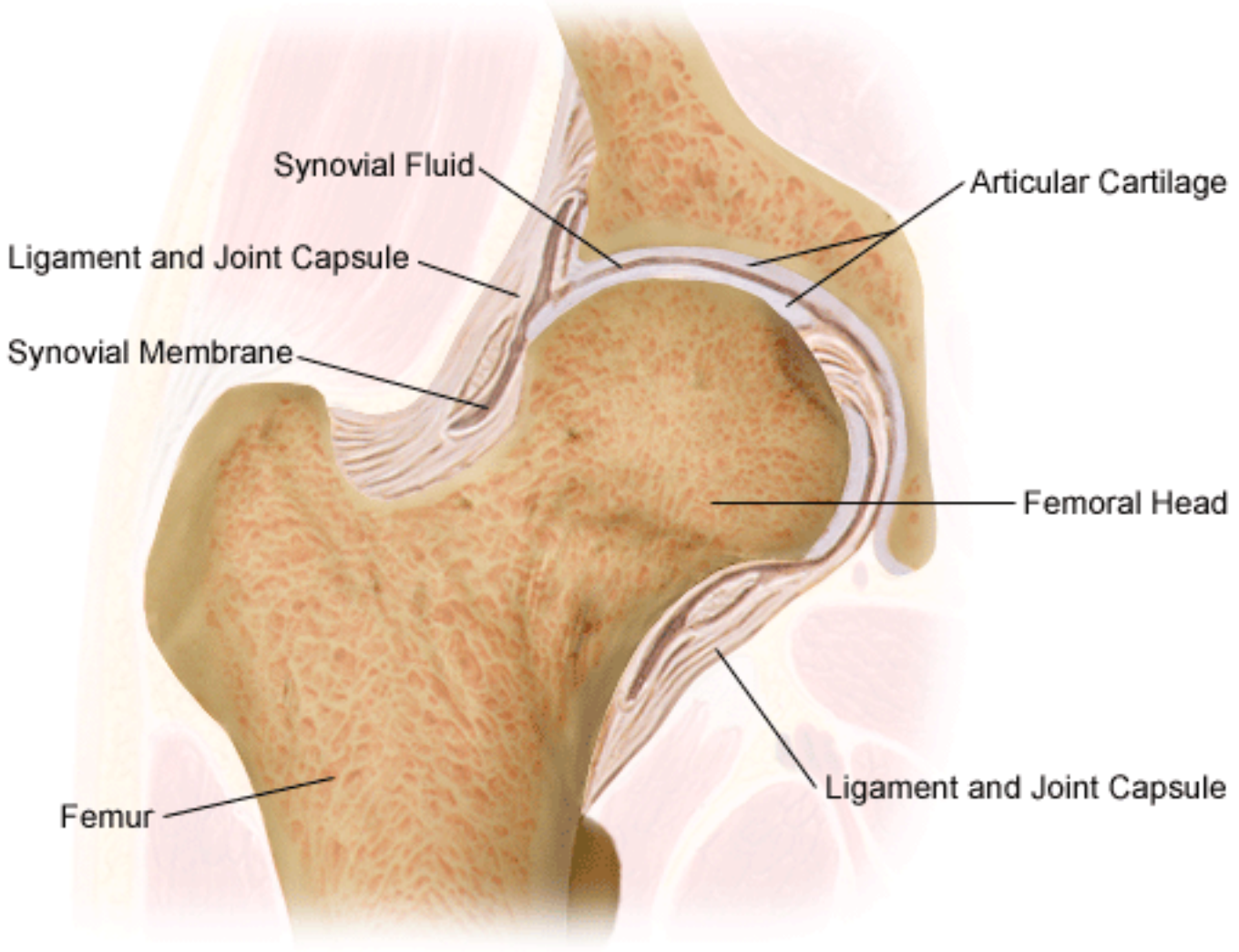
TECHNIQUE

- SCREENING VS. DETAILED UNILATERAL SIDE
- PATIENT COOPERATION VS SEDATION
- PATIENT POSITION
  - SUPINE-MILD INTERNAL ROTATION OF FEET
    SYMMETRY IMPORTANT

# ANATOMY

- Ball and socket joint
- More stable than shoulder
- Less freedom of motion than shoulder
- Acetabulum horseshoe shaped
  - Deficient inferiorly

# Hip Joint


Synovial Fluid
Articular Cartilage
Ligament and Joint Capsule
Synovial Membrane
Femoral Head
Ligament and Joint Capsule
Femur

# OSSEOUS STRUCTURES

EDEMA

FRACTURE

Don’t Forget  to Look at

SACRUM

PUBIC RAMI

FEMOROACETABULAR JOINT

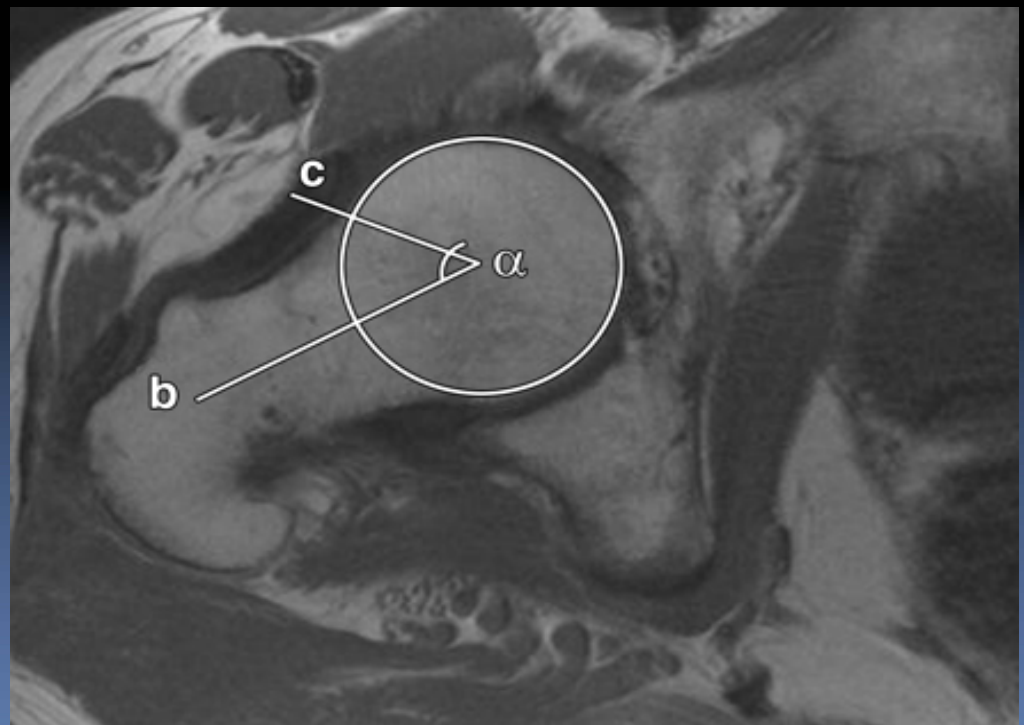
- JOINT FLUID
- ACETABULAR VERSION (XR dx)
  - ANTEVERSION NORMAL
  - RETROVERSION~/=PINCER
- ACETABULAR COVERAGE/OVER
- ALPHA ANGLE
- LABRUM
  - CARTILAGE
  - GANGLION CYST
  - PARALABRAL CYST

ALPHA ANGLE > 55 DEGREES IS ABNORMAL

OBLIQ UE AXIAL IMAGE

WHERE FEMORAL NECK IS NARROWEST
LINE DRAWN PERPENDICULAR TO NECK HERE
DRAW LINE PERP TO THIS FIRST LINE (line b)
BEST FIT CIRCLE OUTLINING FEMORAL HEAD

CALCULATE ANGLE FORMED BETWEEN NECK
AND WHERE FEMORAL HEAD PROTRUDES ANTERIOR TO CIRCLE(line c)



# Labrum Anatomy

- Fibrocartilaginous Rim
- Thicker Posteriorly than Anteriorly
- Attaches to osseous rim of acetabulum
- May overlie articular cartilage
- Blends with transverse ligament at notch

# NORMAL LABRUM

- Function unclear
- Most commonly triangle in X-section
- May be round or flat
- Usually (not invariably) UNIFORMLY LOW T1
- Abnormal labrum…literature states grading systems
    - In practice, many simply use terms to
      Describe fraying, partial tear, full thickness
      Or complete separation of labrum

# NORMAL CORONAL T2




Figure 102-50 Normal acetabular labrum. A, Coronal fat-saturated T2-weighted image. The triangular, hypointense superior lateral aspect of the acetabular labrum is outlined by fluid within the hip joint. B, Coronal, fat-saturated T1-weighted image obtained following direct gadolinium arthrography. Intra-articular administration of a gadolinium contrast solution distends the joint capsule and demonstrates normal superior lateral acetabular labral morphology. C, Coronal fat-saturated T1-weighted image obtained with indirect arthrography. Diffusion of gadolinium contrast into the hip joint following intravenous injection defines the surface of the labrum and articular cartilage. D, Sagittal, fat-saturated T1-weighted image following indirect (intravenous) gadolinium arthrography. Note the normal contour of the acetabular articular cartilage.

NORMAL COR T2

ABNORMAL COR T2

# INDIRECT (IV GAD) CORONAL T1

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NORMAL
DIRECT
INJECTION
OF GAD

NOTE CAPSULE
DISTENTION




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LIGAMENTS

ILIOFEMORAL, PUBOFEMORAL AND ISCHIOFEMORAL LIGAMENTS REPRESENT THICKENED PORTIONS OF THE JOINT CAPSULE

TRANSVERSE ACETABULAR LIGAMENT BRIDGES NOTCH CONNECTING AI AND PI MARGINS OF LABRUM

LIGAMENTUM TERES CROSSES HIP JOINT TO ATTACH TO FOVEA OF FEMORAL HEAD

# BURSAE

TROCHANTERIC BURSAL COMPLEX IS BURSA LOCATED AT GREATER TROCHANTER ALONG WITH INSERTIONS OF THE GLUTEUS MIN AND MED

ILIOPSOAS BURSA IS AT ILIOPSOAS TENDON COMPLEX AND COMMUNICATES WITH ANTERIOR PORTION OF HIP JOINT IN 15% OF PATIENTS

OBTURATOR EXTERNUS BURSA IS AT OBTURATOR EXTERNUS MUSCLE AND COMMUNICATES WITH INFERIOR PORTION OF HIP JOINT

MUSCLES

FLEXORS

ILIOPSOAS, SARTORIUS, TENSOR FASCIA LATA AND RECTUS FEMORIS

EXTENSORS

HAMSTRING MUSCLE GROUP AND GLUT MAX

ABDUCTORS

GLUT MED AND MIN

EXT ROTATORS

GLUT MED AND MIN, PIRIFORMIS, OBT EXT AND INT

ADDUCTORS

ADDUCTOR MAG, LONG, BREV, PECTINEUS, GRACILIS

# DEVELOPMENTAL DYSPLASIA OF THE HIP

ROLE OF MRI CONTROVERSIAL

COST, AVAILABILITY, SEDATION

MOST HELPFUL WITH PERSISTENT DISLOC, LATE DIAGNOSIS, ACETAB DYSPLASIA

- MRI WILL SHOW ACETABULAR CARTILAGE
- FATTY PULVINAR
- SHAPE AND SIGNAL OF FEMORAL HEAD




Figure 110-17 Developmental dysplasia of the hip. A, Plain radiograph demonstrates left hip dislocation, delay in femoral head ossification, and a shallow, steep bony acetabulum. Coronal T1-weighted (600/15) image (B) and gradient-echo (50/20/20°) image (C) demonstrate hypertrophy of the fatty pulvinar (solid arrow) and elevation without inversion of the low signal intensity fibrocartilaginous labrum (arrowheads). The size and shape of the cartilaginous femoral head are well seen (open arrow).




