

Precourse

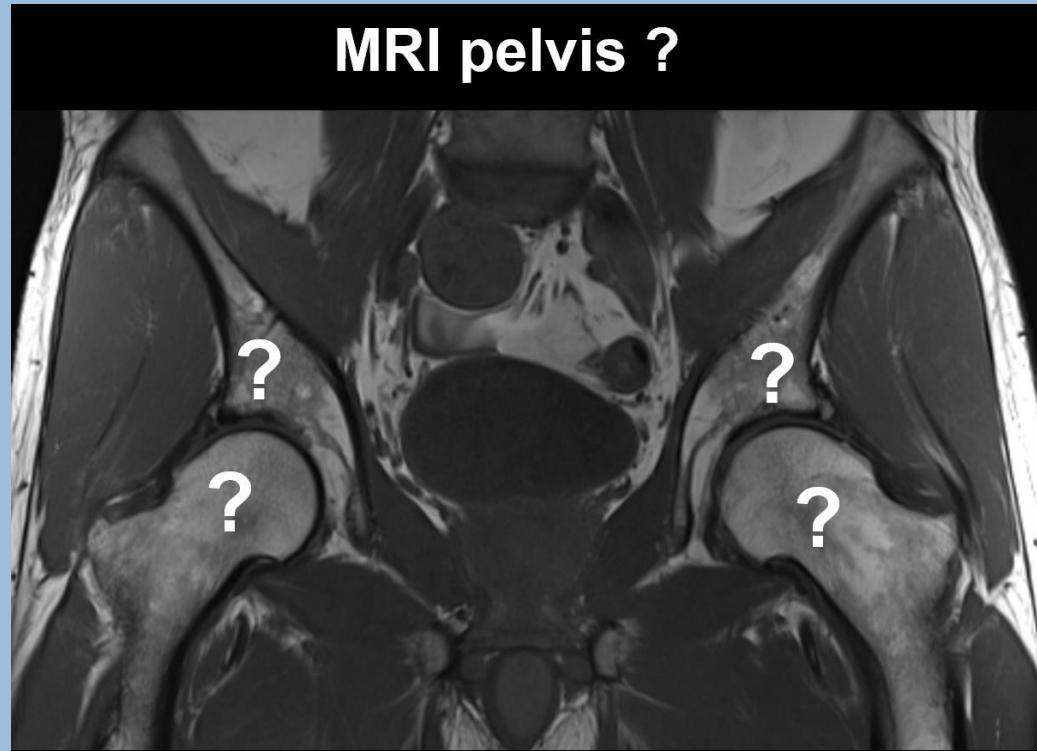
**Miss the forest for the trees:
MRI and intraoperative Correlation**

Florian Schmaranzer

Diagnostic-, Interventional- and Paediatric Radiology, Inselspital

MRI in joint preserving hip surgery: Which protocol?

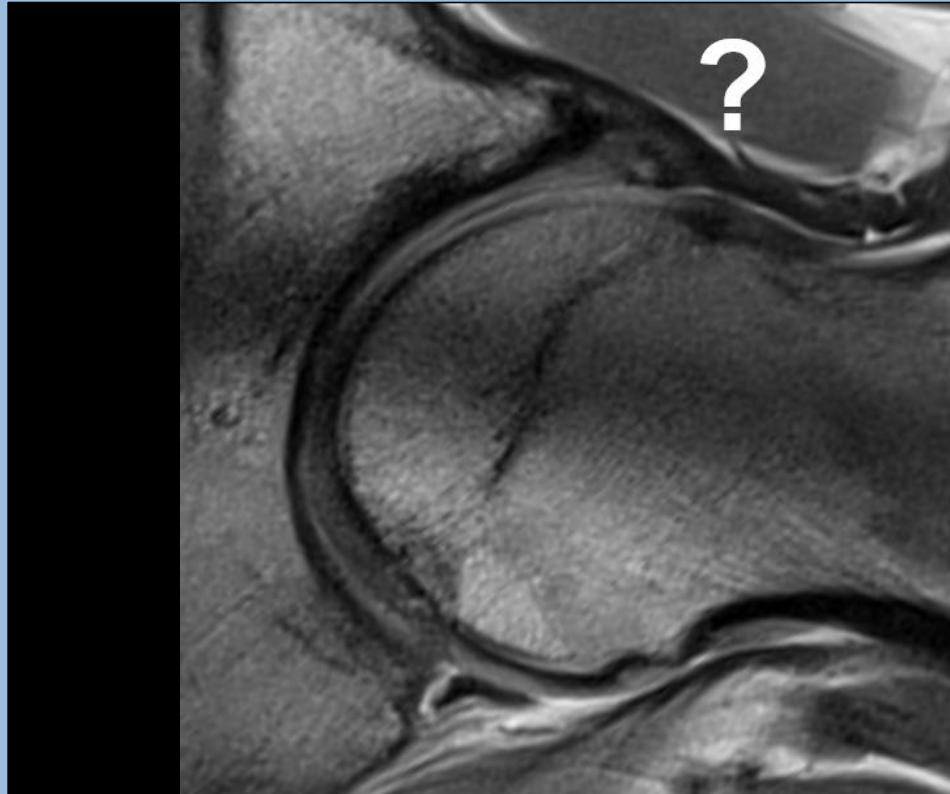
- > MRI pelvis ?
 - low resolution



MRI in joint preserving hip surgery: Which protocol?

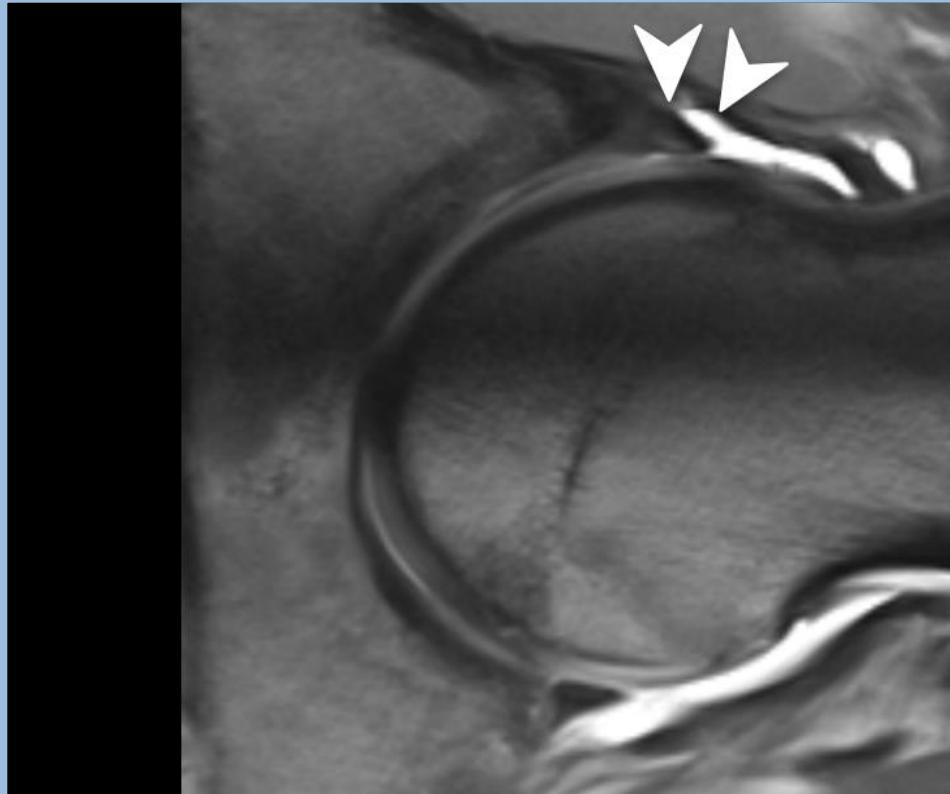
- > **MRI pelvis ?**
 - low resolution

- > **Non-contrast MRI hip**
 - high resolution
 - no joint distension



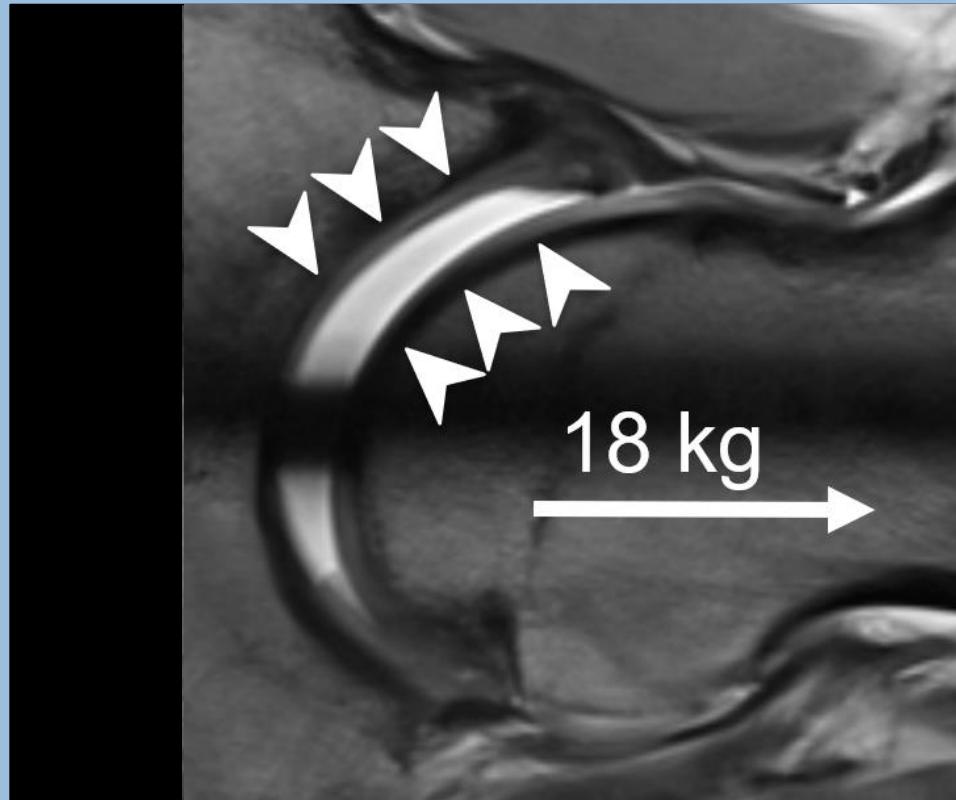
MRI in joint preserving hip surgery: Which protocol?

- > **MRI pelvis ?**
 - low resolution
- > **Non-contrast MRI hip**
 - high resolution
 - no joint distension
- > **MR arthrography**
 - outlines labrum + joint recess

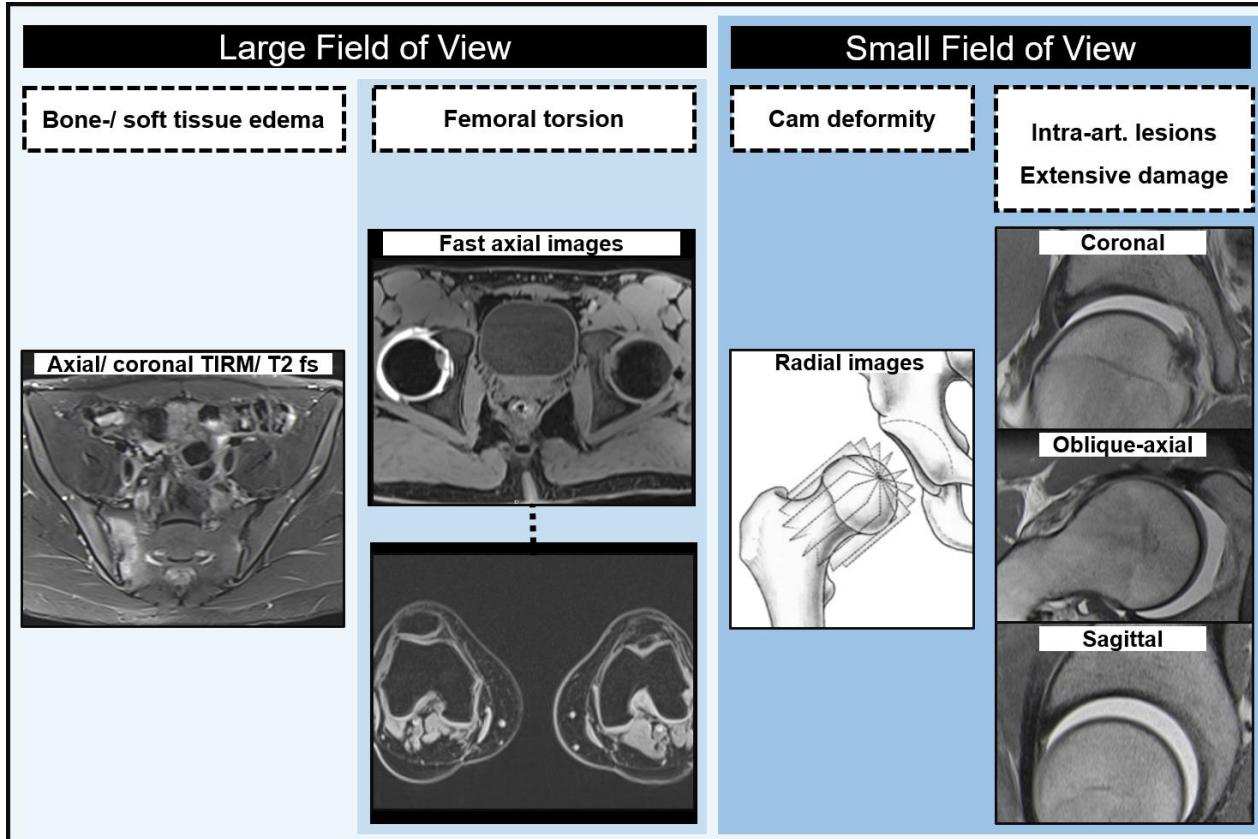


MRI in joint preserving hip surgery: Which protocol?