VIS OF CARTILAGE

CORONAL T1 WITH HYPERTROPHY FATTY PULVINAR

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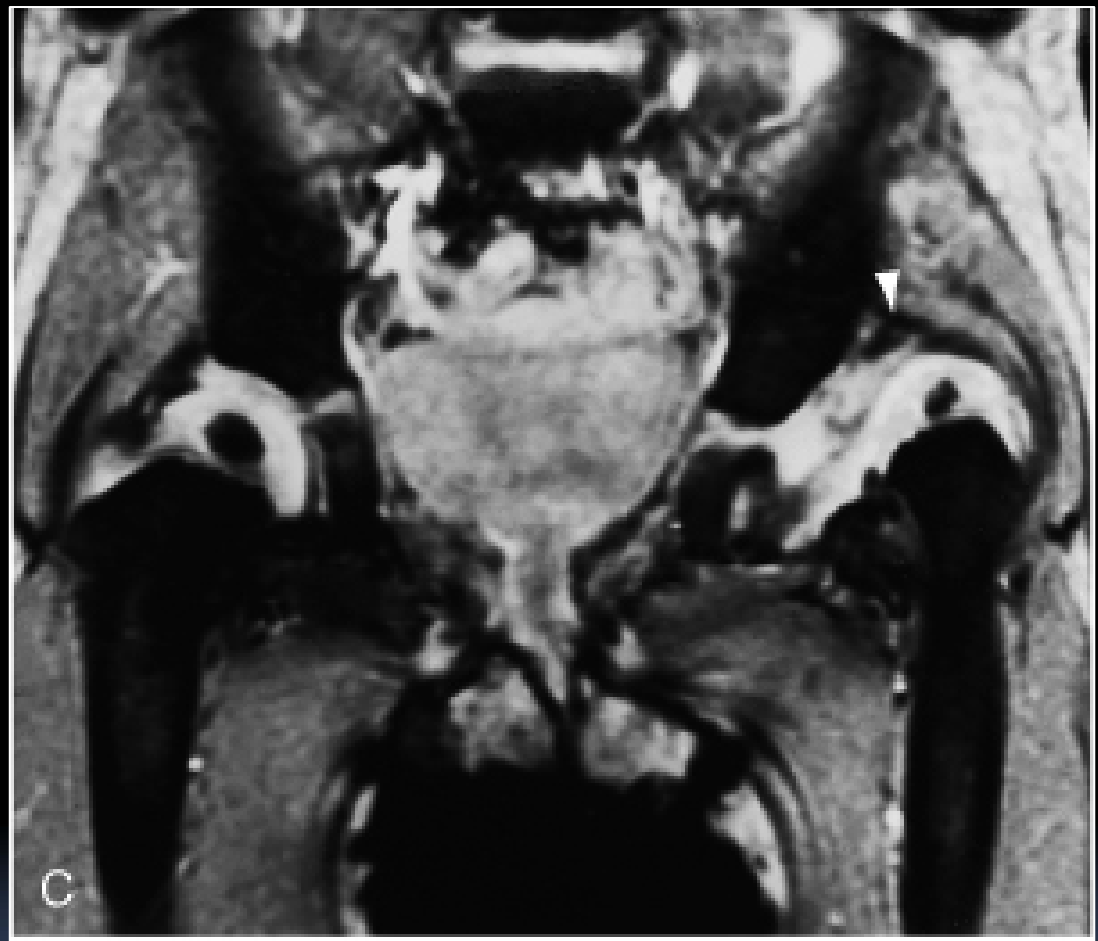
GRADIENT ECHO

CARTILAGE VISIBLE



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# LEGG-CALVE-PERTHES AVN

# LEGG-CALVE-PERTHES (LCP)

IDIOPATHIC ASEPTIC NECROSIS

3-12 Y.O. MOST COMMON

BILATERAL IN 10%

BOYS > GIRLS

INCIDENCE 5.5 TO 15.6 PER 100,000

LCP

USUALLY PREDICTABLE PROGRESSION OF CAP FEM EPIPH

CONDENSATION

FRAGMENTATION

REPARATION

Cartilage Thickening Least Pronounced Superiorly

Characteristic Broadening of Femoral Head

Uncovering-Secondary DJD

PHYSEAL BRIDGING – GROWTH ARREST

# LCP (OR OTHER AVN) ON MRI

Positive on MRI before XR
- •Transient Marrow Edema as Precursor
  To Reversible Process

•Acetabular Coverage of the Head

•Signal in Marrow of Head
- •NORMAL Fat is Bright on T1
- •AVN Marrow Dark on T1
  - •Bright on T2

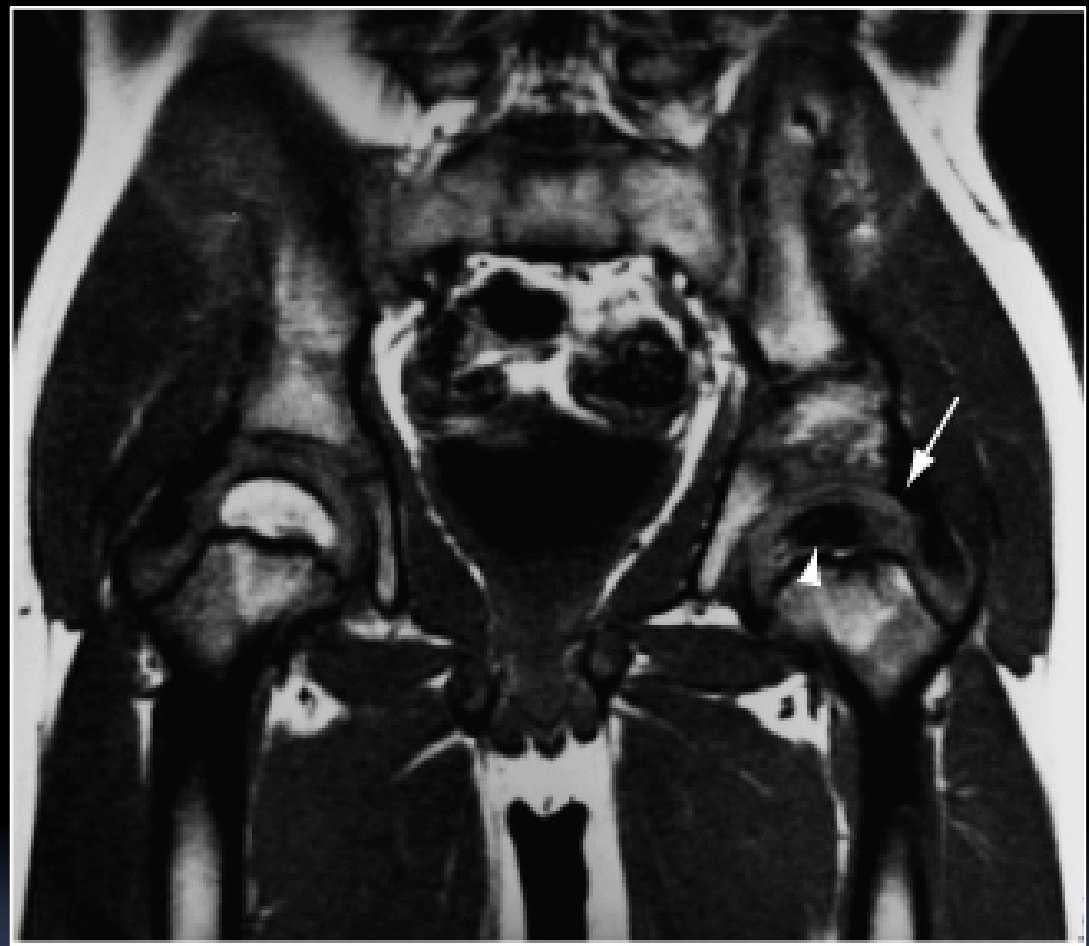




Figure 110-30 Legg-Calvé-Perthes disease. Coronal T1-weighted (600/20) image demonstrates decreased marrow signal intensity in the left femoral head (arrowhead). There is adequate coverage of the cartilaginous femoral head by the low signal intensity fibrocartilaginous labrum (arrow).

# SLIPPED CAPITAL FEMORAL EPIPHYSIS

# SCFE ON MR

- Best diagnosis XR
- Slip is a Type 1 Salter-Harris
- If XR negative, MR signal abnormality may be of value in early slip

  T2 signal (edema) in PHYSIS

  Also shows marrow signal of head to R/O complicating AVN



Figure 110-13 Slipped capital femoral epiphysis. T1-weighted (500/20) coronal image demonstrates marked displacement of the left femoral epiphysis. Marrow signal in the femoral head is normal (no evidence of avascular necrosis). The right side is normal.

# DERMATOMYOSITIS

# DERMATOMYOSITIS ON MRI

- T2 Axial and Coronals
  - Increased T2 Muscle Intensity
  - Axial Best to Differentiate Muscle Groups

    ADDUCTORS>GLUTE>QUAD>Ham
- Helps the Clinicians with Extent and Activity

  Monitors Therapy

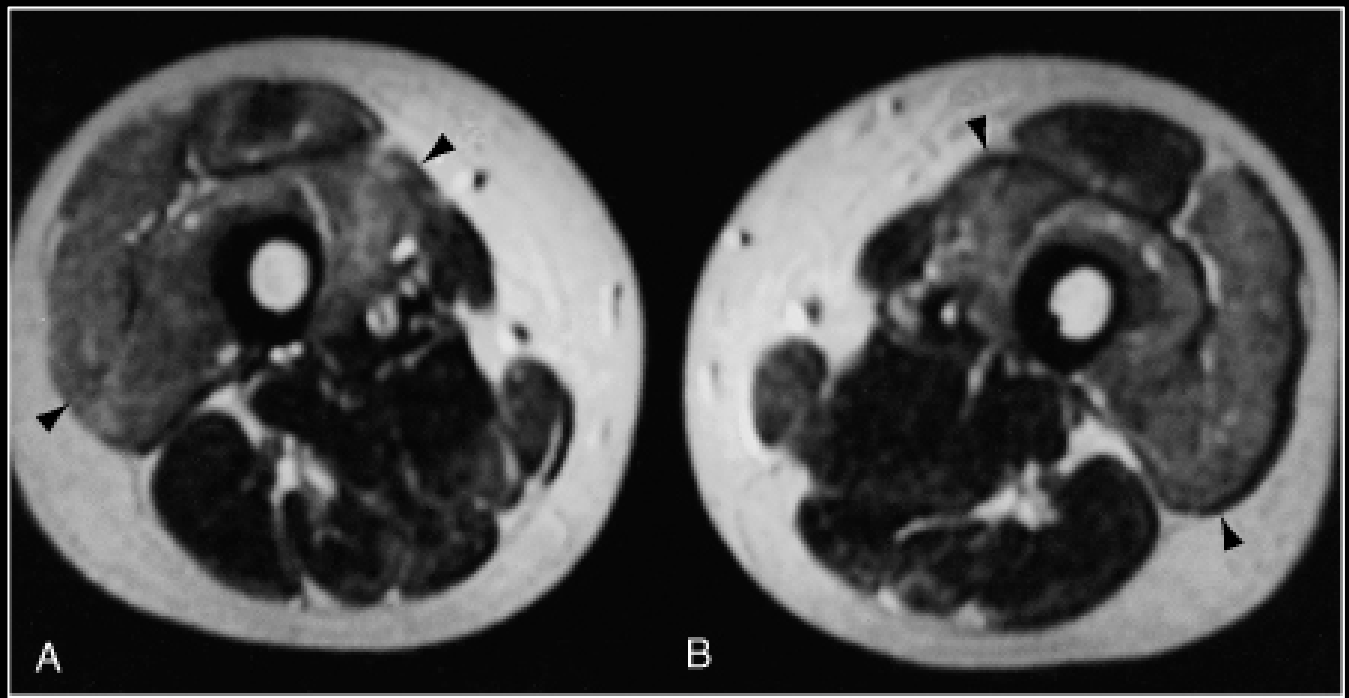





Figure 110-6 Dermatomyositis. Axial T2-weighted (2000/85) image of the thighs demonstrates diffuse increased signal intensity involving primarily the anterior and lateral thigh musculature (arrowheads).

# INFECTION

ARTHRITIS

MYOSITIS

OSTEOMYELITIS

# ARTHRITIS ON MR

## Non Specific

Effusion…Arthritis vs. Reactive Synovitis
vs. Trauma vs. JRA , etc.

Gad Helpful to See Pannus and Synovial Hypertrophy

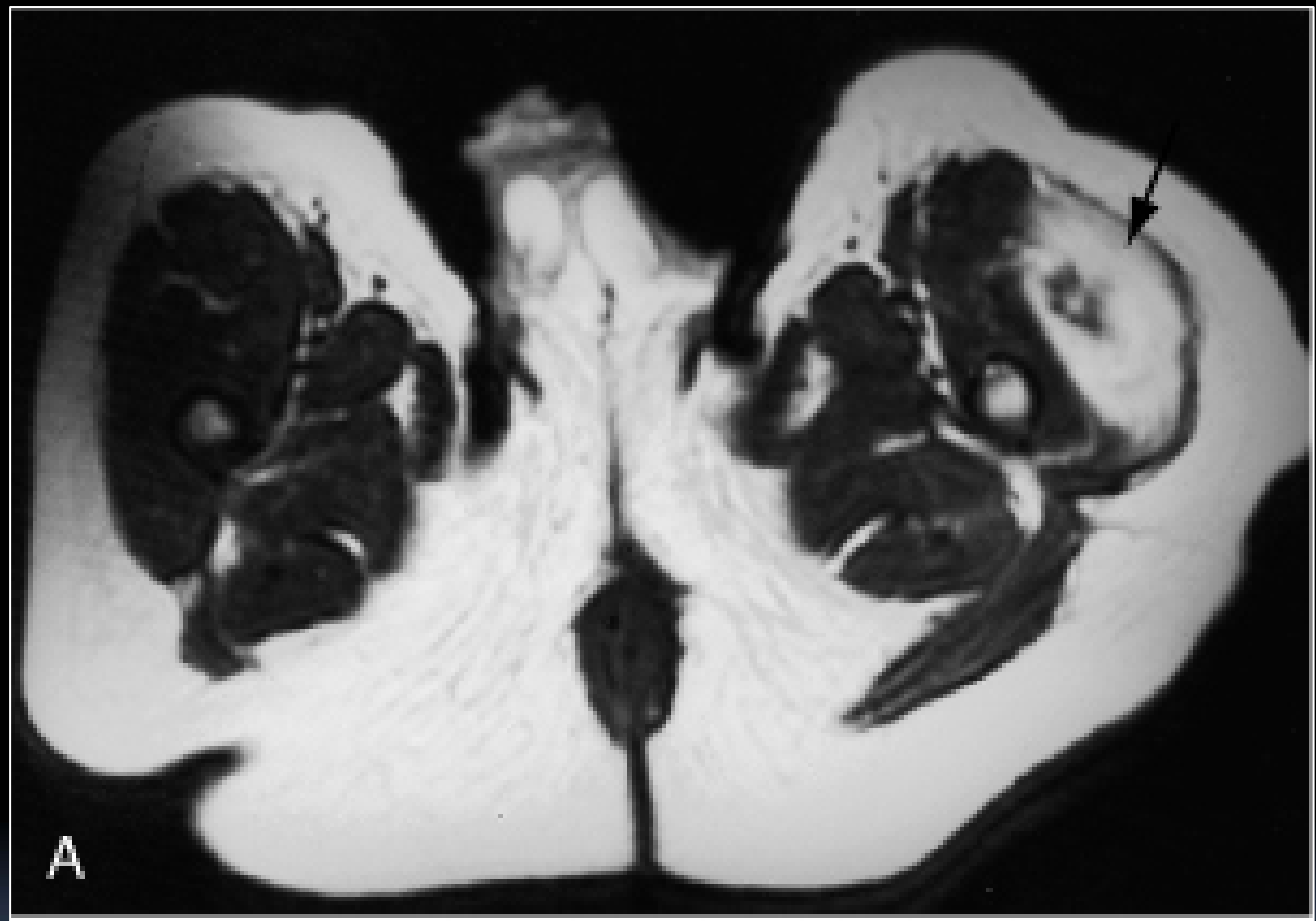
Marrow Signal Normal
but can be abnormal in edema OR osteo


Figure 110-7 Septic right hip. Coronal T2-weighted image with fat saturation demonstrates a right joint effusion (arrow). Marrow signal is normal. The left hip is normal.

# MYOSITIS ON MR

- T2 Muscle Signal INCREASED INTENSITY
- Gad Enhancement of Abscess

Surgical Drainage or Medical Rx

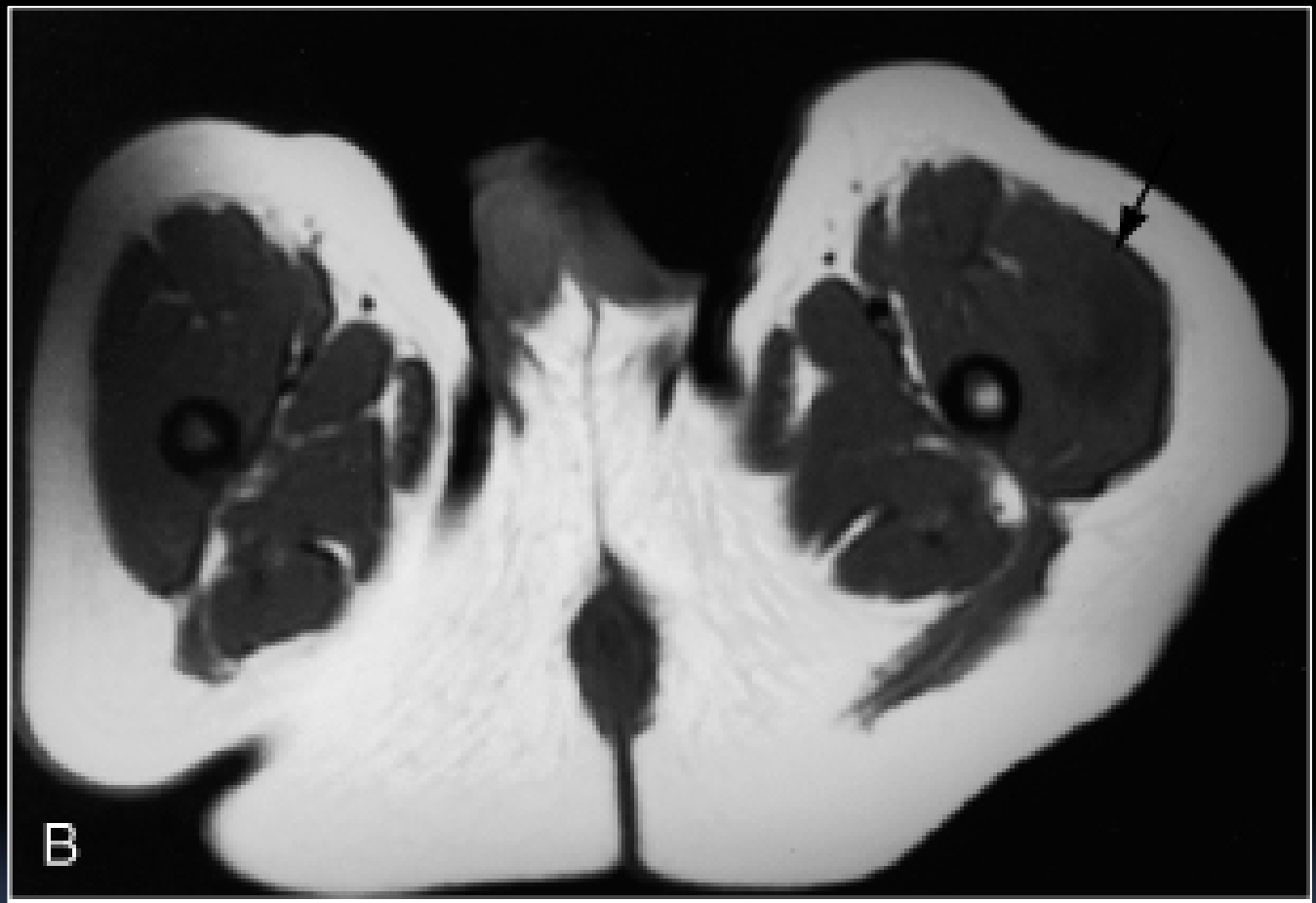





T2

Not
Fat Sat

Figure 110-5 Myositis. A, Axial T2-weighted (2700/85) image of the proximal thighs demonstrates localized mixed, primarily increased muscle signal intensity and swelling (arrow). T1-weighted (500/12) images before (B) and after (C) contrast enhancement demonstrate irregular ring enhancement (arrows).




T1 AX
NON
GAD



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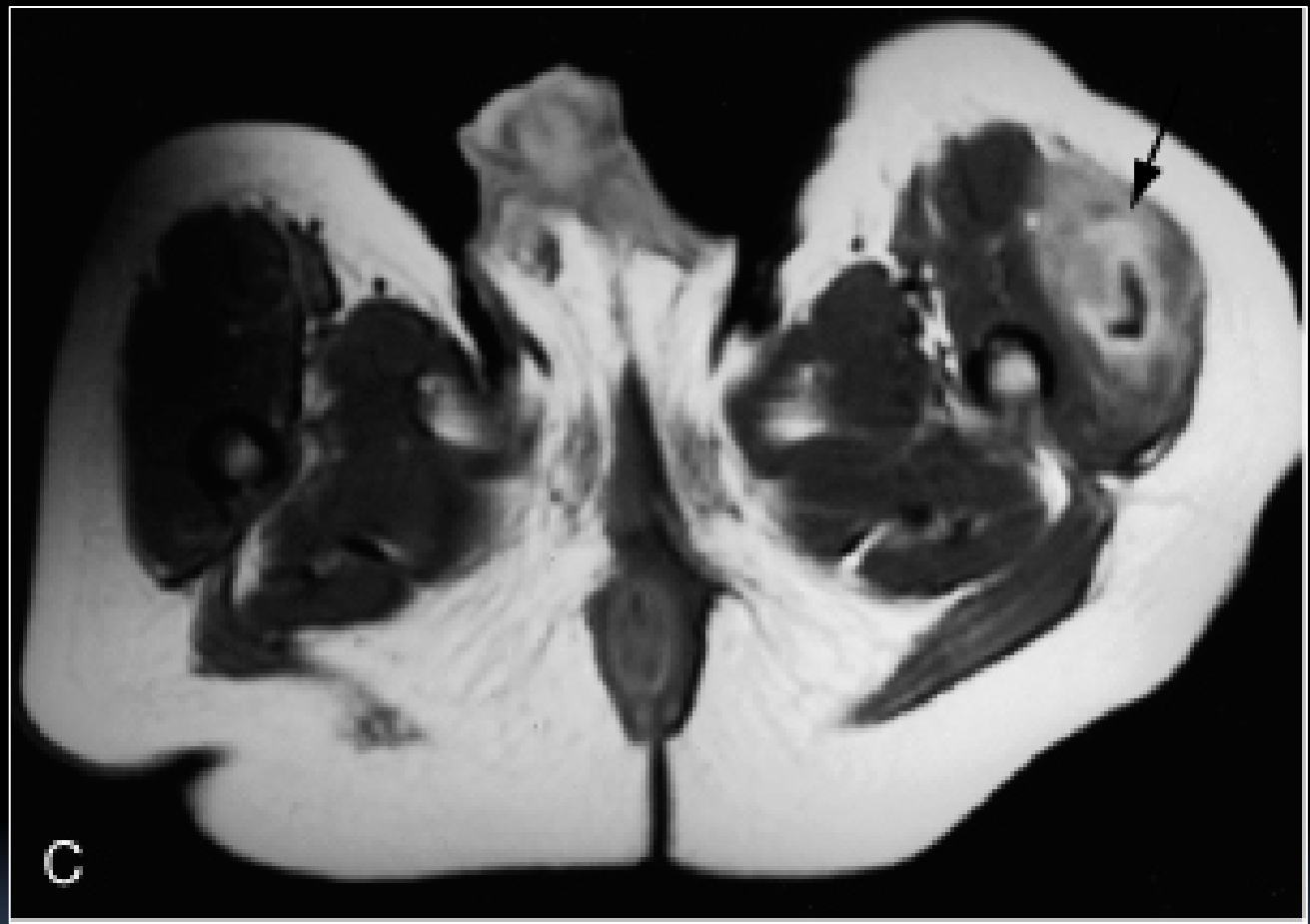


T1
POST GAD



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# OSTEOMYELITIS

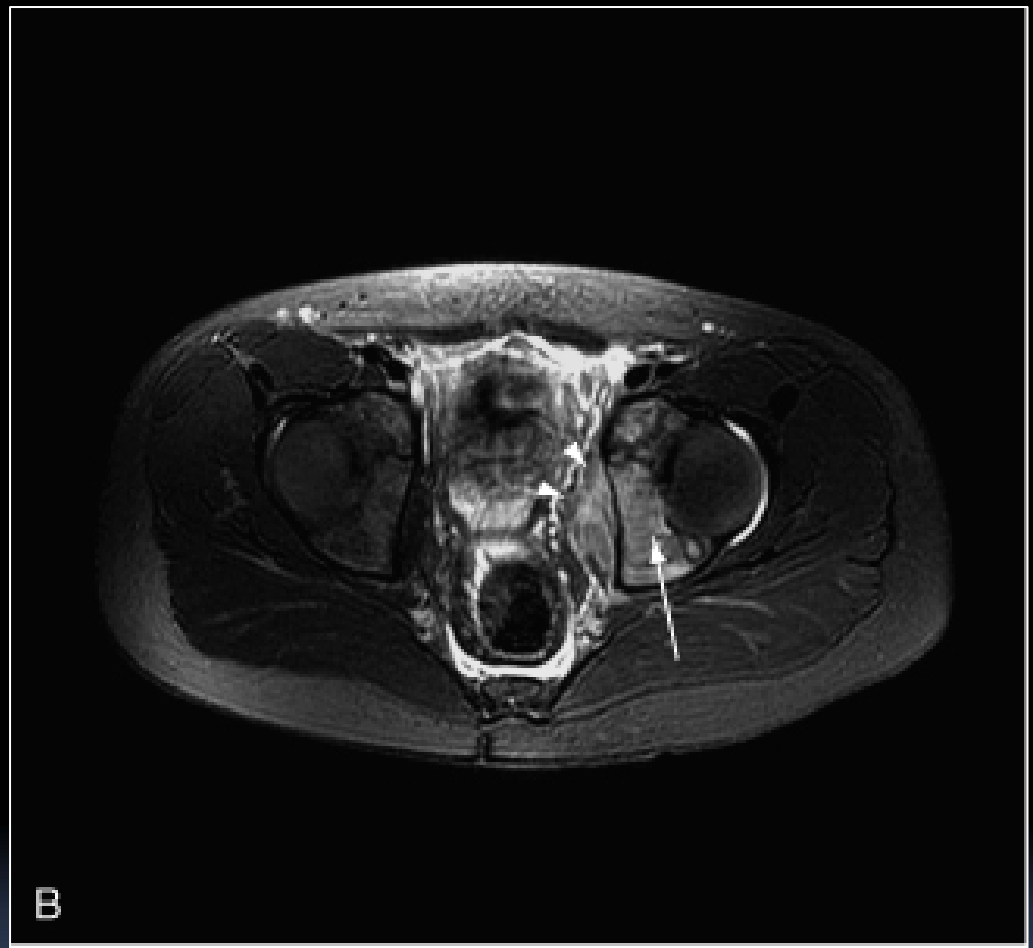
# OSTEOMYELITIS ON MR

- Marrow Edema
  - T1 dark
  - T2 bright
- Subperiosteal Collection
  - Surgical Drainage
- Sinus tract
  - Surgical Drainage




T1 LOW SIGNA
LEFT ACETAB

Figure 110-2 Acute osteomyelitis. A, Coronal T1-weighted image of the pelvis demonstrates decreased signal within the left acetabulum (arrows) as a result of acute osteomyelitis. B, Axial T2-weighted image at the same level demonstrates characteristic high signal from marrow edema within the left acetabulum (arrows) and associated soft-tissue inflammatory changes involving the left obturator internus (arrowheads).