- > **MRI pelvis ?**
 - low resolution
- > **Non-contrast MRI hip**
 - high resolution
 - no joint distension
- > **MR arthrography**
 - outlines labrum + joint recess
- > **Traction MR arthrography**
 - outlines cartilage layers



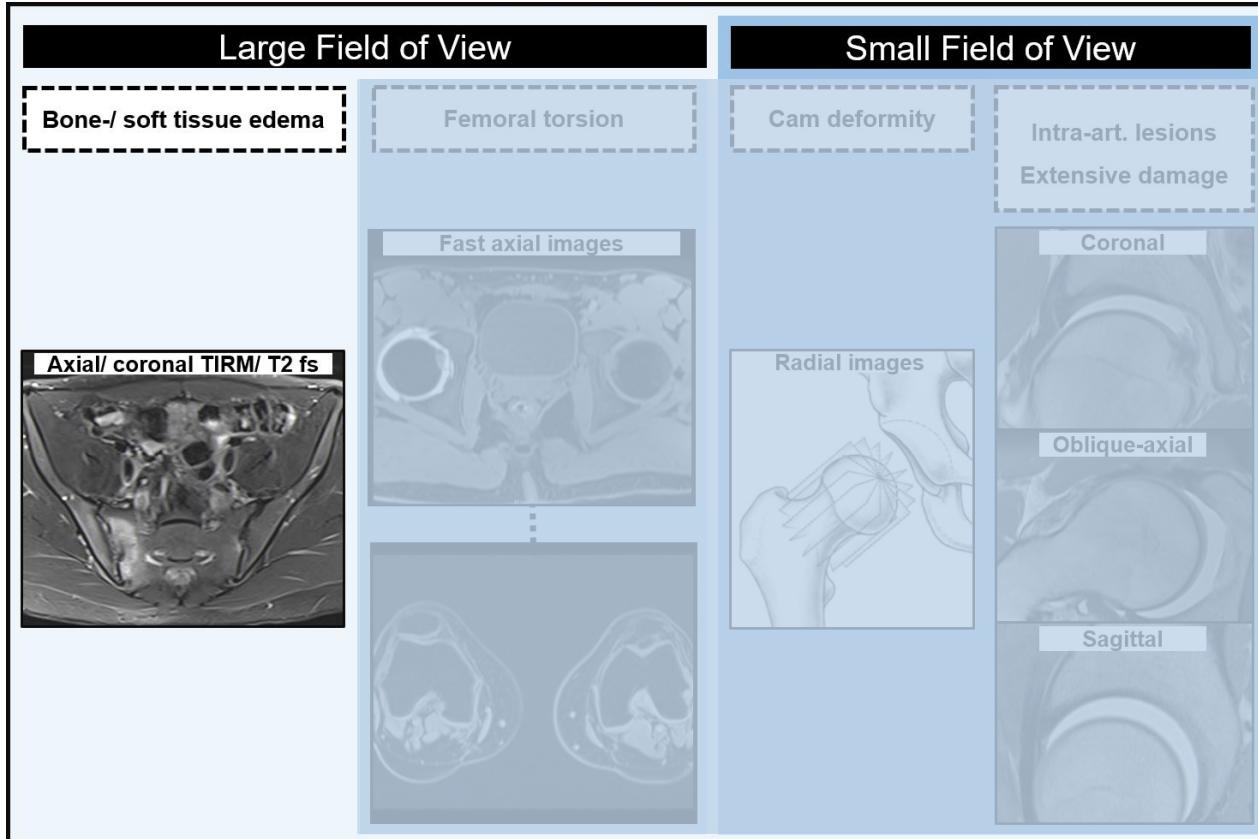
Recommended MRI Protocol of the hip



Mascarenhas V et al.
Eur Radiol 2022

Schmaranzer F et al.
AJR 2021

Recommended MRI Protocol of the hip

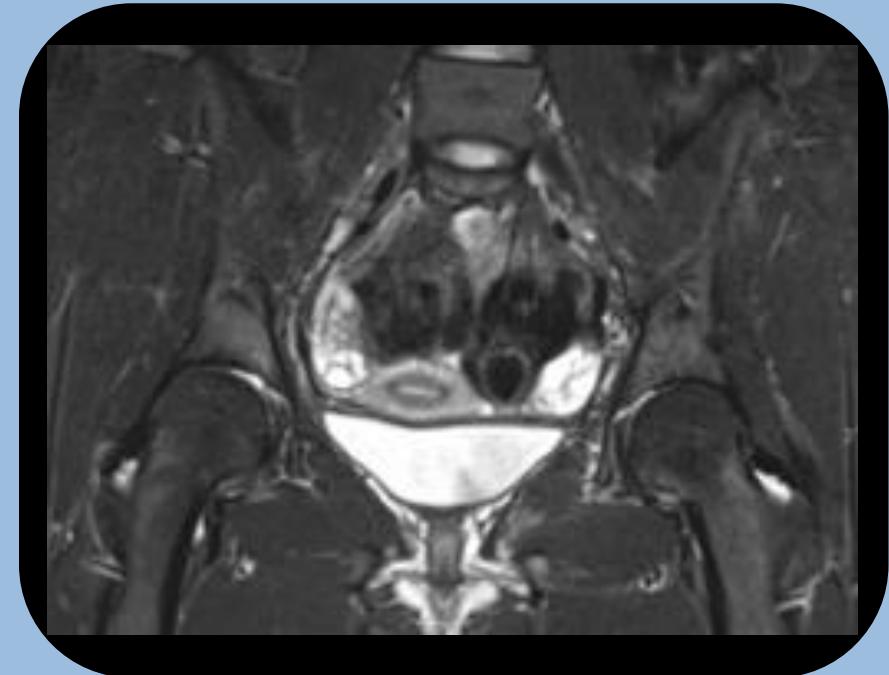


Mascarenhas V et al.
Eur Radiol 2022

Schmaranzer F et al.
AJR 2021

„Screening Image“

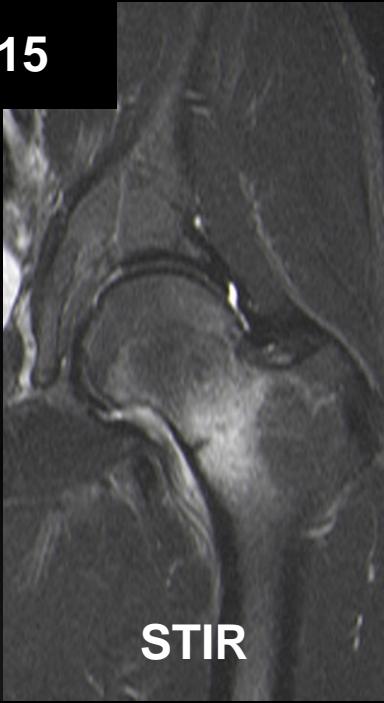
- > Coronal/ axial fluidsensitive sequence
 - T2 TSE fs, STIR
 - Leser trochanter – iliac wing
 - SAIS – sacrum



Stress injury



2015



STIR

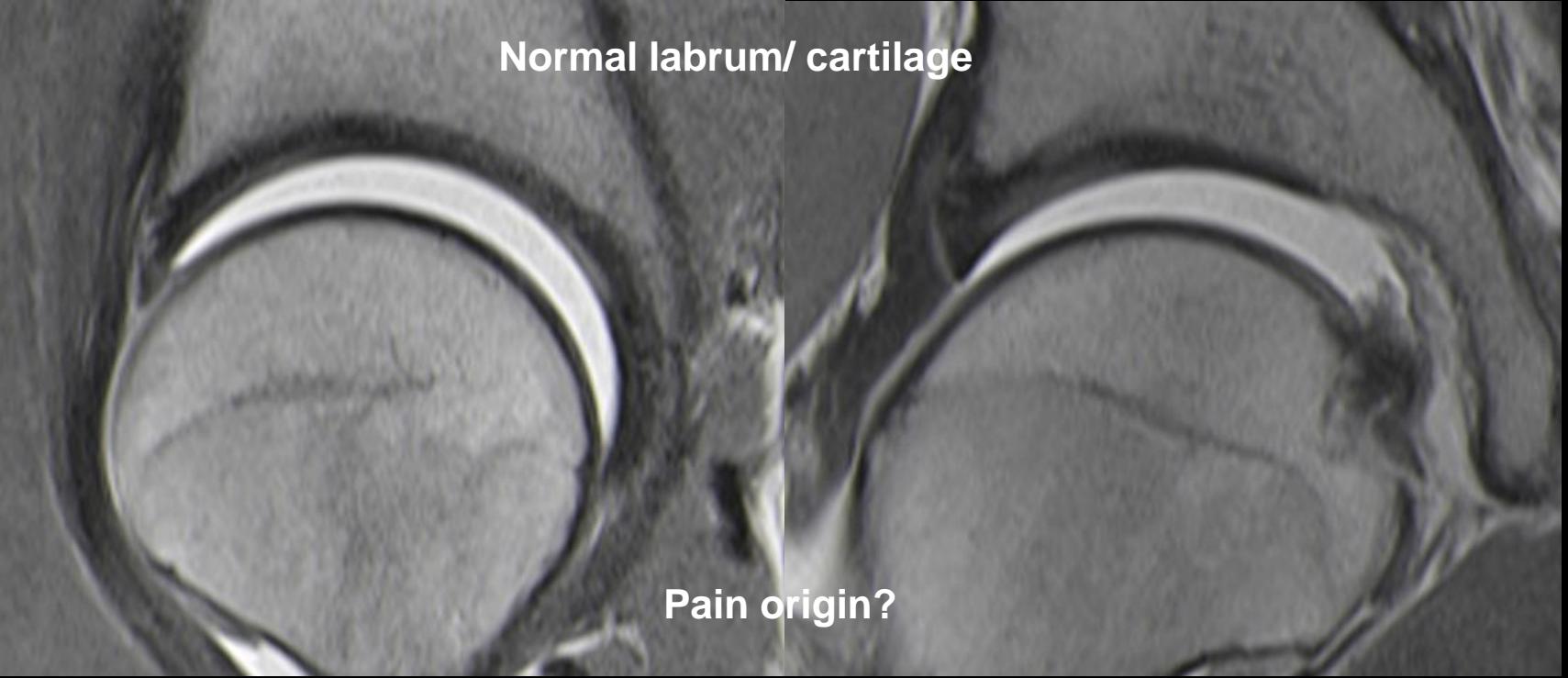
36y football player

Stress injury



24y back and groin pain





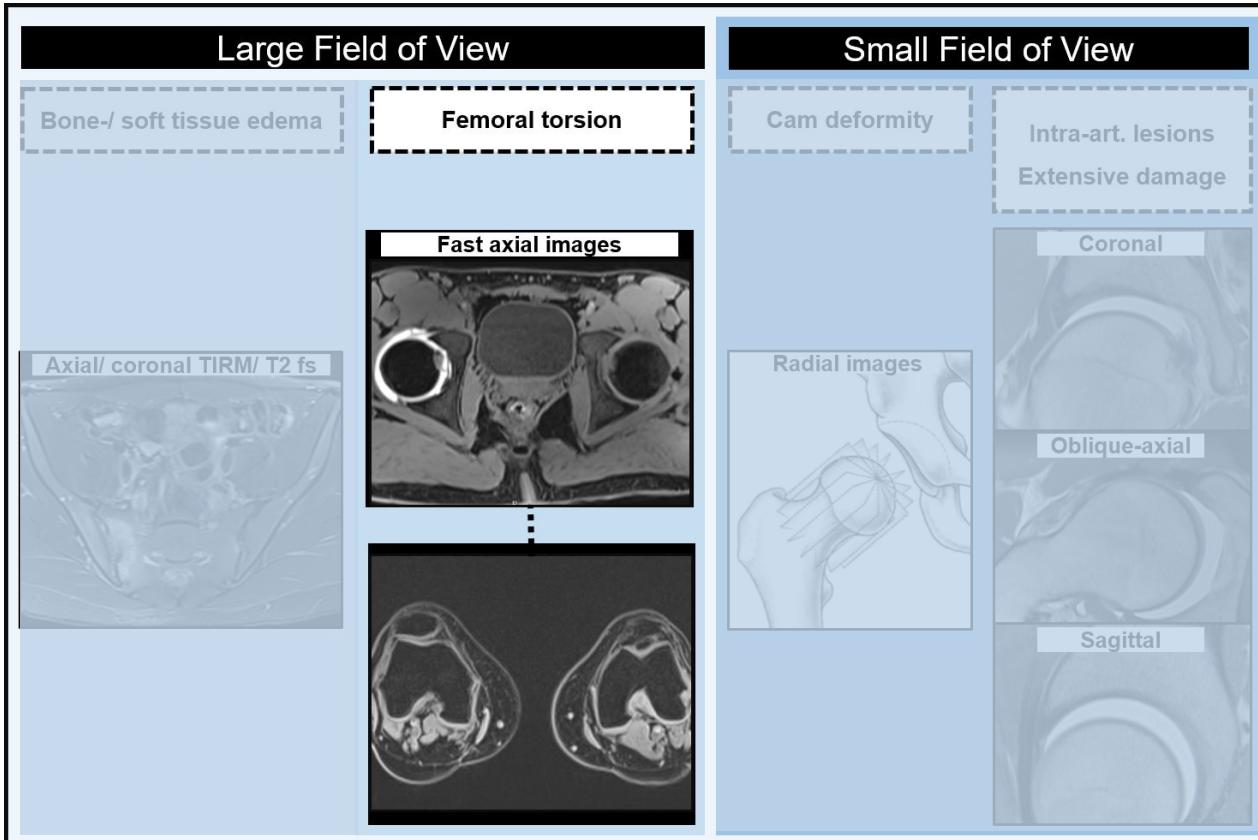
Normal labrum/ cartilage

Pain origin?

axial Spondylarthropathy



Recommended MRI Protocol of the hip



Mascarenhas V et al.
Eur Radiol 2022

Schmaranzer F et al.
AJR 2021

Femoral torsion: Significance

- > 1/6 adult patients eligible for joint preserving surgery: abnormal high/ low femoral torsion
- > Can aggravate/ compensate impingement or instability



Lerch et al. AJSM. 2018

Femoral torsion: Significance

- > 1/6 adult patients: abnormal high/ low femoral torsion
- > Can aggravate/ compensate hip impingement or instability
- > Femoral torsion considered third pillar aside of AC morphology, cam deformity
 - should be routinely measured in workup of joint preserving surgery
 - different (!) measurement methods exist

Lerch et al. AJSM. 2018

Schmaranzer et al. Radiology. 2020

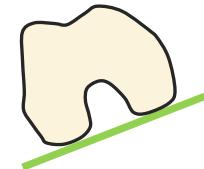
Schmaranzer et al. CORR. 2019

Measurement methods

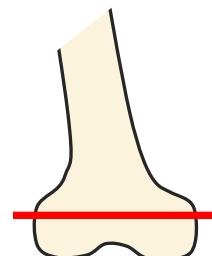
- Proximal
 - FH center
- Distal
 - Condyles



IR: add up

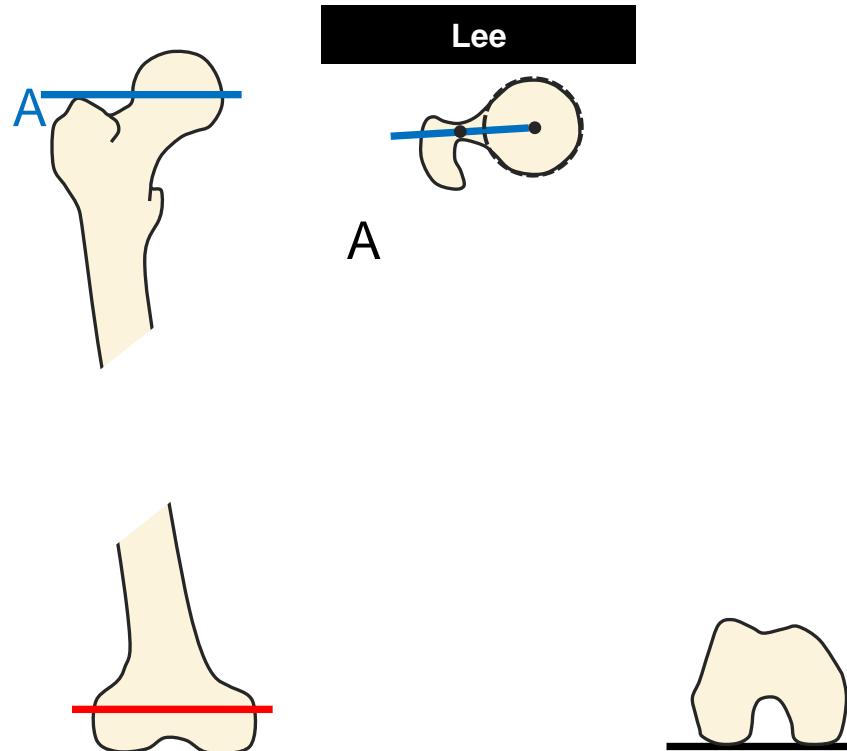


ER: subtraction



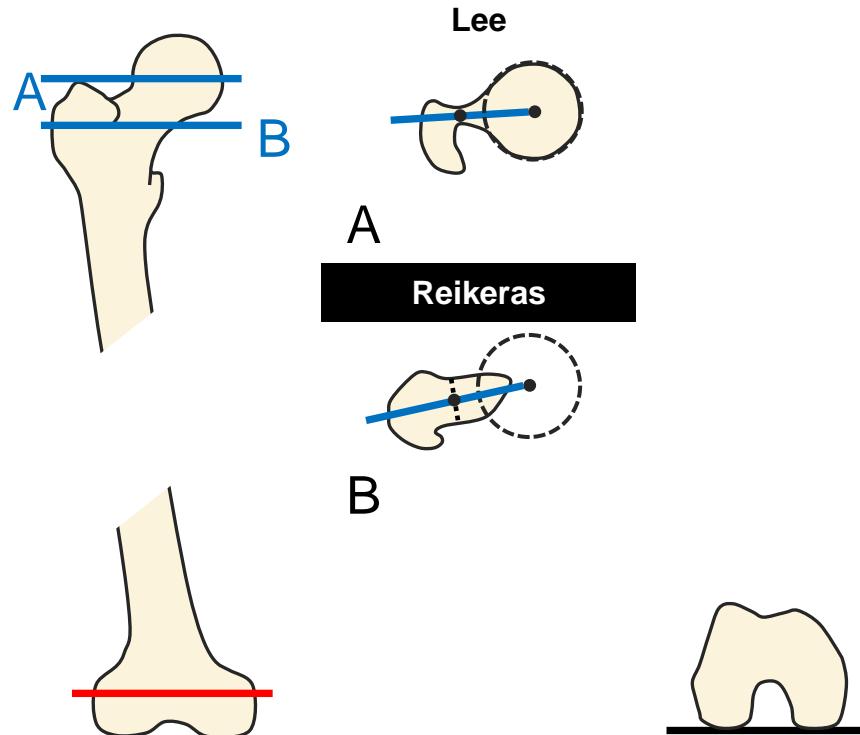
Landmark selection

- Proximal
 - FH center
 - **Connection with GT**
- Distal
 - Condyles



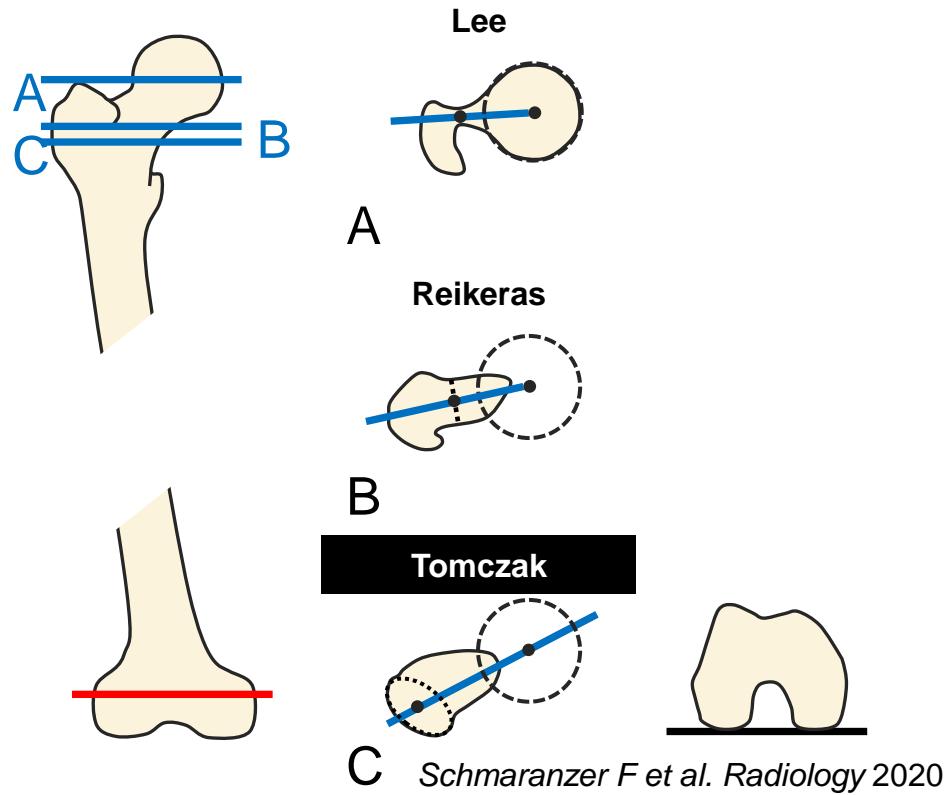
Landmark selection

- Proximal
 - FH center
 - **Midpoint neck axis**
- Distal
 - Condyles



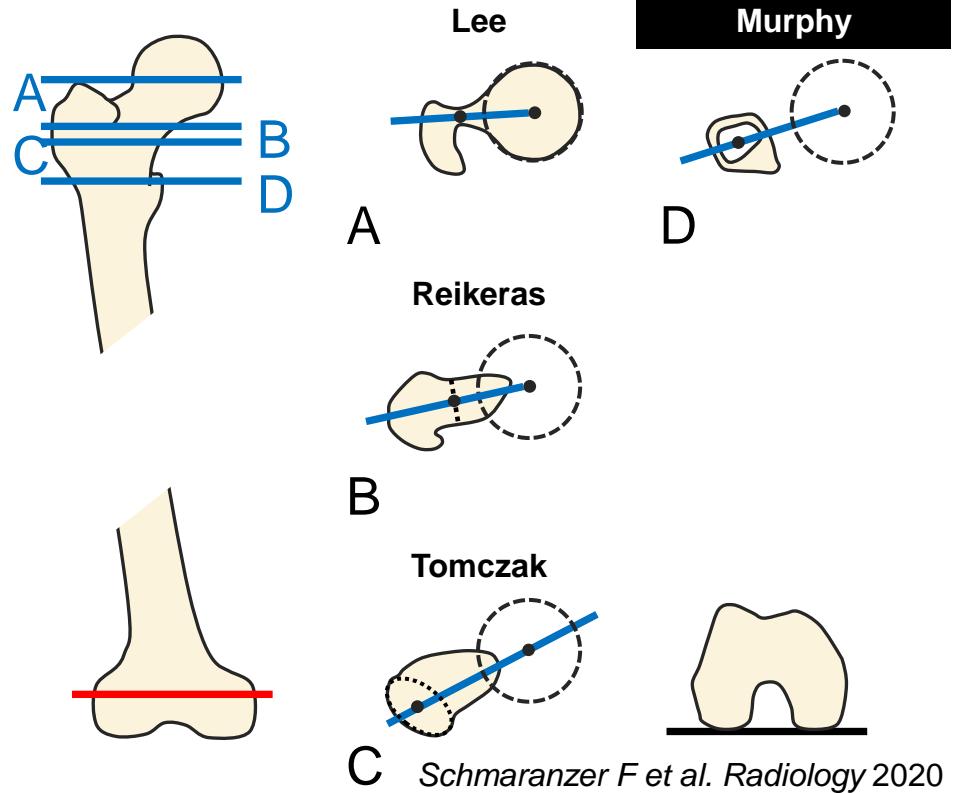
Landmark selection

- Proximal
 - FH center
 - **Center base of the GT**
- Distal
 - Condyles

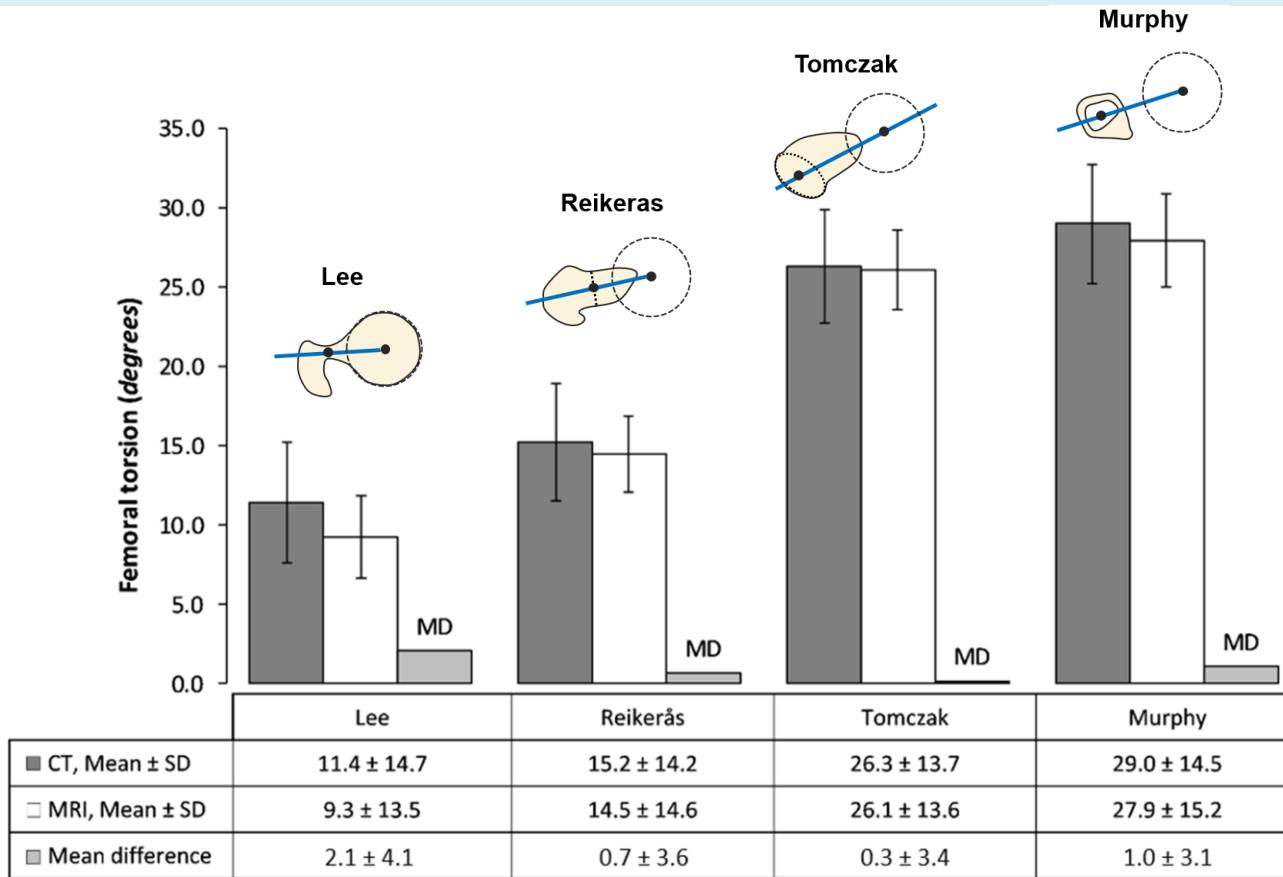


Landmark selection

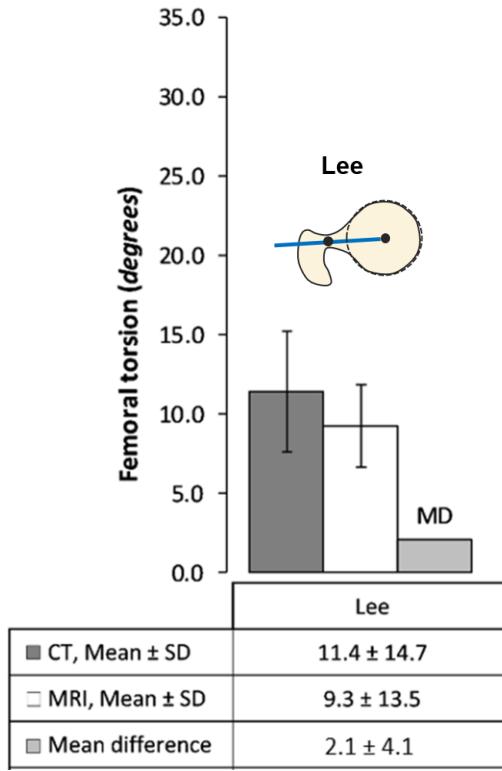
- Proximal
 - FH center
 - **Base neck at level LT**
- Distal
 - Condyles