T2 INC
SIGNAL
Ax image
At same level

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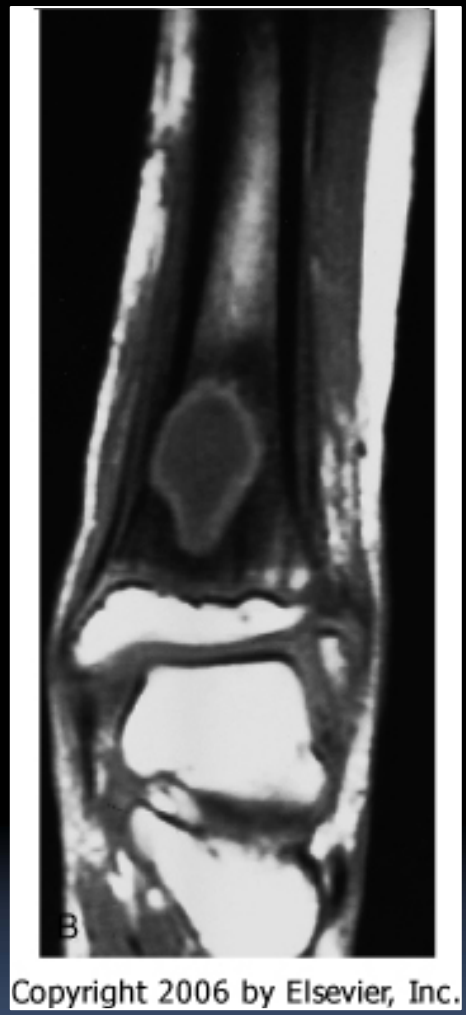
# CHRONIC OSTEO WITH TRACT, T1 AND GAD CORTEX THICK AT SITE OF TRACT




Figure 110-3 Chronic osteomyelitis with sinus tract formation. Coronal T1-weighted (600/20) image before contrast enhancement (A) and axial T1-weighted (600/12) image after contrast enhancement (B) demonstrate cortical thickening of the femoral diaphysis with a curvilinear sinus tract (arrow) extending from the marrow space to an adjacent area of soft-tissue signal abnormality. The orientation and location of the tract are well demonstrated.


Figure 110-4 Brodie's abscess. A, Plain radiograph demonstrates localized lucent defect in the distal tibial metaphysis and adjacent periosteal reaction (arrow). B, Coronal T1-weighted (500/12) image demonstrates abscess cavity as well as more extensive marrow signal abnormality not seen on the plain radiograph.

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# Femoroacetabular Impingement

# FEMOROACETABULAR IMPINGEMENT

- Cause of Early Onset DJD
- Characteristic Clinical, Physical, Radiologic Findings
- May Present as Young Adults…Sharp, Intermittent Groin Pain
  - Exacerbated by Physical Activity
  - Exacerbated by Sitting for a Prolonged Period
- Positive Impingement Test
  - Pain during HIP FLEXION and INTERNAL ROTATION

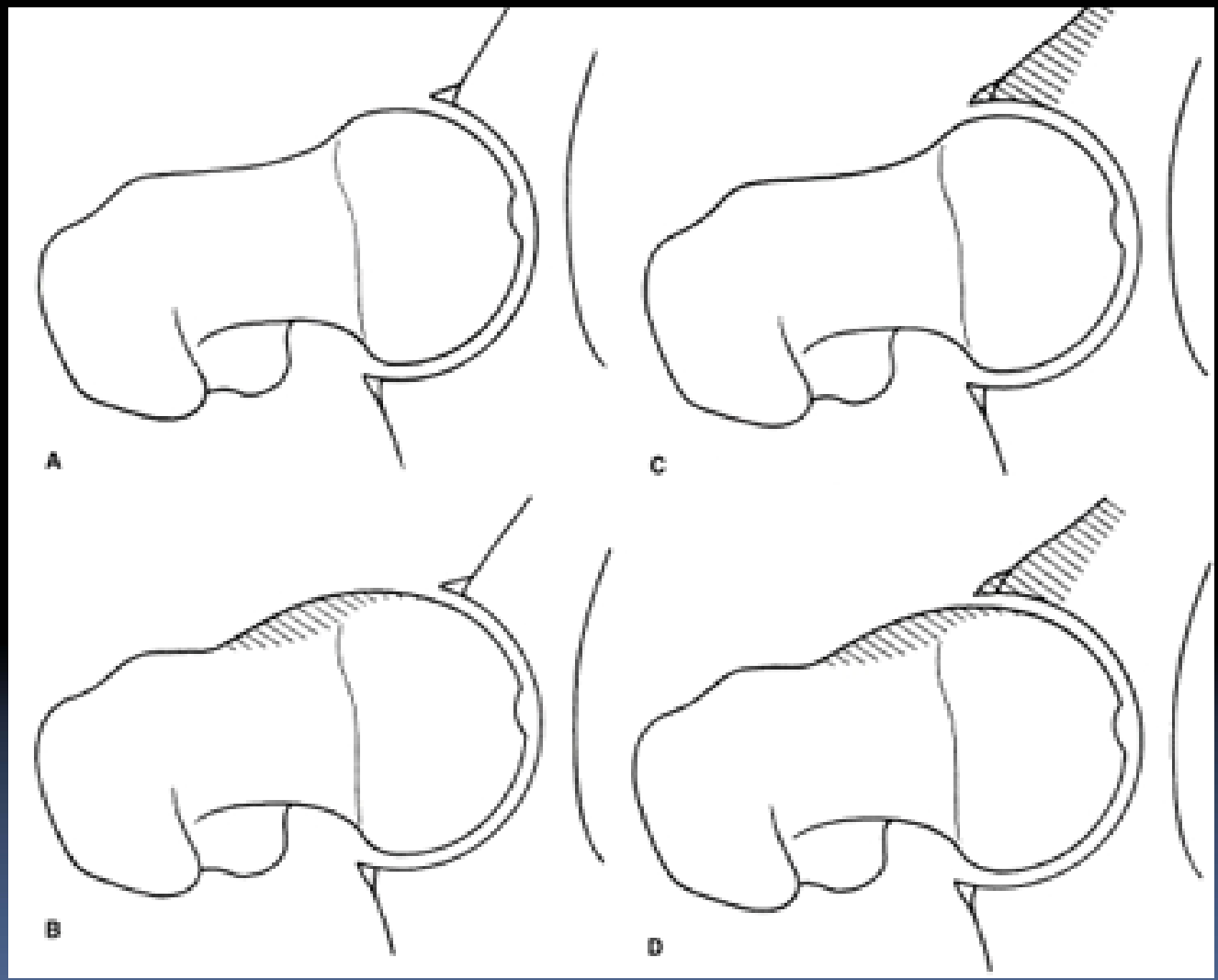
# FEMORACETABULAR IMPINGEMENT

CAM (Femoral)

PINCER (Acetabular)