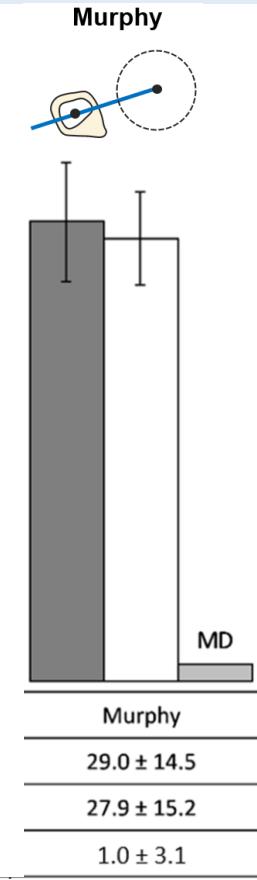
Modality (MRI/ CT) vs. landmarks for femoral torsion



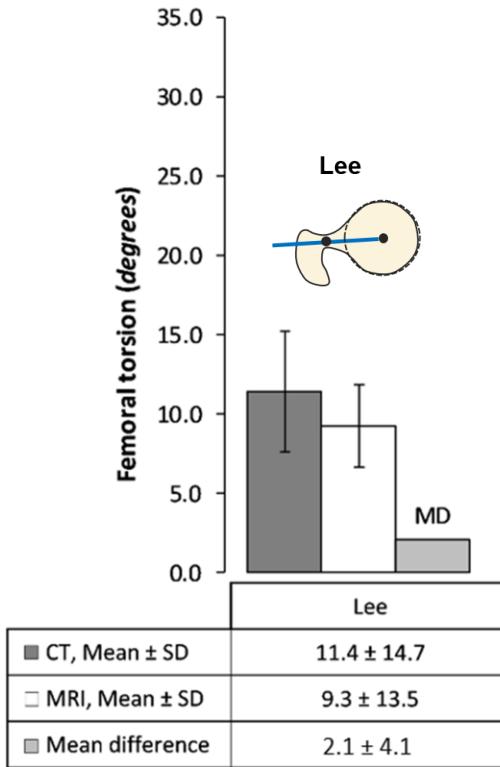
Small differences between CT and MRI



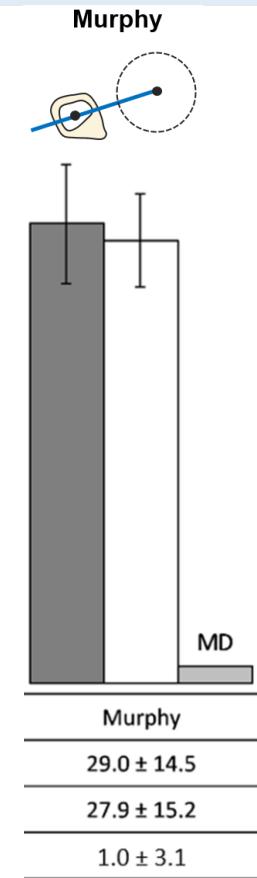
Difference MRI vs CT
Lee: 2°
Murphy: 1°
Negligible (= within ICC range)



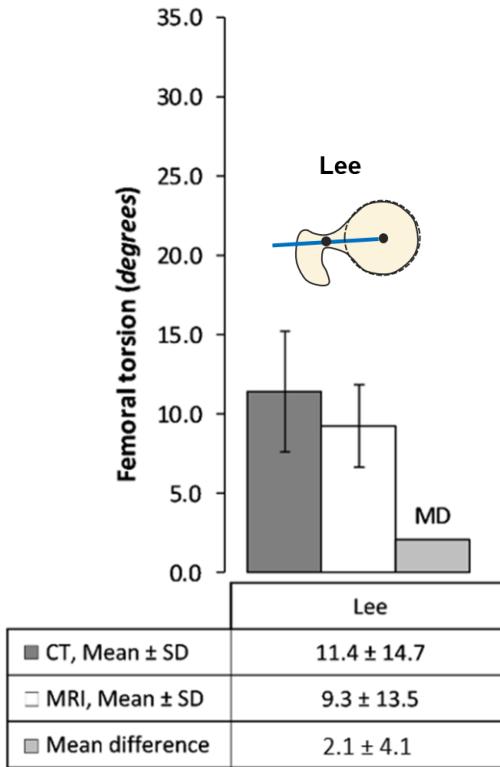
Great differences: Proximal vs. distal landmarks



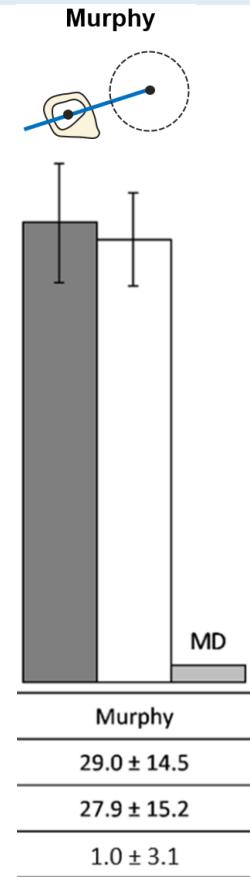
almost 20° difference:
 - exceeds normal range
 - degree of sx correction



Great differences: Proximal vs. distal landmarks



CONSISTENT
MEASUREMENT AND
REPORTING ESSENTIAL!



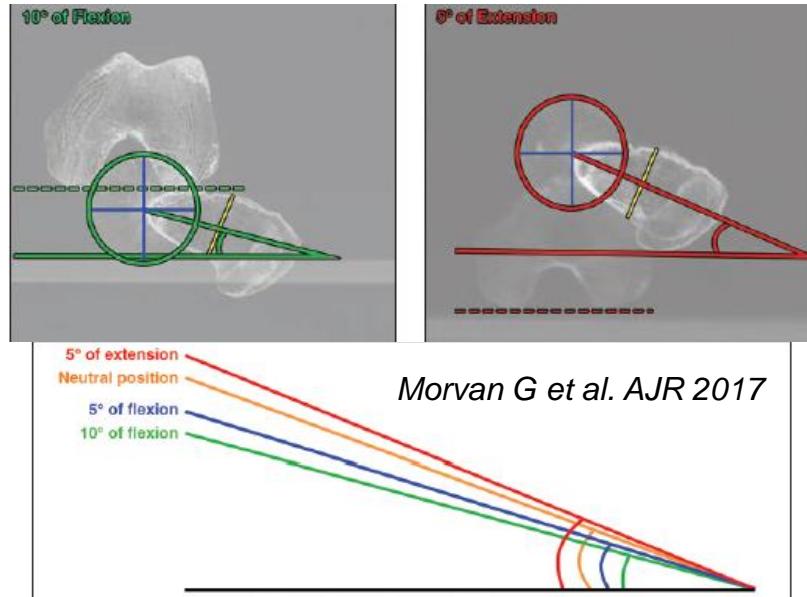
CAVE: MRI patient positioning

- Standardized MRI patient positioning
 - Toes taped together to prevent involuntary movement



CAVE: MRI patient positioning

- Standardized MRI patient positioning
 - Toes taped together to prevent involuntary movement
 - **NO bolstering** under knee to “increase patient comfort”

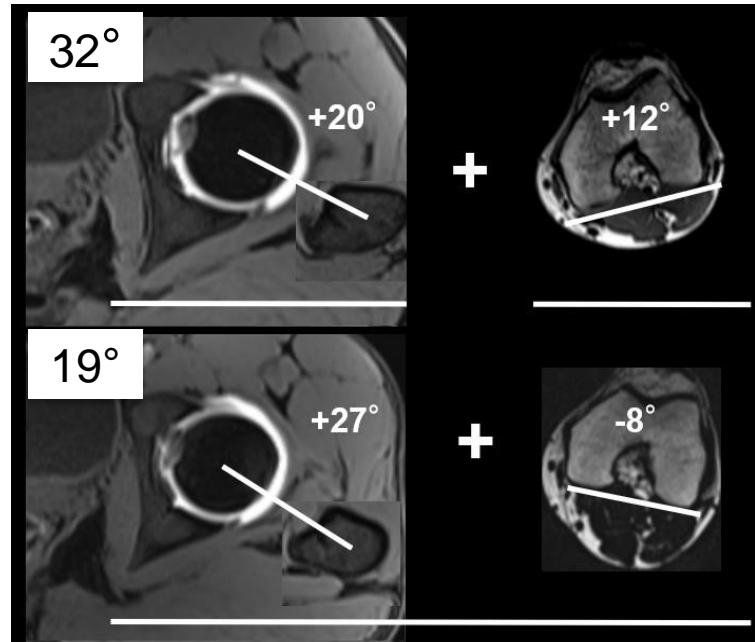


Small changes in hip flexion affect measurements!

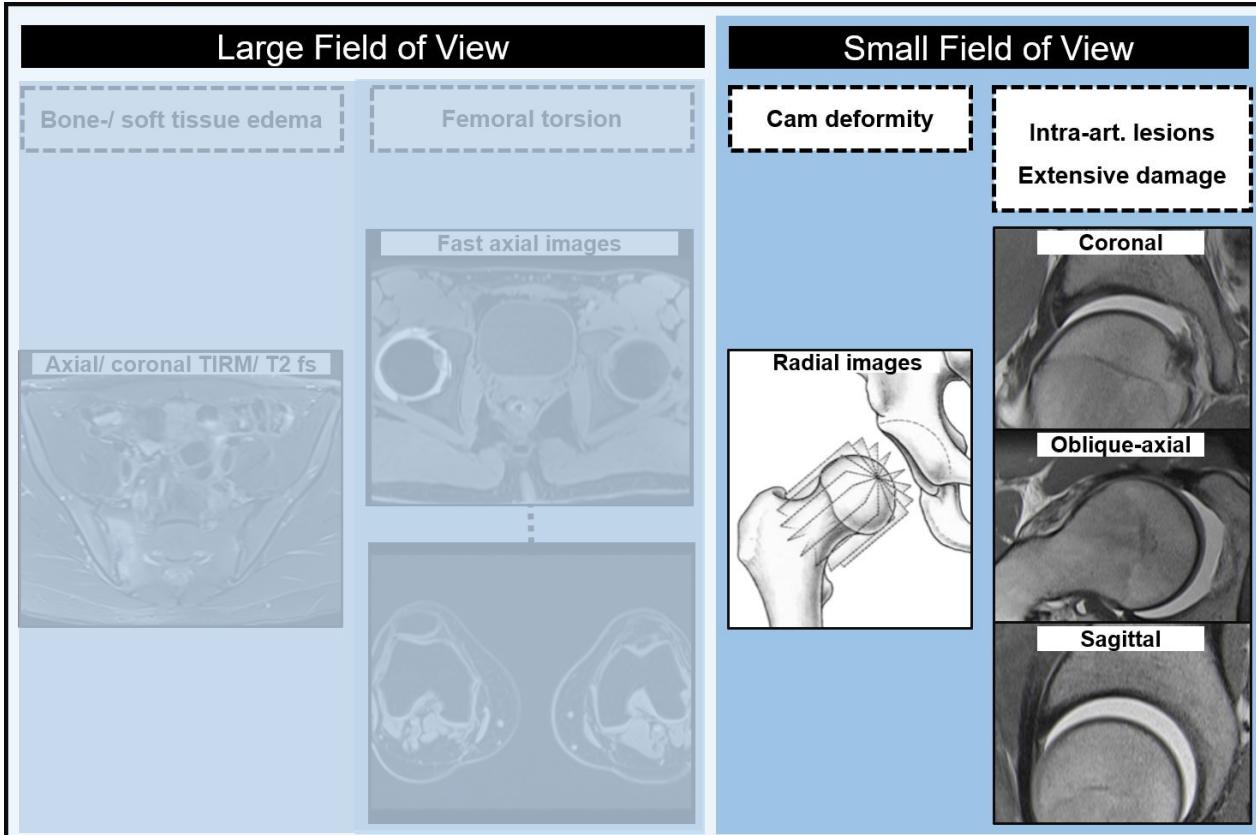
CAVE: MRI patient positioning

- Standardized MRI patient positioning
 - Toes taped together to prevent involuntary movement
 - NO bolstering under knee to “increase patient comfort”
 - **Fast consecutive sequences** (pelvis, knee) within 2-3 minutes

3D T1 VIBE DIXON 1mm³: 45 sec



Recommended MRI Protocol of the hip

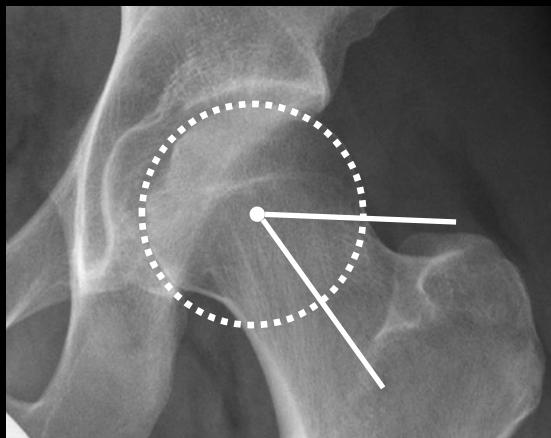


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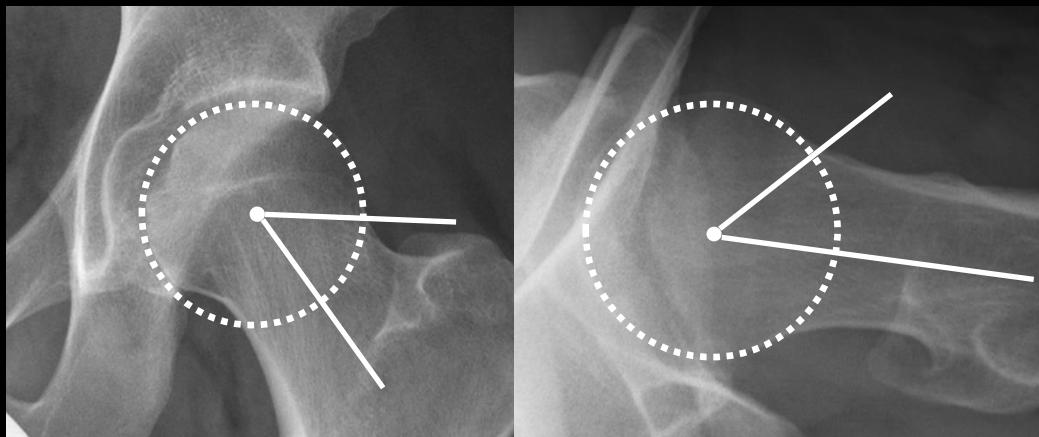
X-ray vs radial MRI/ CT

- AP pelvis view → superolateral ,pistol grip deformity'



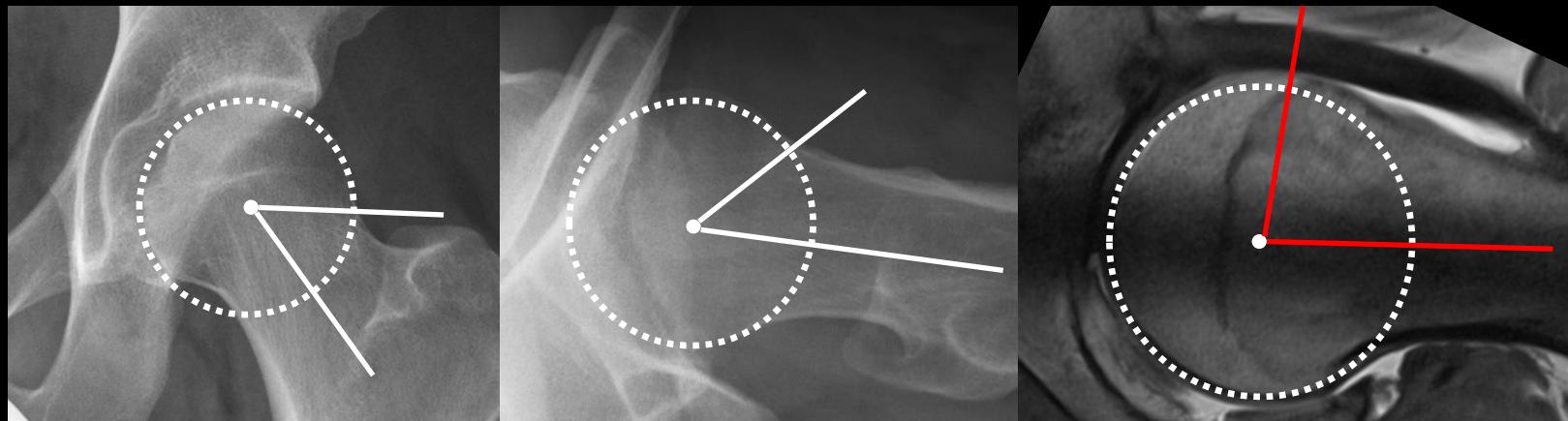
X-ray vs radial MRI/ CT

- AP pelvis view → superolateral ,pistol grip deformity‘
- Axial views: 45 Dunn > cross-table lateral > frog leg lateral view



X-ray vs radial MRI/ CT

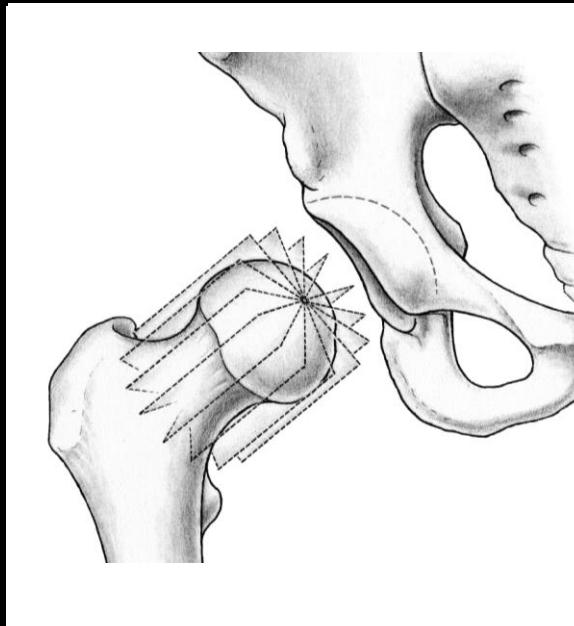
- AP pelvis view → superolateral ,pistol grip deformity‘
- Axial views: 45 Dunn > cross-table lateral > frog leg lateral view
- Radial images gold standard → part of every diagnostic workup



CAVE: X-rays cannot exclude presence of a cam deformity

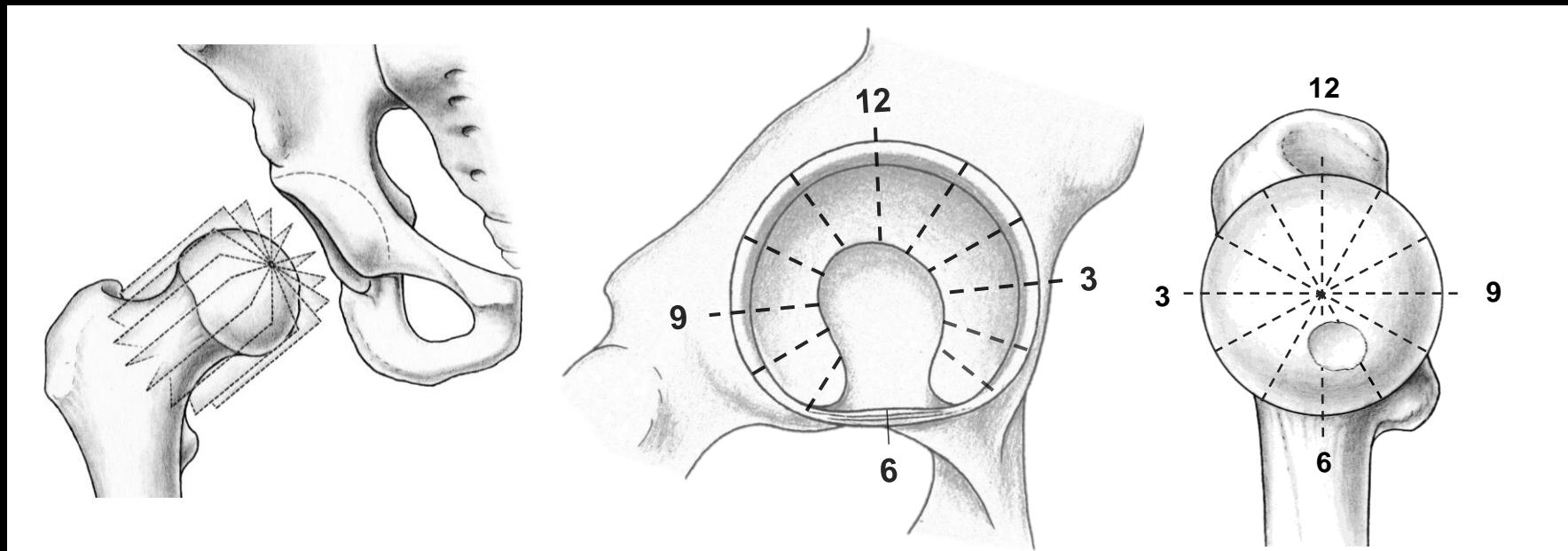
Radial images

- Femoral neck serves as axis of rotation
- Circumferential, perpendicular visualization of cam deformity



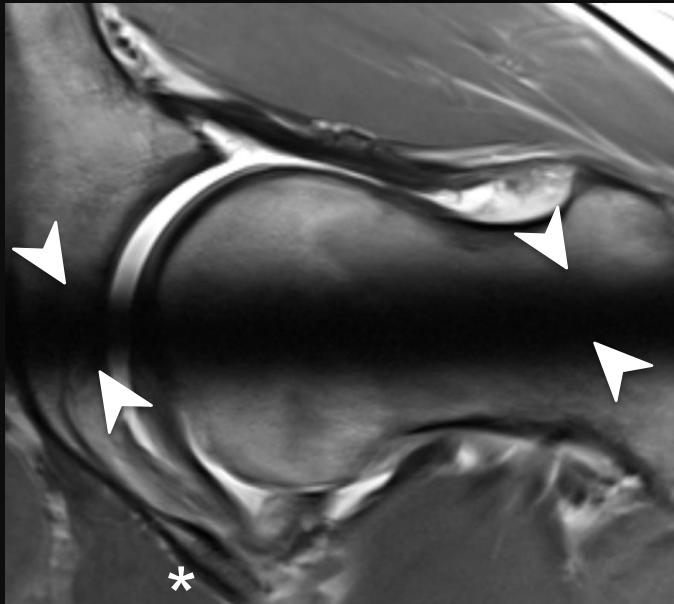
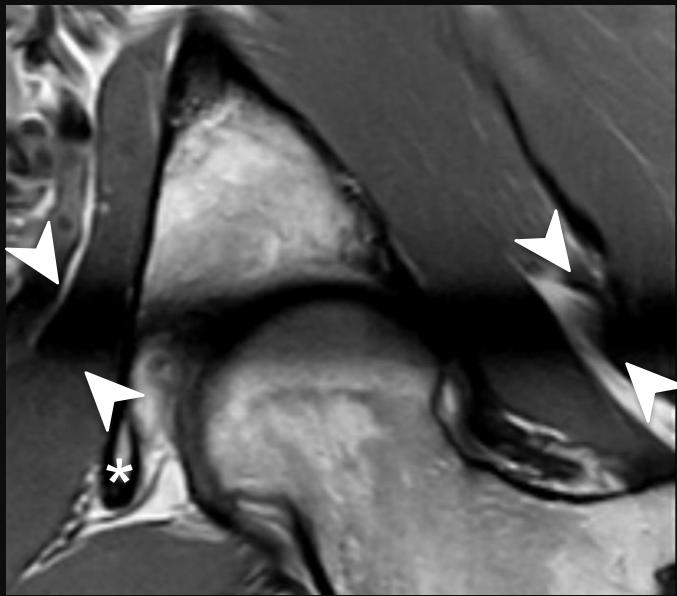
Radial images

- Enable accurate „accurate mapping“ cam deformity based on anatomic landmarks



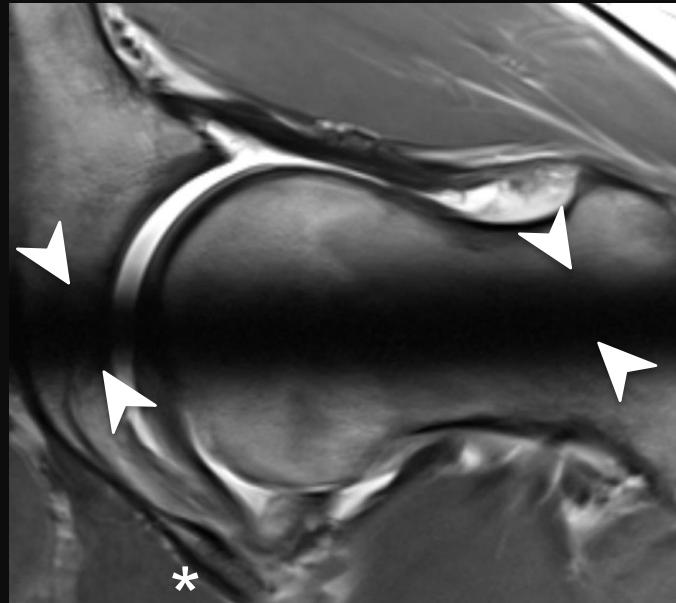
Radial images

- CAVE orientation of axis of rotation



Radial images

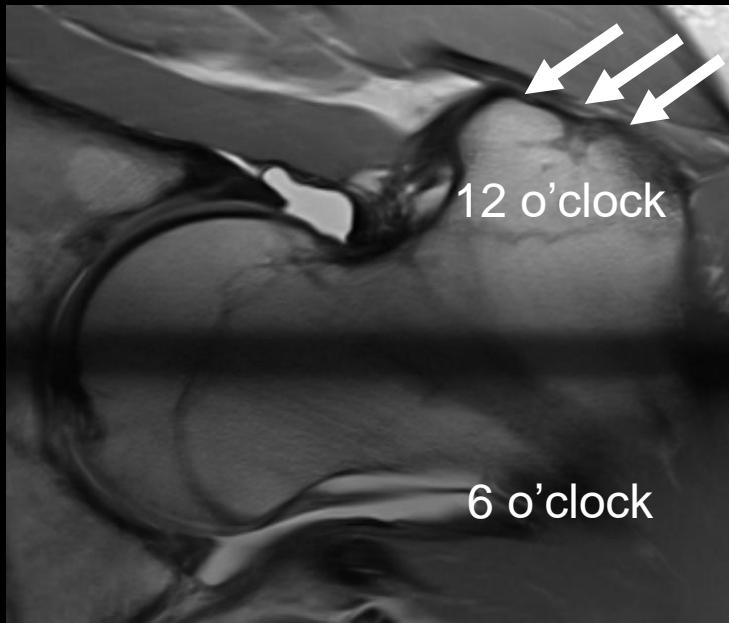
- CAVE orientation of axis of rotation



Radial images

Klenke et al. *Skeletal Rad.* 2015

- Femoral 12 o'clock landmark: greater trochanter

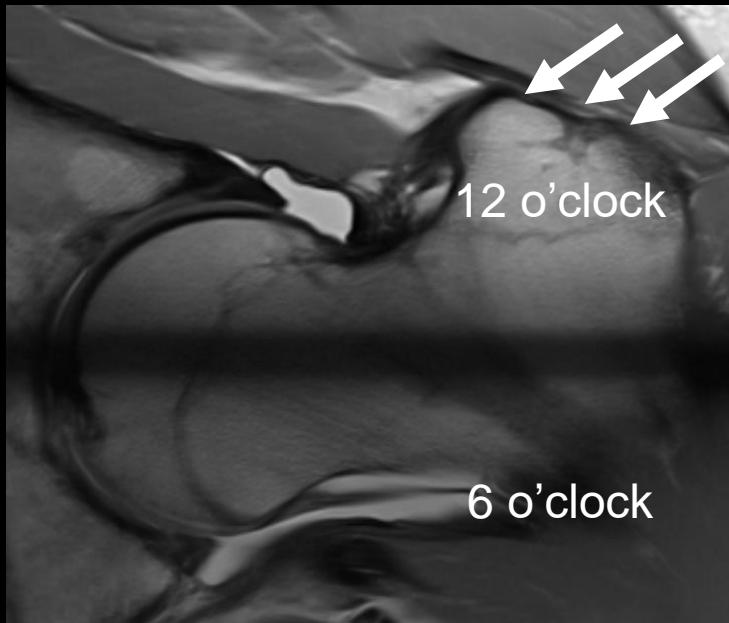


Radial images

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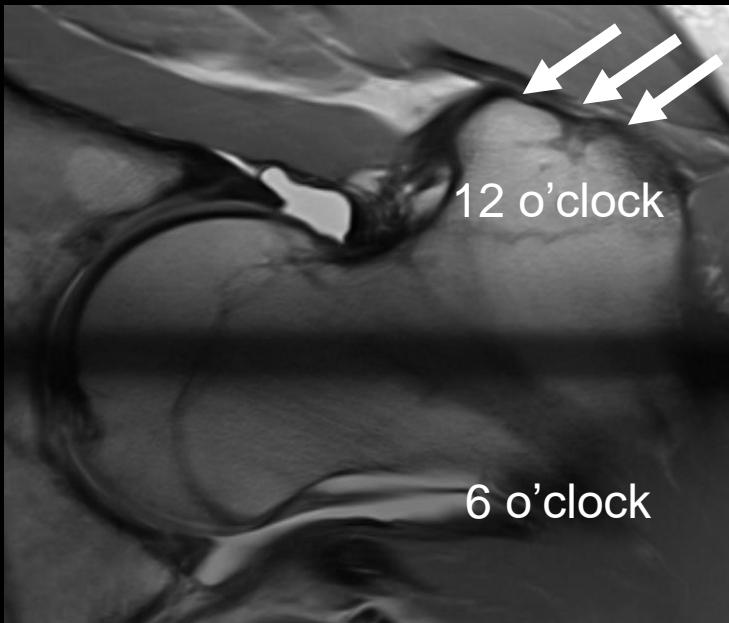
→ Location of cam deformity relative to the retinacular vessels