NORMAL

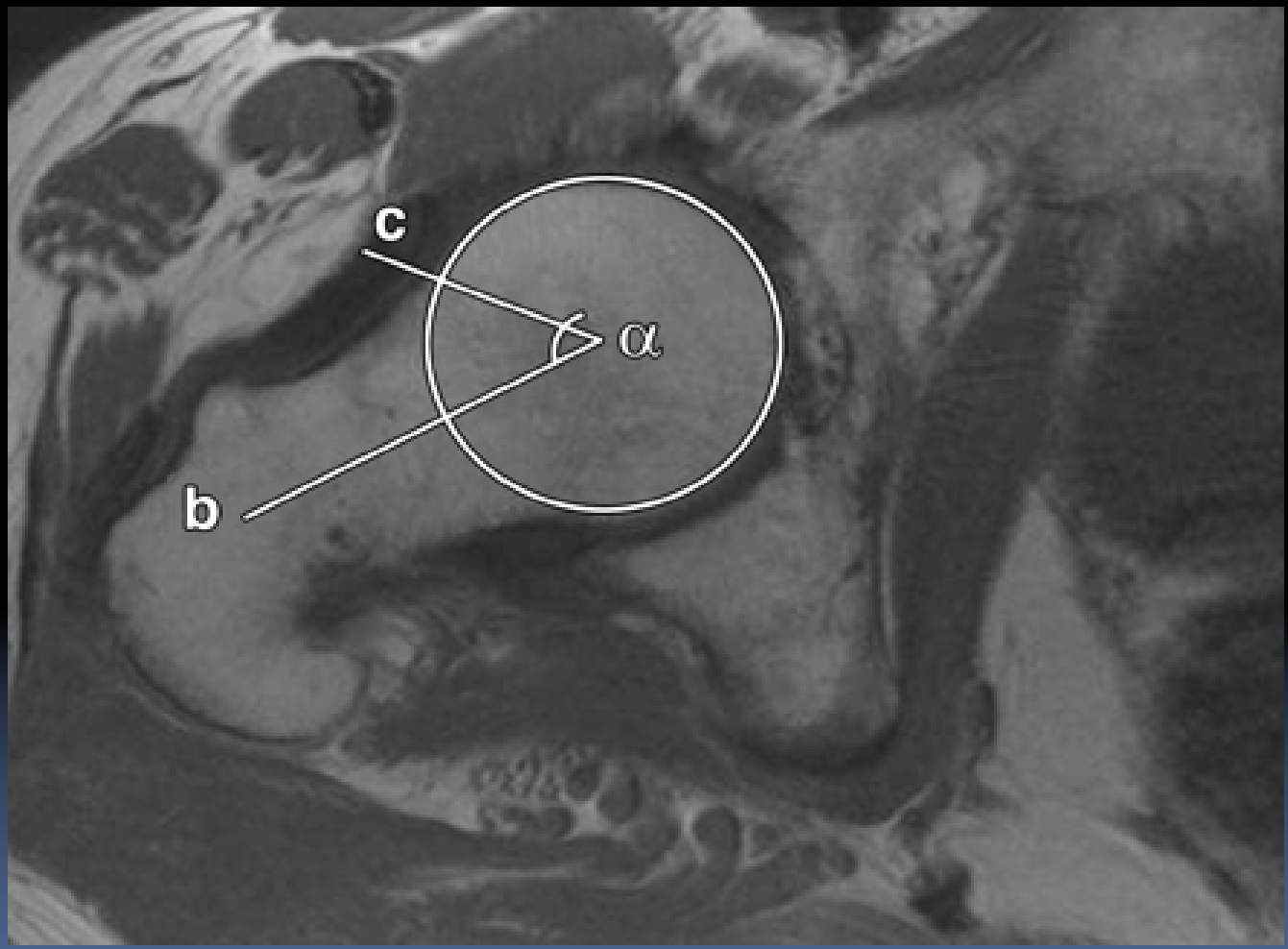
PINCER




CAM

MIXED

# ALPHA ANGLE



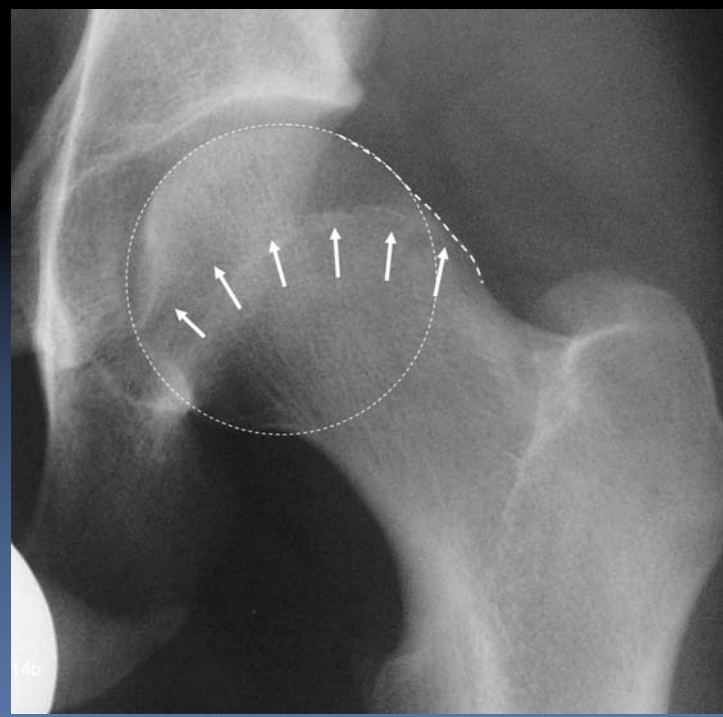
# CAM TYPE

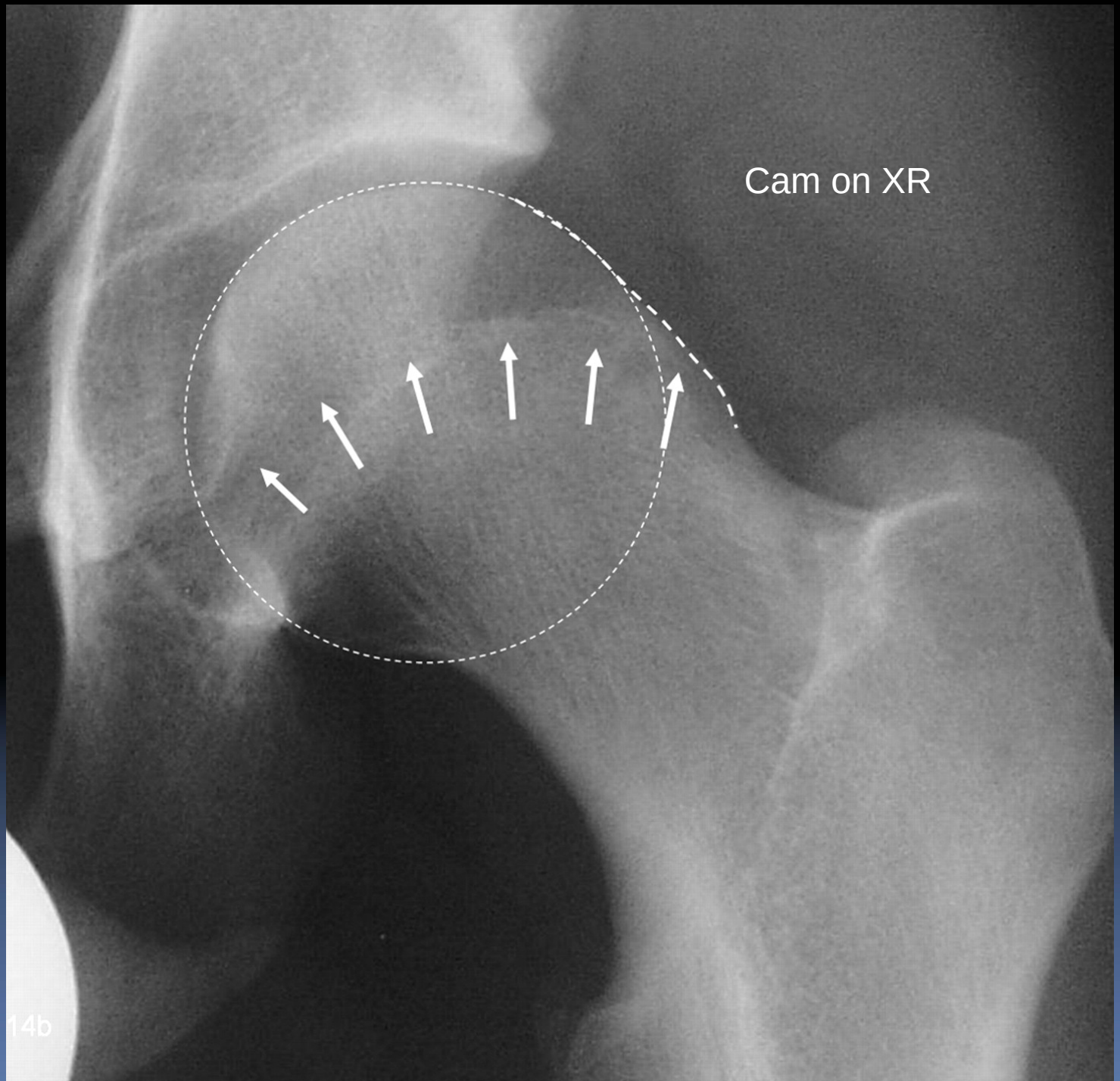
Abnormal Morphology of Femoral Head/Neck Junction