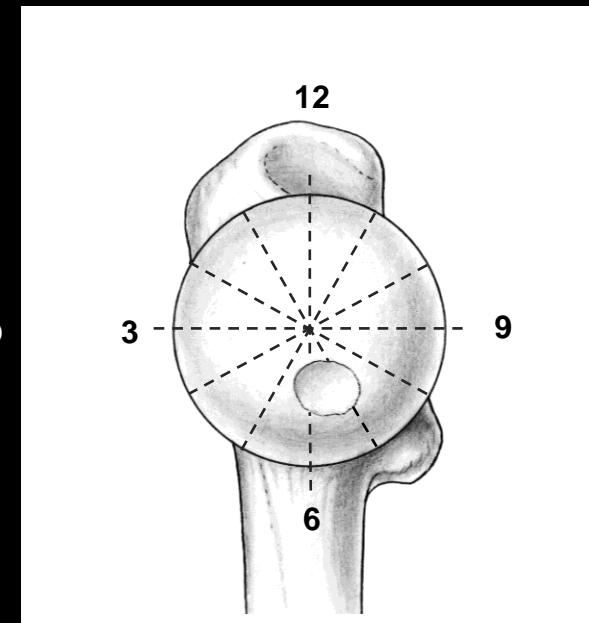
Radial images

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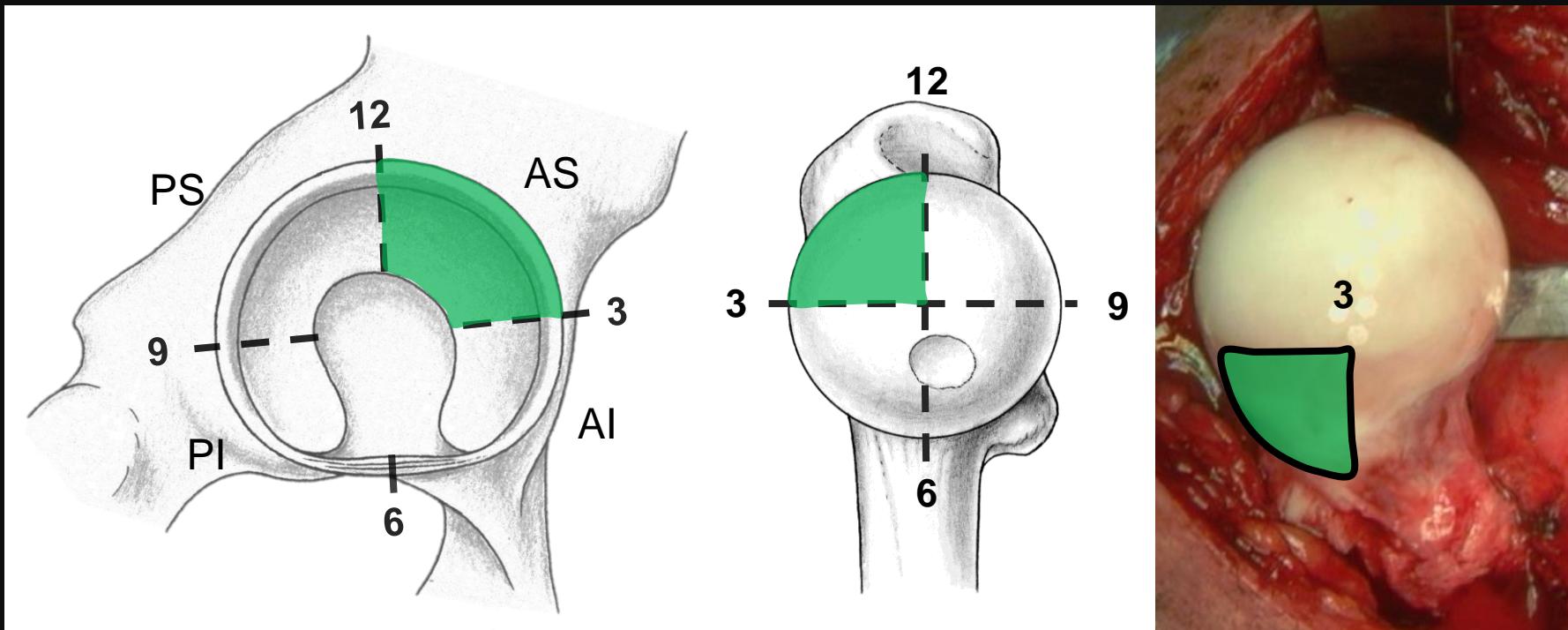


12 sections:
slice gap = 30 min gap



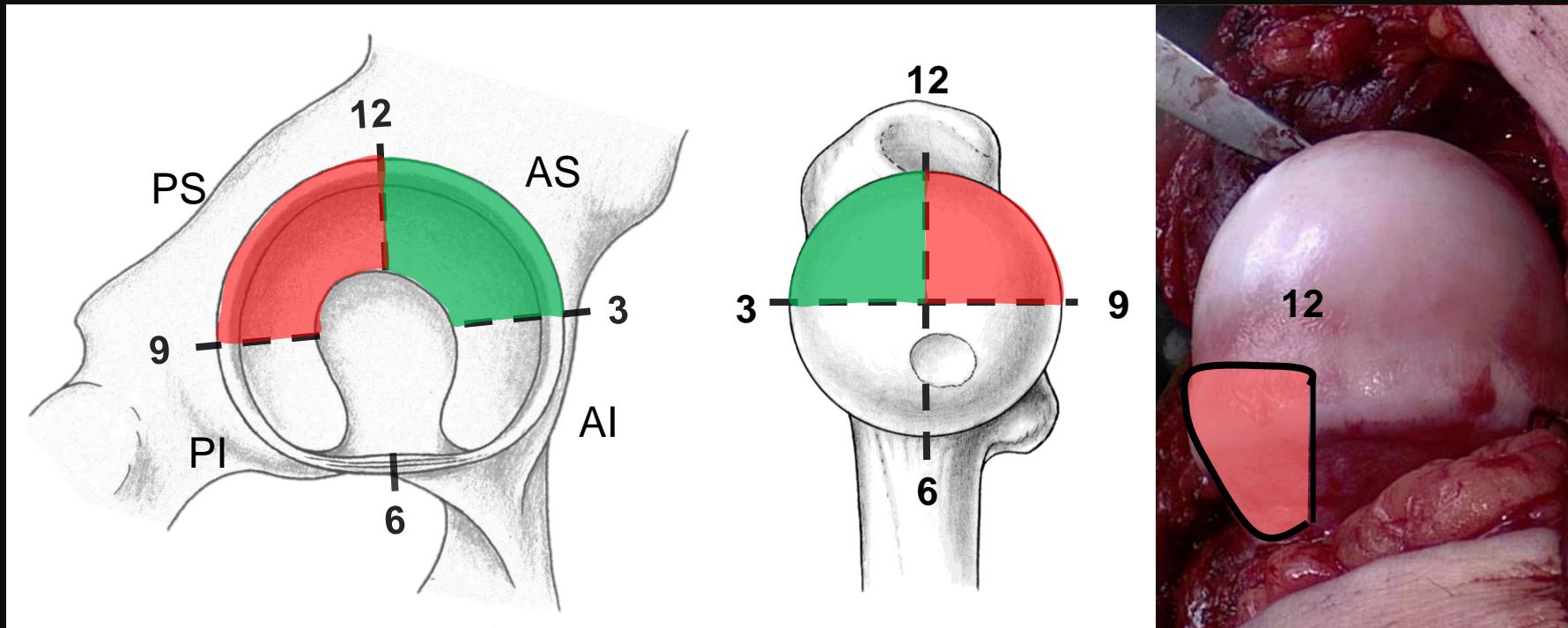
Radial images: Where is the deformity?

- Anterior: good arthroscopic access

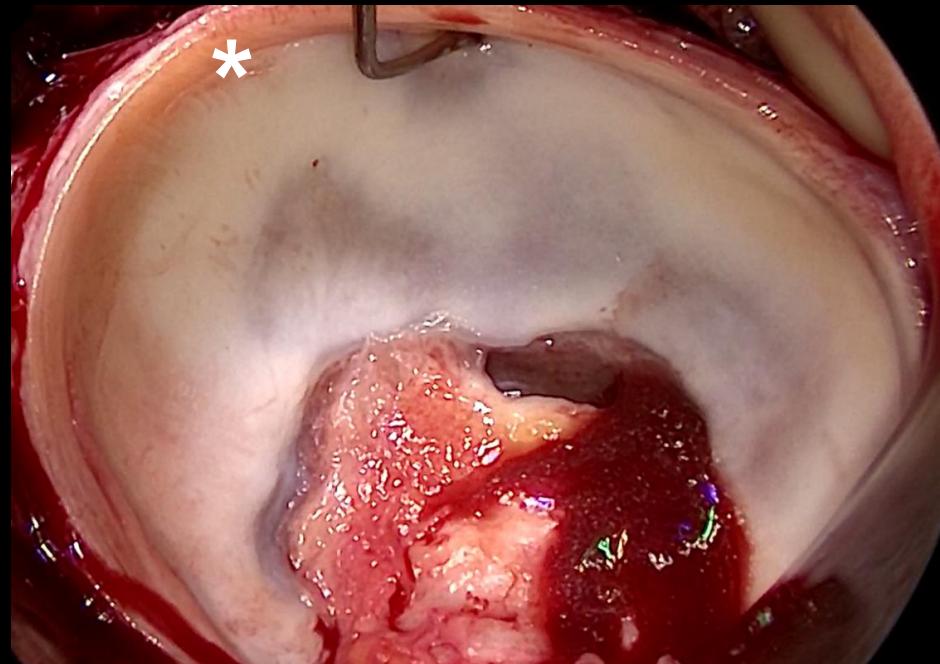


Radial images: Where is the deformity?

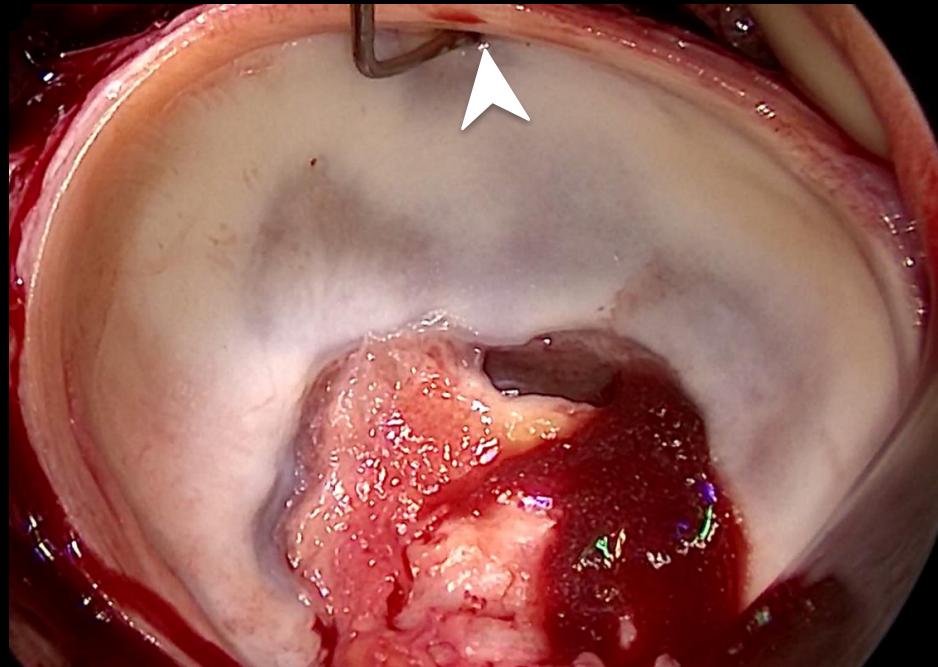
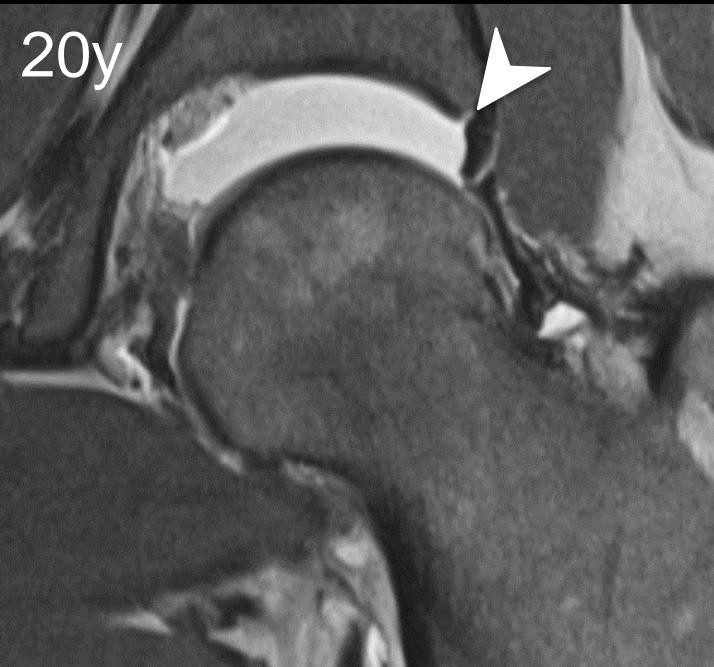
- Posterior: more difficult to address arthroscopically