Decrease in Normal Concavity

I.E. alpha angle > 55 degrees

Abnormal Contact of Femur with Rim

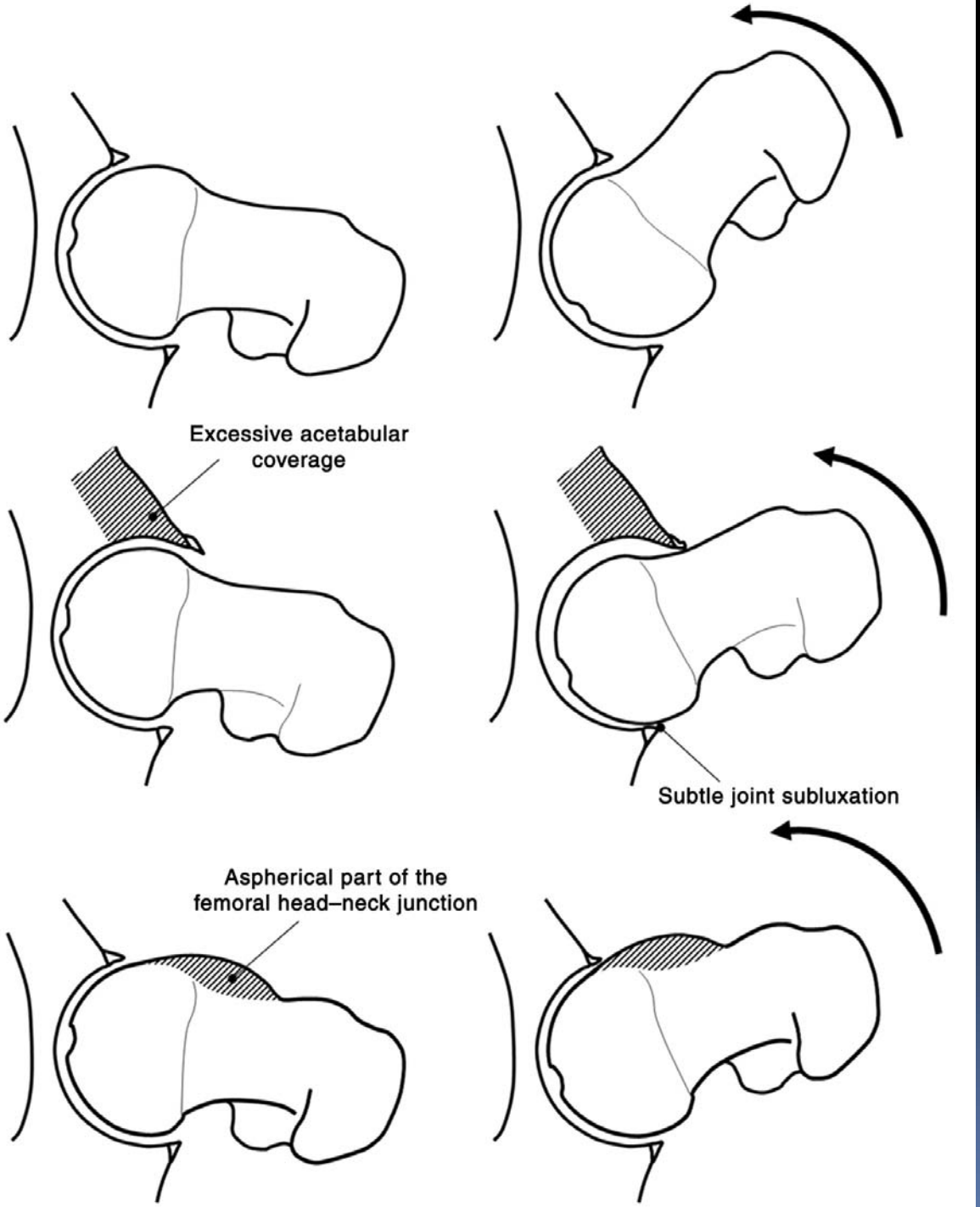



Cam on XR
14b

NORMAL

PINCER

CAM

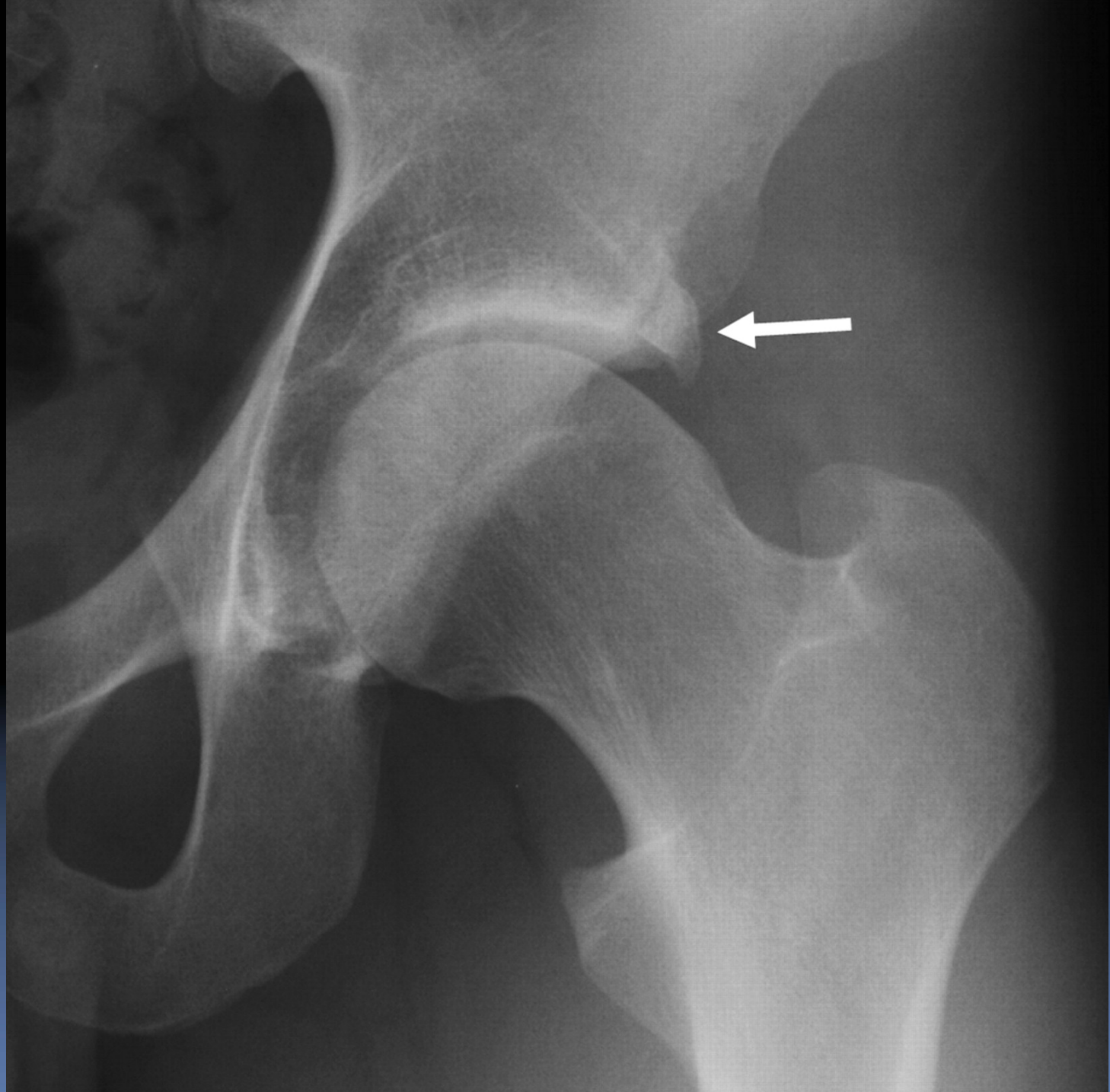


FEMOROACETABULAR IMPINGEMENT

# CAM TYPE

# MRI FINDINGS

- ALPHA ANGLE LARGE
- ANTEROSUPERIOR ACETABULAR CARTILAGE LESION
- ANTEROSUPERIOR ACETABULAR LABRAL TEAR



Secondary Signs of cam Impingement

FEMOROACETABULAR IMPINGEMENT

# PINCER

Linear Contact Between Acetabular Rim and Femur

Usually Secondary to Acetabular Overcoverage

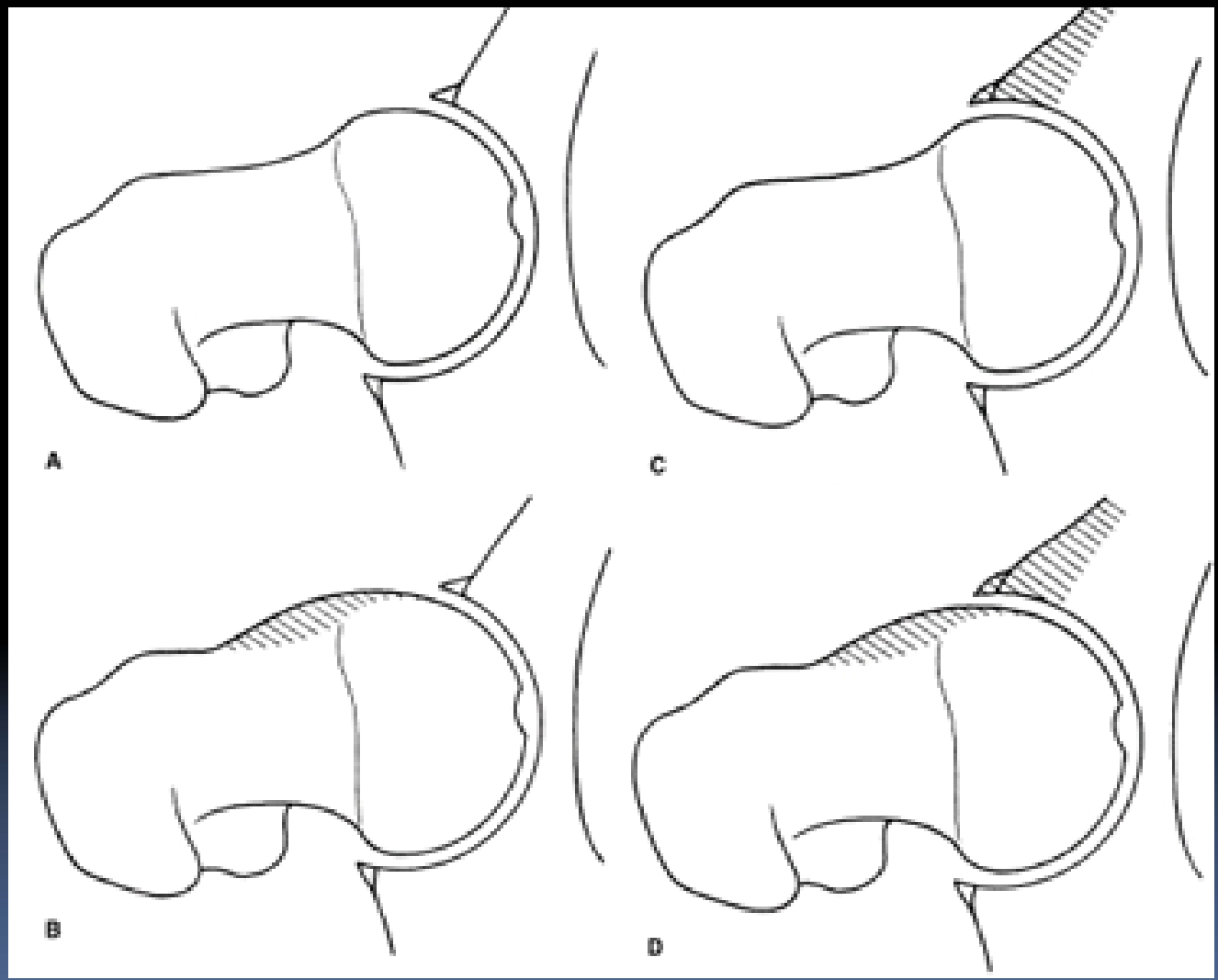
Coxa Profunda

Acetabular Retroversion

Protrusion Acetabuli

NORMAL

PINCER



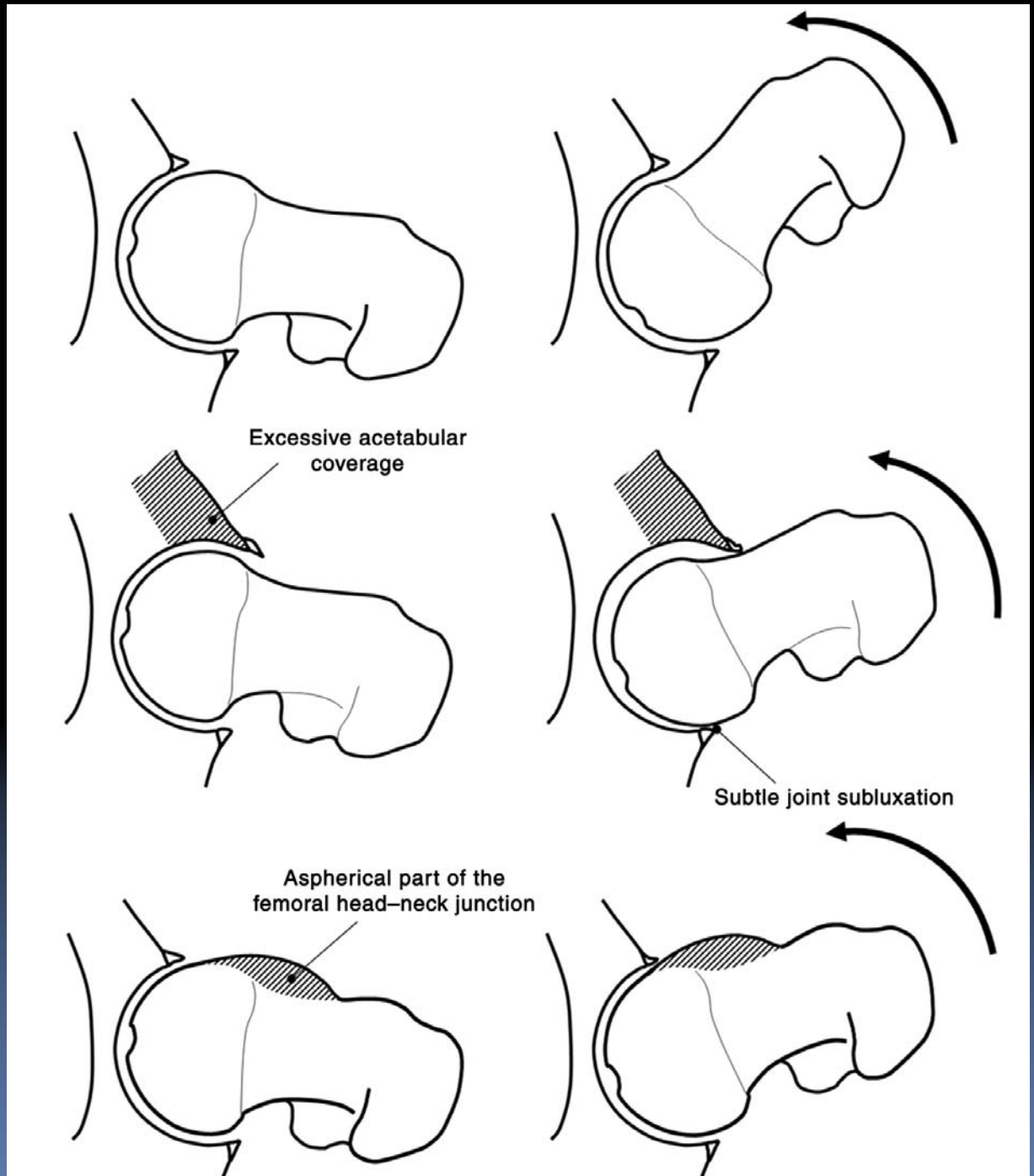

CAM

MIXED

NORMAL

PINCER

CAM



FEMOROACETABULAR IMPINGEMENT

# PINCER TYPE

Contact More Anteriorly Along Femoral Neck

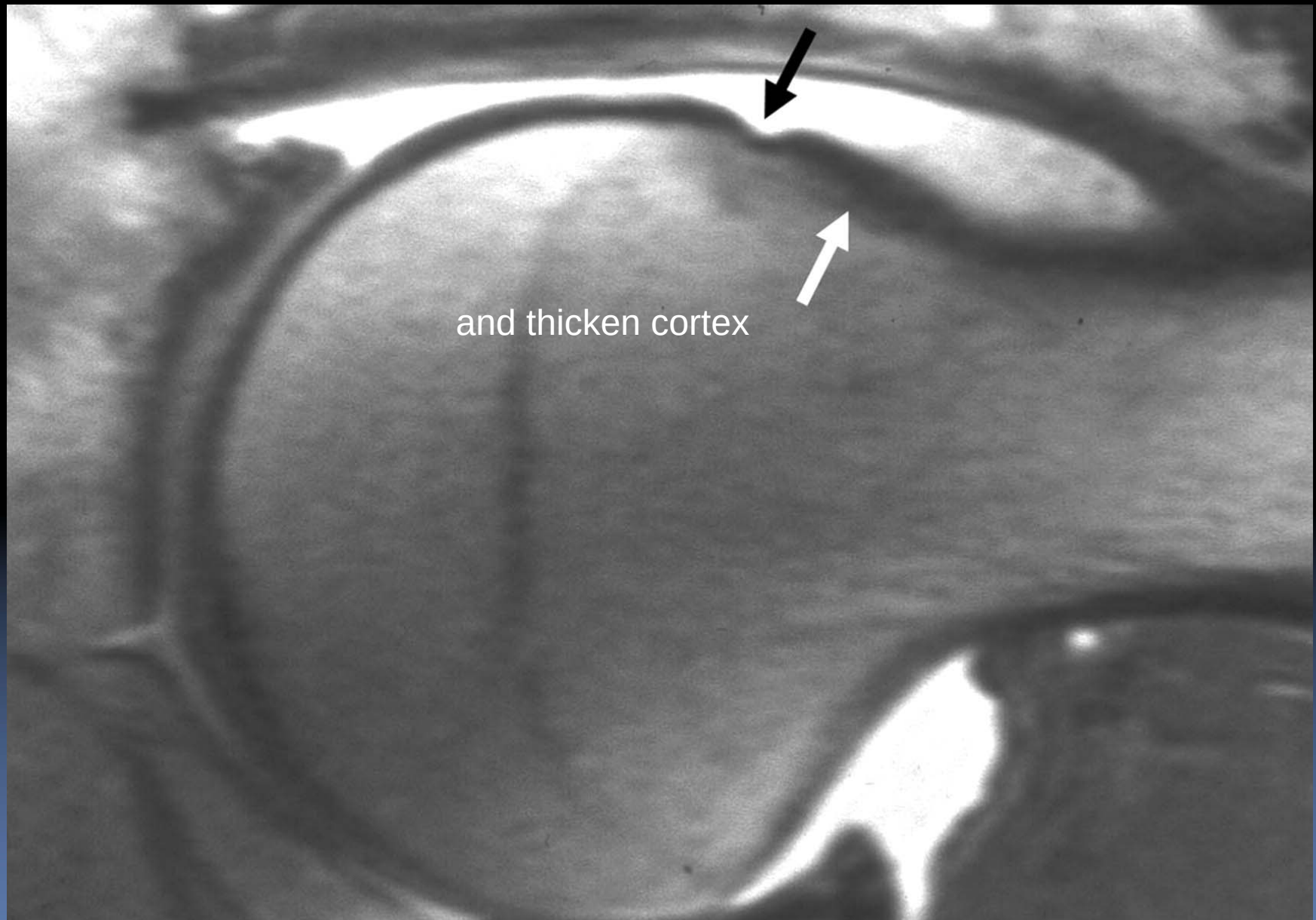
Degeneration of Labrum with Intralabral Cyst

or Ossification of Overhanging Rim

Minor Cartilage Lesions Along Acetabular Rim

and Posteroinferior Acetabulum

Pincer deformity will impact femur



FEMOROACETABULAR IMPINGEMENT

# PINCER TYPE

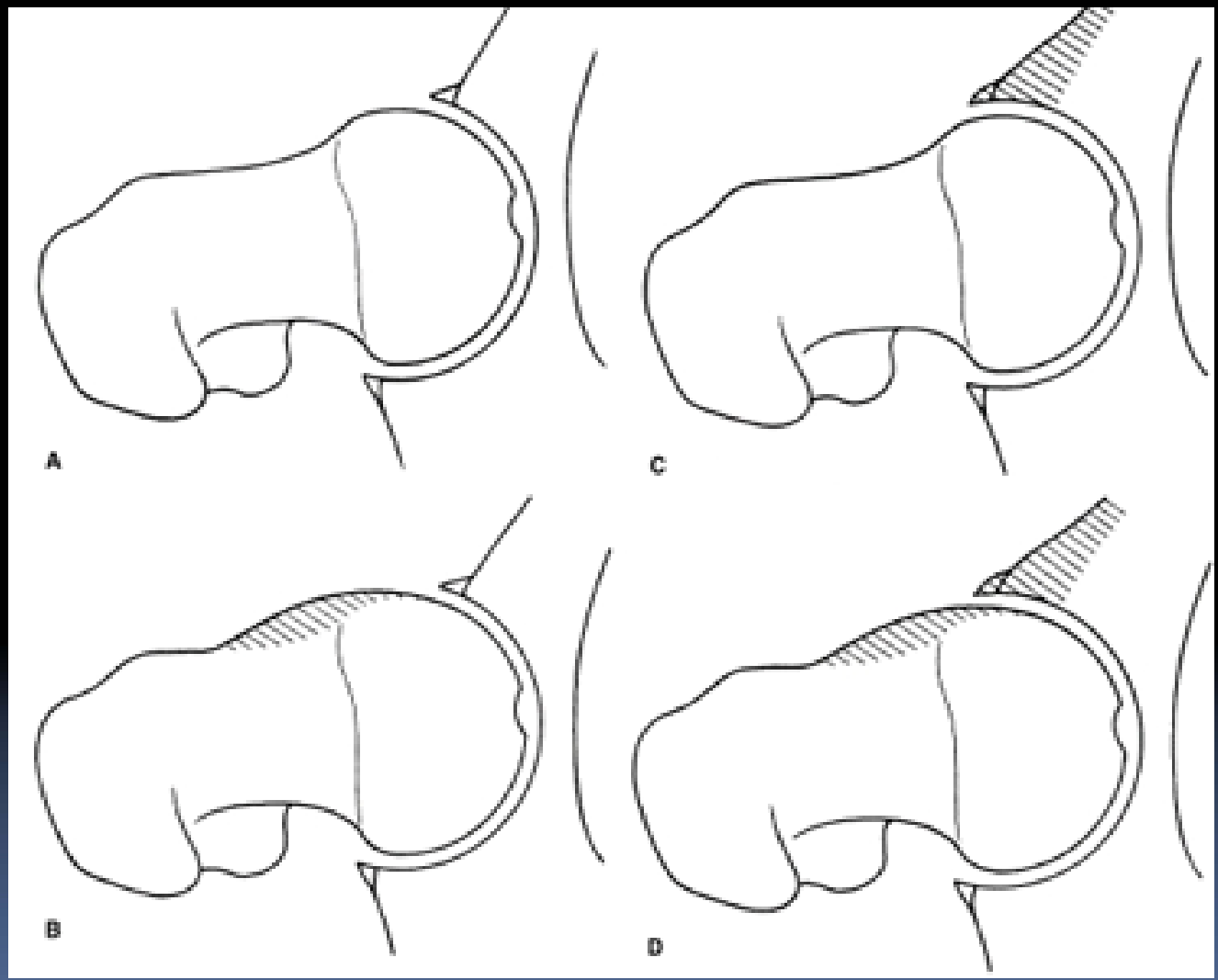
POSSIBLE ASSOC OF SYNOVIAL HERNIATION PITS AND FIBROCYSTIC CHANGE (UP TO 1/3)