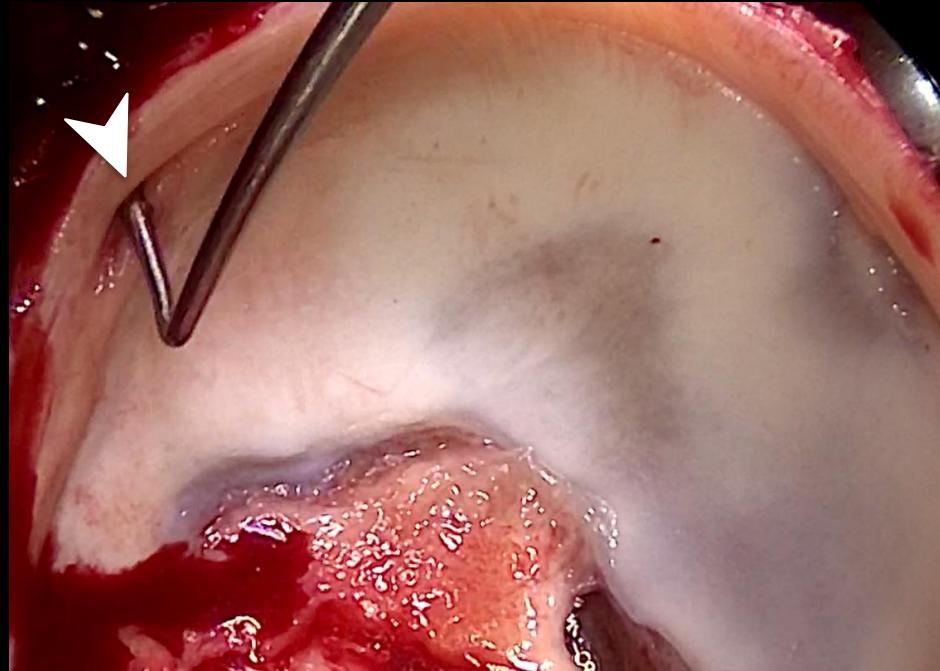
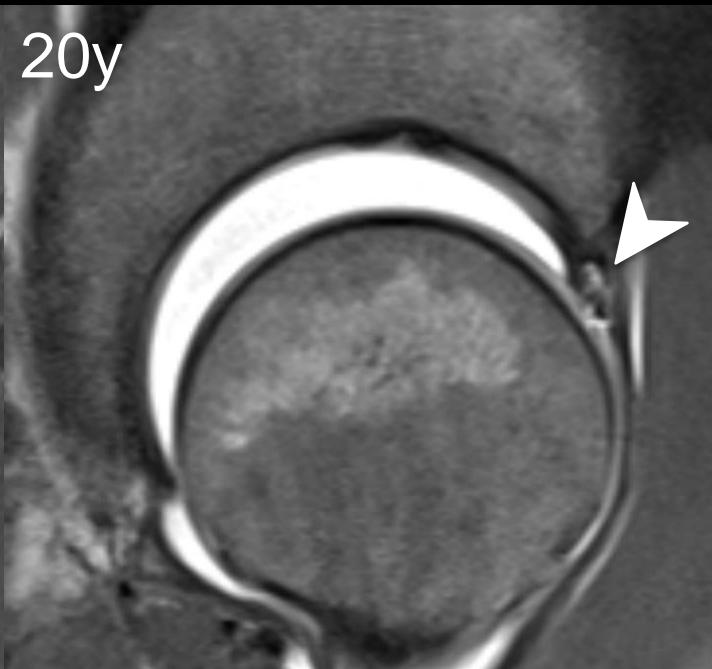
Normal chondro-labral transition



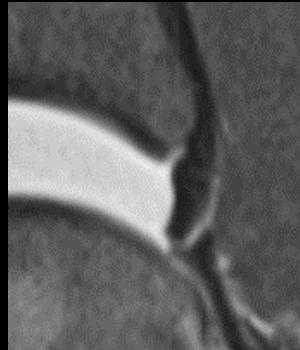
Sublabral recess/ sulcus



20 y: anteriorer Labrumriss, Knorpeldelamination



Sublabral sulcus



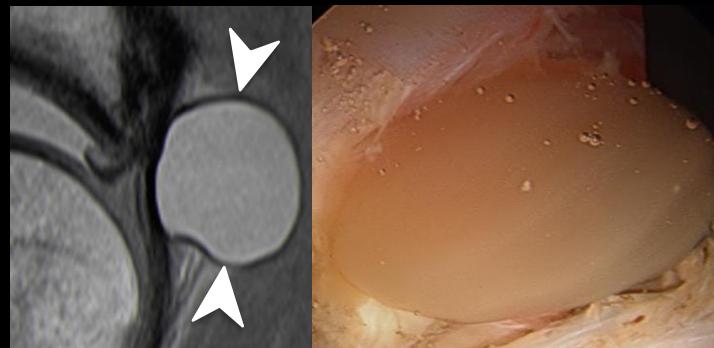
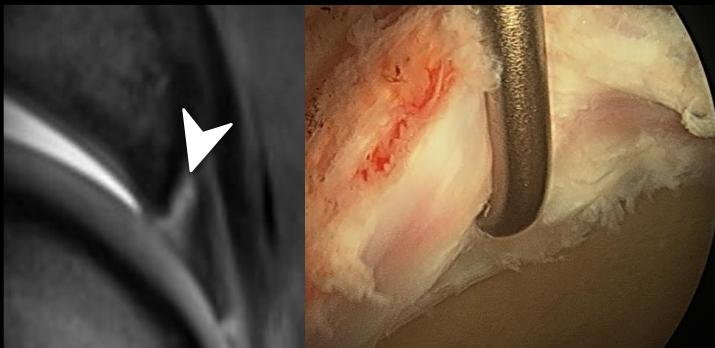
DD

Labrum tear



- 5-10% normal finding
- Any location
- Superficial
- Labrum normal signal
- > 90 % patients
- Antero-superior
- Labral base, intra-substance
- Altered signal

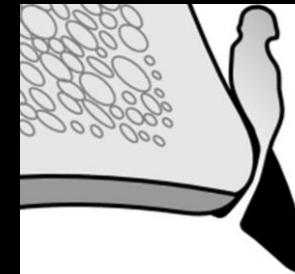
Labrum lesion: Classification



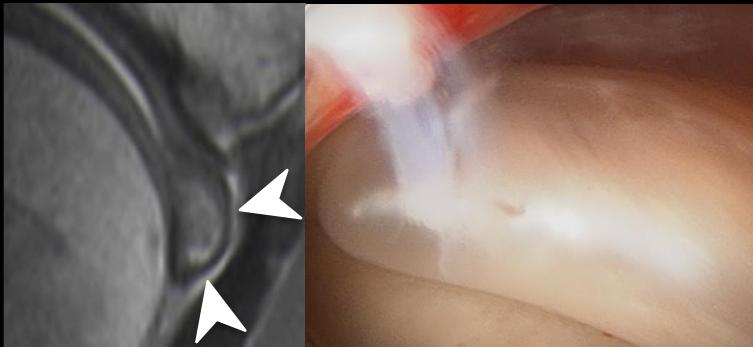
- Detachment
- Labral base
- Cam FAI



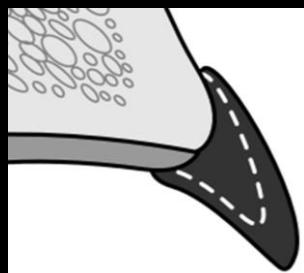
- Cyst
- Base/ intra-subst
- DDH > Cam FAI



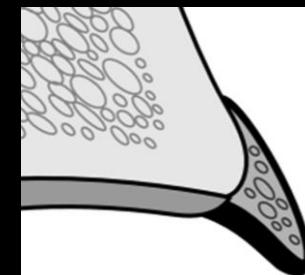
Labrum lesion: Classification



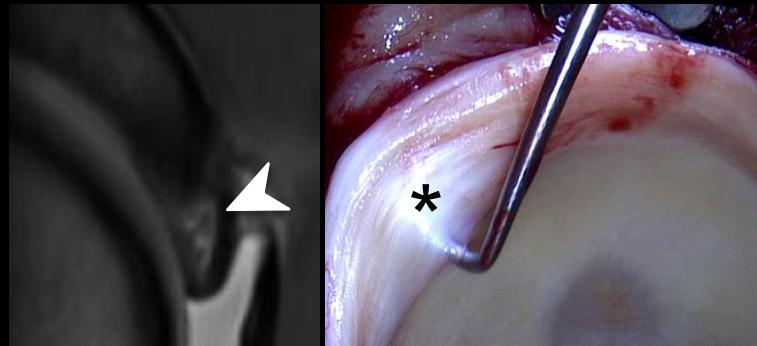
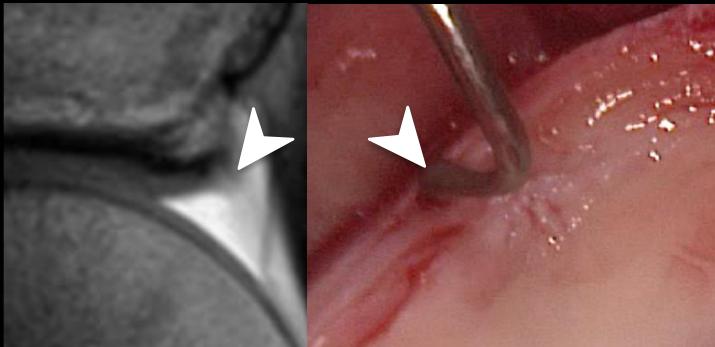
- „Dysplasia labrum“
- Mucoid degeneration
- Hypertrophy



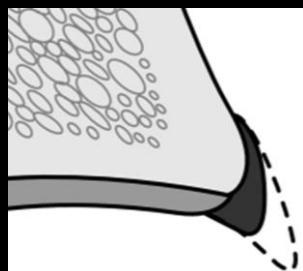
- Ossification
- peri-/ intralabral
- Pincer FAI



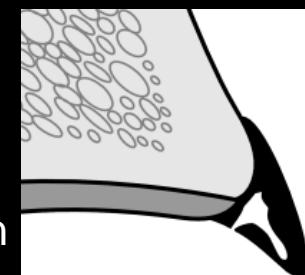
Labrum lesion: Classification



- Small, abutted
- Retrotorsion
- Pincer FAI



- Intrasubstance tear
- Large labrum
- High femoral torsion



Normal variants of lunate surface

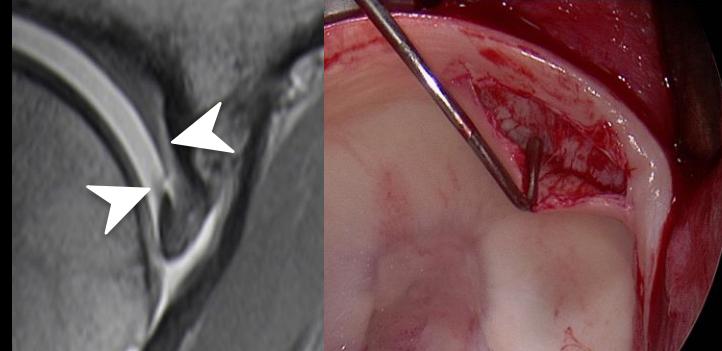
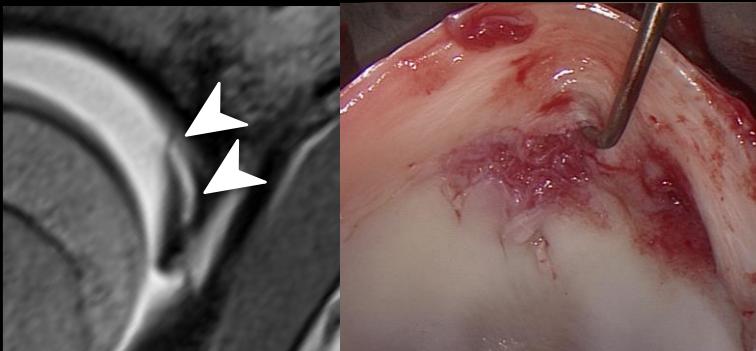


- Tubular tracking (5%)

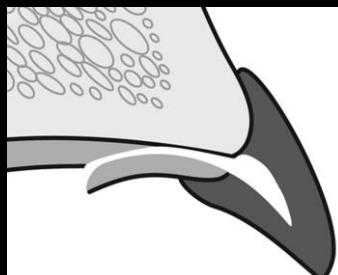


- Fossa supraacetabularis (10%)

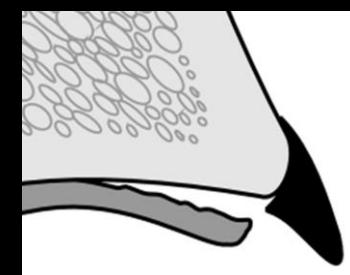
Cartilage damage: Classification



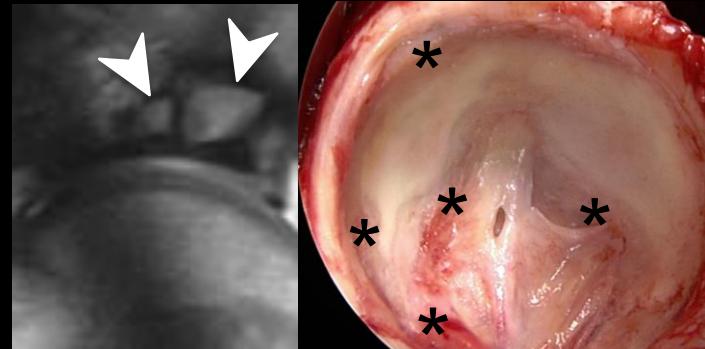
- Inside out
- Central → per
- DDH/ LCPD



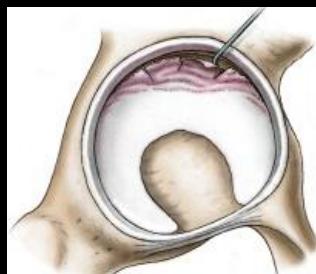
- Outside in
- Per → central
- Cam FAI



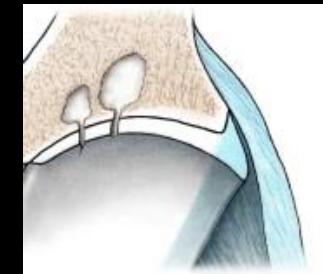
Cartilage damage: Classification



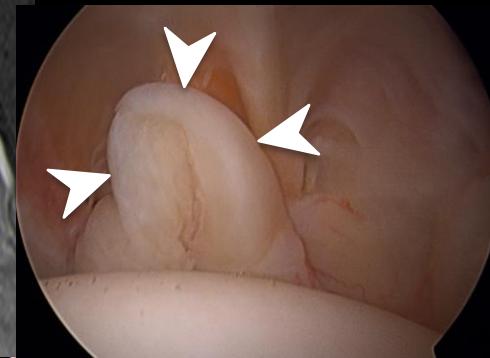
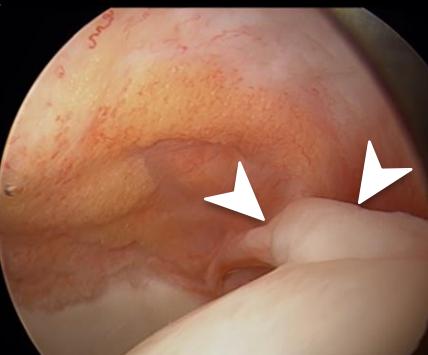
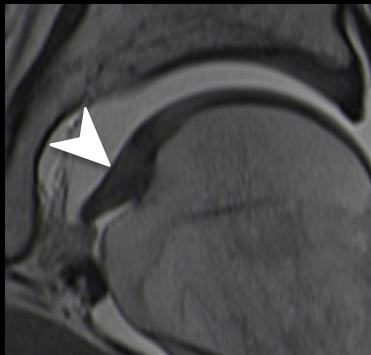
- Defect
- beg. OA
- any deformity