ASSOCIATED WITH OS ACETABULI (SEEN IN UP TO 42 % WITH CAM IMPINGEMENT

HETEROTOPIC BONE FORMATION MAY BE DUE TO ABNORMAL CONTACT WITH FEMUR

NORMAL

PINCER




CAM

MIXED (MOST)


USA
39505
93378
83583

# LABRAL TEARS

CAUSE OF MECHANICAL HIP PAIN

REPORTED IN PATIENTS WITH DDH, LCP, OA, TRAUMA, FAI

HIGH PERCENTAGE OF PATIENTS WITH INTRAARTICULAR HIP PAIN FROM SYNOVITIS, LOOSE BODIES, AND CARTILAGE DEFECTS ALSO HAVE TEARS

# LABRAL TEARS

DETACHMENTS MORE COMMON THAN PARTIAL TEARS

CLASSIFY ACCORDING TO

LOCATION
- ANTERIOR MOST COMMON
- POST/SUP IN YOUNG
- POSTERIOR POST DISLOC/DYSPLASIA

ETIOLOGY
- DEGENERATIVE
- DYSPLASTIC
- TRAUMATIC
- IDIOPATHIC

MORPHOLOGY
- ASSOCIATION WITH CYSTS/CARTILAGE

NORMAL COR T2

ABNORMAL COR T2

# SUPEROLAT LEFT IRREGULAR ON COR T2




Figure 102-51 Labral cyst with acetabular labral tear involving the left hip in a 35-year-old male with chronic hip pain. A, Coronal fat-saturated T2-weighted image. The superior lateral aspect of the left acetabular labrum is markedly irregular in contour, consistent with degeneration and tear. B, Coronal fat-saturated T1-weighted image obtained following intravenous administration of gadolinium contrast material. The complex tear of the superior lateral aspect of the left acetabular labrum is outlined by gadolinium within the synovial fluid. Adjacent superior lateral acetabular osseous reaction is present. Note the normal appearance of the right acetabular labrum. C, Coronal fat-saturated T2-weighted image. A rounded, hyperintense labral cyst is identified adjacent to the posterior superior margin of the left acetabulum, immediately posterior to the labral tear. D, Coronal fat-saturated T1-weighted image obtained with indirect arthrography. The posterior superior lateral labral cyst does not exhibit internal diffusion of gadolinium contrast to the extent observed within the hip joint. Communication between a labral cyst and the joint does not necessarily persist. Enhancement of the soft-tissue adjacent to the cyst is observed, indicative of chronic angiofibroblastic reaction.

# T1 POST IV GAD (INDIRECT) – LABRAL CYST LEFT

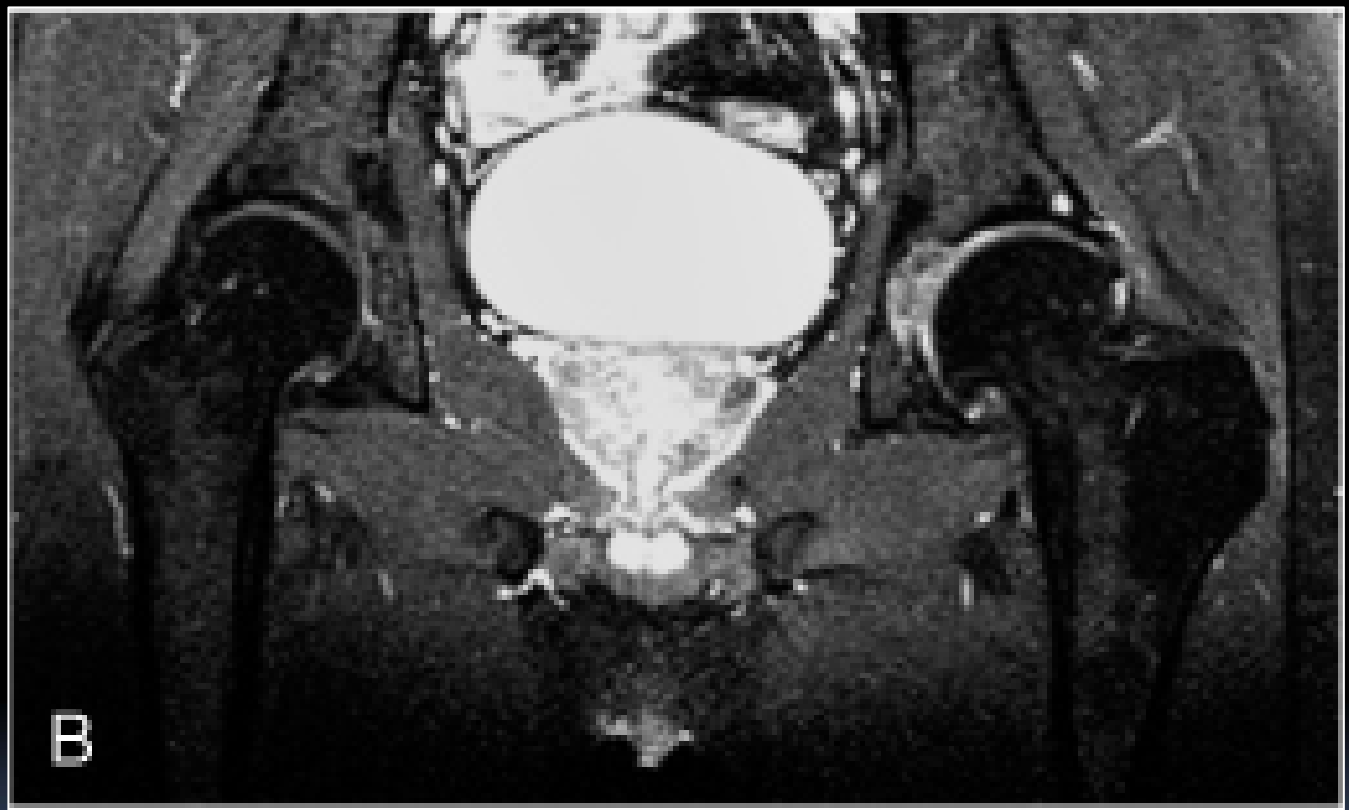





Figure 102-51 Labral cyst with acetabular labral tear involving the left hip in a 35-year-old male with chronic hip pain. A, Coronal fat-saturated T2-weighted image. The superior lateral aspect of the left acetabular labrum is markedly irregular in contour, consistent with degeneration and tear. B, Coronal fat-saturated T1-weighted image obtained following intravenous administration of gadolinium contrast material. The complex tear of the superior lateral aspect of the left acetabular labrum is outlined by gadolinium within the synovial fluid. Adjacent superior lateral acetabular osseous reaction is present. Note the normal appearance of the right acetabular labrum. C, Coronal fat-saturated T2-weighted image. A rounded, hyperintense labral cyst is identified adjacent to the posterior superior margin of the left acetabulum, immediately posterior to the labral tear. D, Coronal fat-saturated T1-weighted image obtained with indirect arthrography. The posterior superior lateral labral cyst does not exhibit internal diffusion of gadolinium contrast to the extent observed within the hip joint. Communication between a labral cyst and the joint does not necessarily persist. Enhancement of the soft-tissue adjacent to the cyst is observed, indicative of chronic angiofibroblastic reaction.

LABRAL CYST ON COR T2… NO GAD

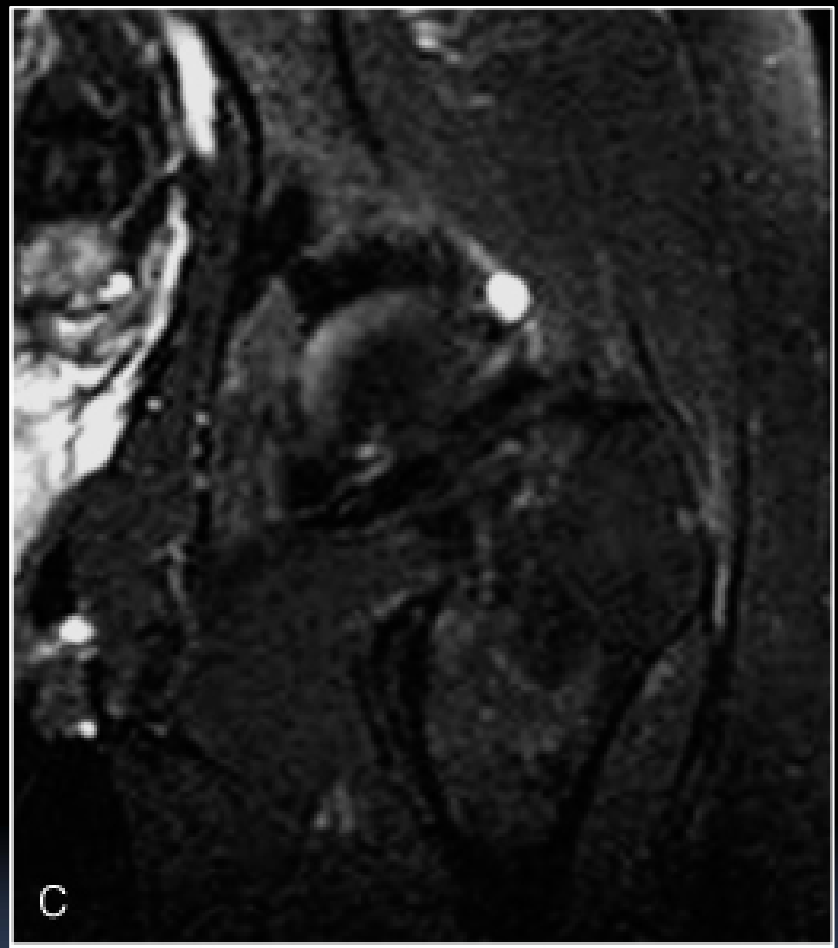





Figure 102-51 Labral cyst with acetabular labral tear involving the left hip in a 35-year-old male with chronic hip pain. A, Coronal fat-saturated T2-weighted image. The superior lateral aspect of the left acetabular labrum is markedly irregular in contour, consistent with degeneration and tear. B, Coronal fat-saturated T1-weighted image obtained following intravenous administration of gadolinium contrast material. The complex tear of the superior lateral aspect of the left acetabular labrum is outlined by gadolinium within the synovial fluid. Adjacent superior lateral acetabular osseous reaction is present. Note the normal appearance of the right acetabular labrum. C, Coronal fat-saturated T2-weighted image. A rounded, hyperintense labral cyst is identified adjacent to the posterior superior margin of the left acetabulum, immediately posterior to the labral tear. D, Coronal fat-saturated T1-weighted image obtained with indirect arthrography. The posterior superior lateral labral cyst does not exhibit internal diffusion of gadolinium contrast to the extent observed within the hip joint. Communication between a labral cyst and the joint does not necessarily persist. Enhancement of the soft-tissue adjacent to the cyst is observed, indicative of chronic angiofibroblastic reaction.

CORONAL T2 IRREG UNDER RIGHT

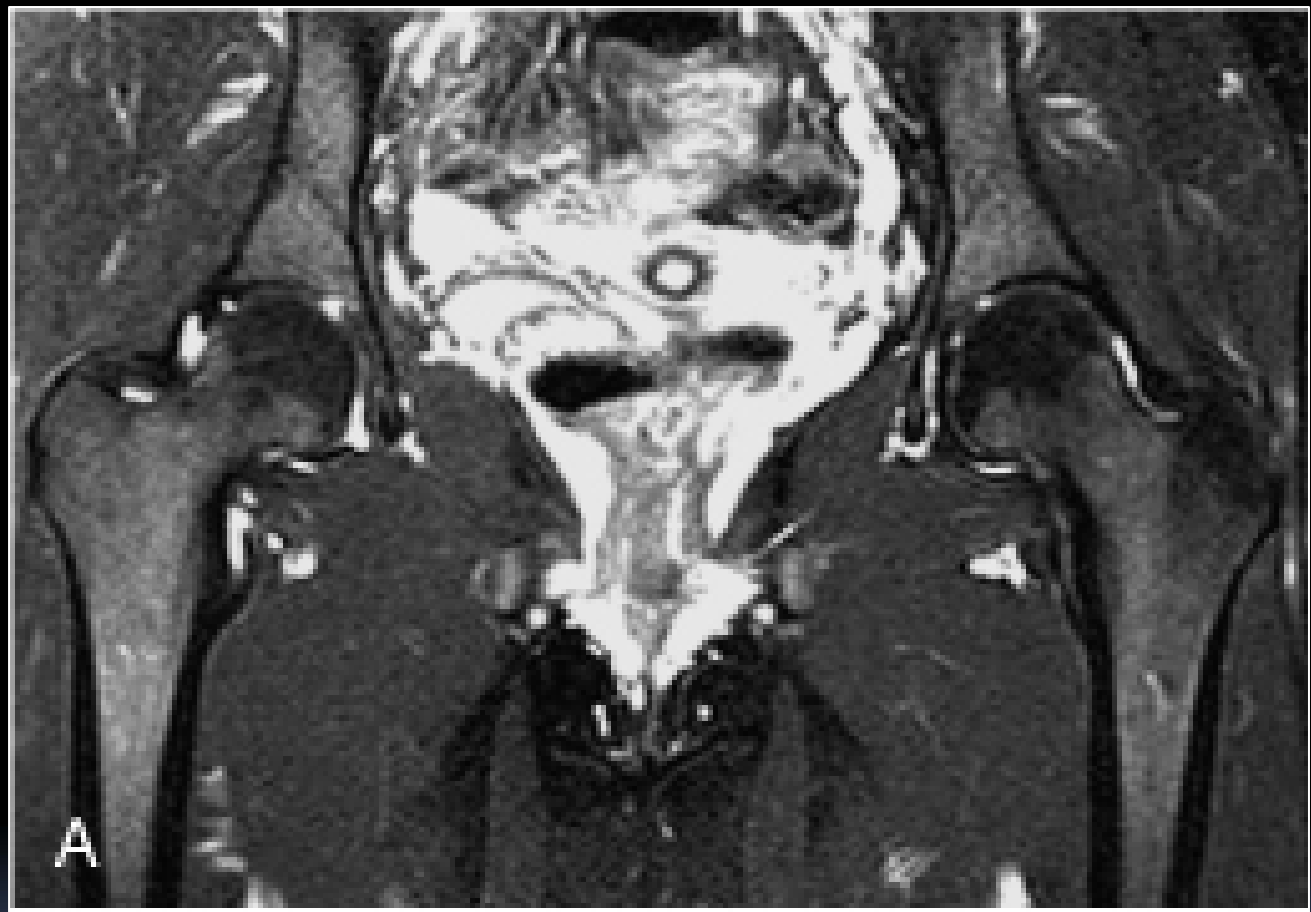





Figure 102-54 Acetabular labral tear involving the right hip in a 27-year-old female with groin pain, surgically proven. A, Coronal fat-saturated T2-weighted image. Hyperintense synovial fluid penetrates into the undersurface of the right acetabular labrum. A small right hip joint effusion is present. Note the normal left acetabular labrum for comparison. B, Coronal fat-saturated T1-weighted image obtained following the intravenous administration of gadolinium contrast material. The tear of the undersurface of the right acetabular labrum is defined by diffusion of gadolinium into the synovial fluid.

Osteochond Frag post Right

post trauma




Figure 102-52 Acetabular osteochondral fragmentation related to posterior hip dislocation on the right. A, Axial T1-weighted image. An osteochondral fracture involving the posterior aspect of the right acetabulum is identified (compare to the normal posterior left acetabulum). B, Coronal STIR image. Slight lateral displacement of the osteochondral fragment is identified and marrow edema involves the posterior lateral aspect of the right acetabulum adjacent to the fracture.

# LABRAL TEARS

## PITFALLS

- Technique
- Anatomy
- DDH
- LCP/AVN
- SCFE
- Dermatomyositis
- Infection
    - Arthritis vs Myositis vs Osteo
- Femoroacetabular Impingement
- Labral Tears

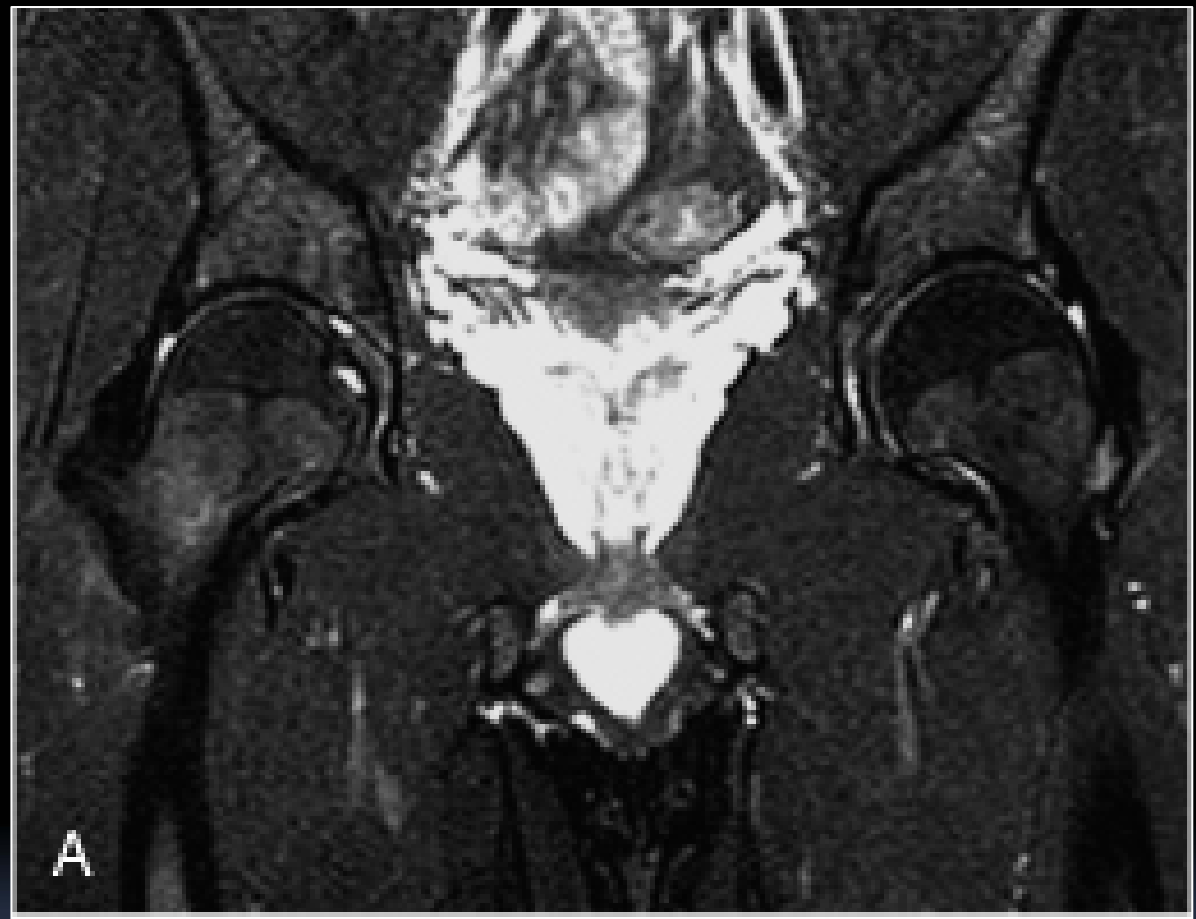





Figure 102-53 Acetabular labral tear of the left hip in a 45-year-old male martial arts competitor, surgically proven. A, Coronal fat-saturated T2-weighted image. A hyperintense tear of the superior lateral aspect of the left acetabular labrum is identified. The right acetabular labrum is normal in contour and signal intensity. B, Cropped image of the left hip from A. Abnormal hyperintense signal intensity, indicative of tear, interrupts the acetabular labrum.

CORONAL
T2 ABNORMAL
SUPEROLAT
LEFT




Figure 102-53 Acetabular labral tear of the left hip in a 45-year-old male martial arts competitor, surgically proven. A, Coronal fat-saturated T2-weighted image. A hyperintense tear of the superior lateral aspect of the left acetabular labrum is identified. The right acetabular labrum is normal in contour and signal intensity. B, Cropped image of the left hip from A. Abnormal hyperintense signal intensity, indicative of tear, interrupts the acetabular labrum.

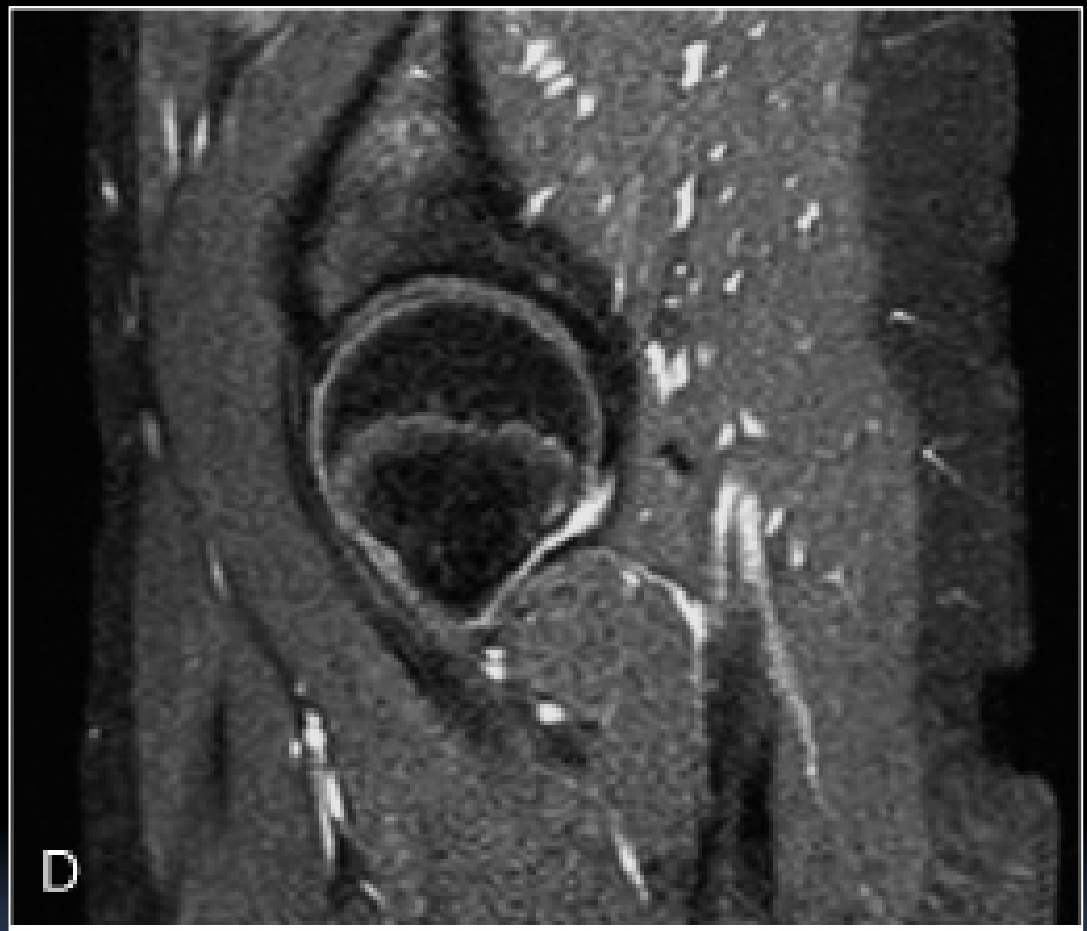





Figure 102-50 Normal acetabular labrum. A, Coronal fat-saturated T2-weighted image. The triangular, hypointense superior lateral aspect of the acetabular labrum is outlined by fluid within the hip joint. B, Coronal, fat-saturated T1-weighted image obtained following direct gadolinium arthrography. Intra-articular administration of a gadolinium contrast solution distends the joint capsule and demonstrates normal superior lateral acetabular labral morphology. C, Coronal fat-saturated T1-weighted image obtained with indirect arthrography. Diffusion of gadolinium contrast into the hip joint following intravenous injection defines the surface of the labrum and articular cartilage. D, Sagittal, fat-saturated T1-weighted image following indirect (intravenous) gadolinium arthrography. Note the normal contour of the acetabular articular cartilage.




Figure 102-54 Acetabular labral tear involving the right hip in a 27-year-old female with groin pain, surgically proven. A, Coronal fat-saturated T2-weighted image. Hyperintense synovial fluid penetrates into the undersurface of the right acetabular labrum. A small right hip joint effusion is present. Note the normal left acetabular labrum for comparison. B, Coronal fat-saturated T1-weighted image obtained following the intravenous administration of gadolinium contrast material. The tear of the undersurface of the right acetabular labrum is defined by diffusion of gadolinium into the synovial fluid.