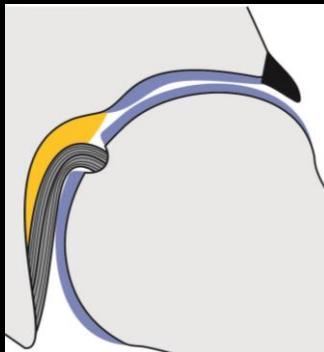
- Rim cyst
- beg. OA
- DDH > FAI



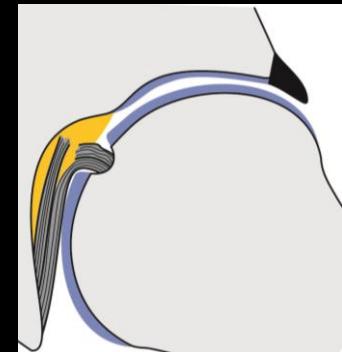
Lesions of the Ligamentous – Fossa – Fovea Complex



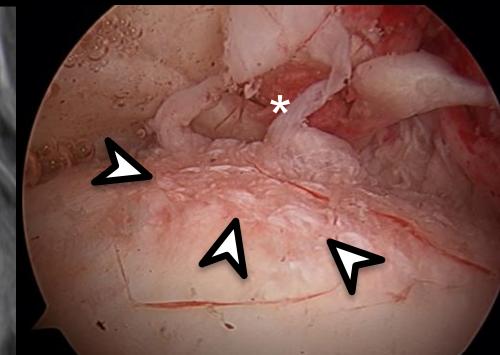
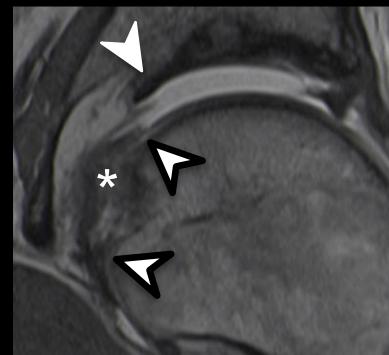
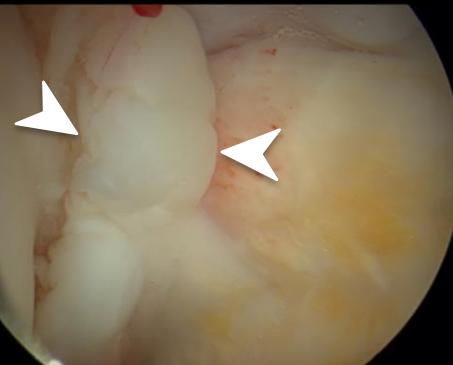
- Normal LT
- Thin
- Hypointense



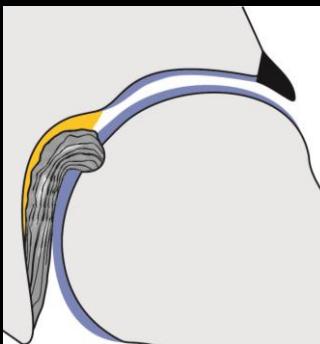
- Partial LT tear
- Rarely isolated



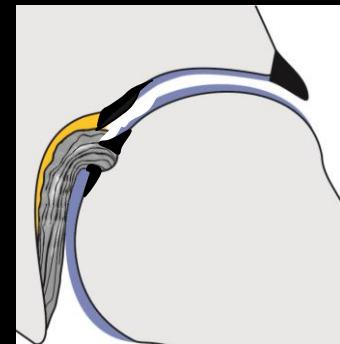
Lesions of the Ligamentous – Fossa – Fovea Complex



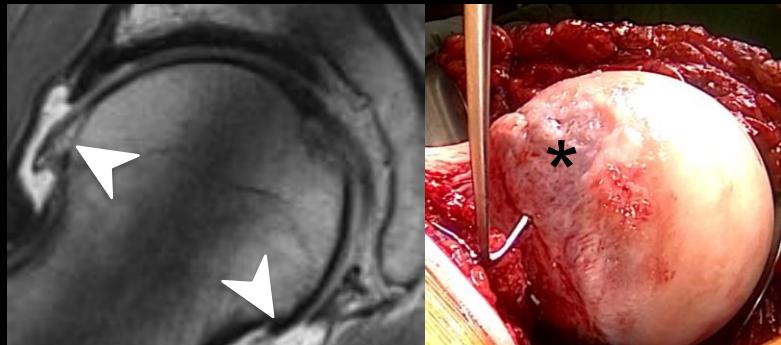
- Hypertrophy
- Mucoid deg
- DDH/ high torsion



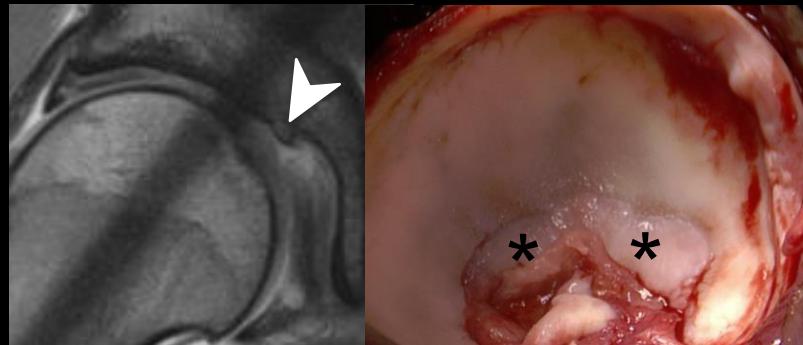
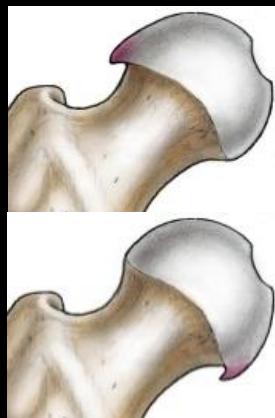
- LT degeneration
- Osteophytes
- Parafoveal cartilage lesion



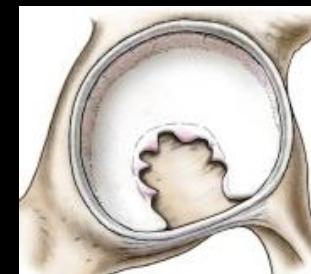
Osteophytes



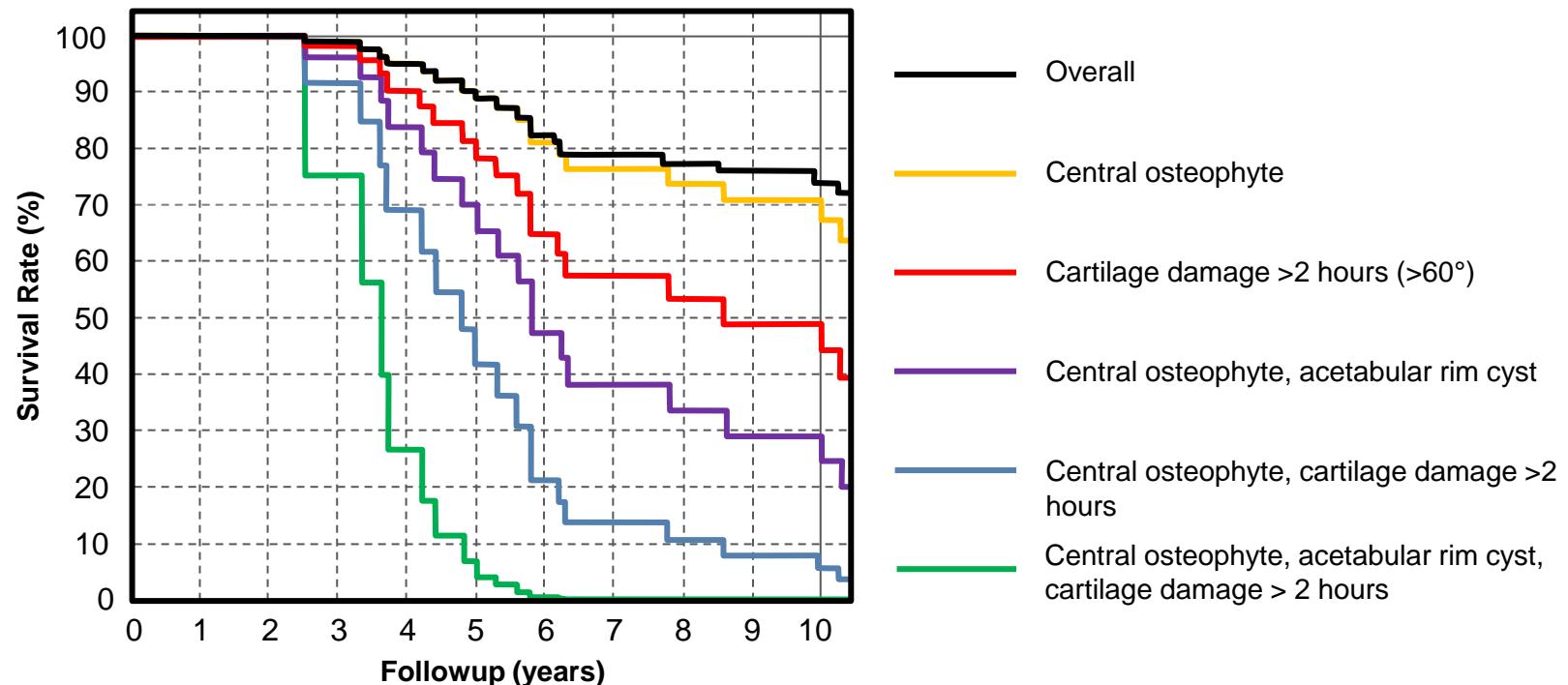
- Peripheral



- Central



Prognostic curve for surgical decision making in FAI



28 y man

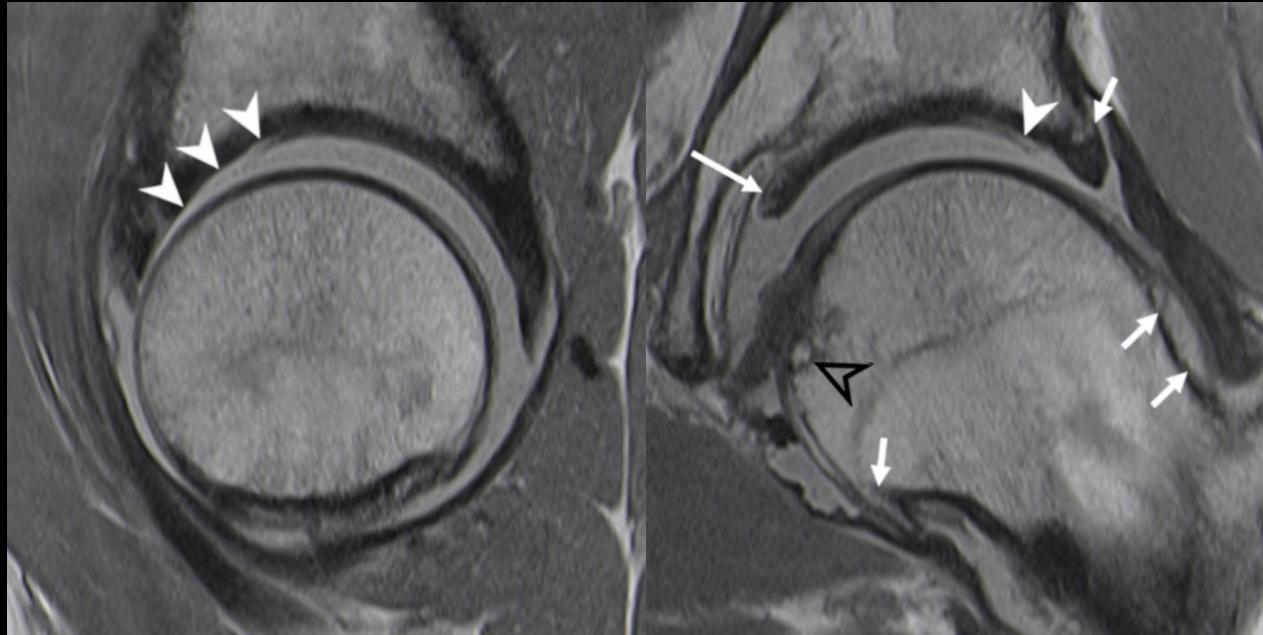


Mild joint space narrowing
Osteophytes

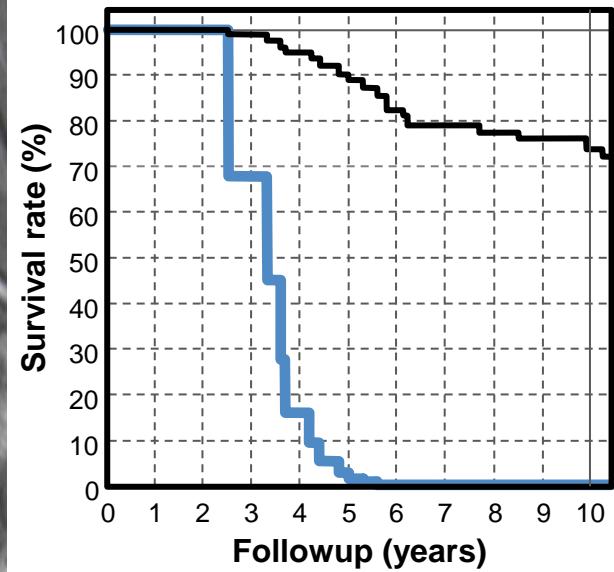
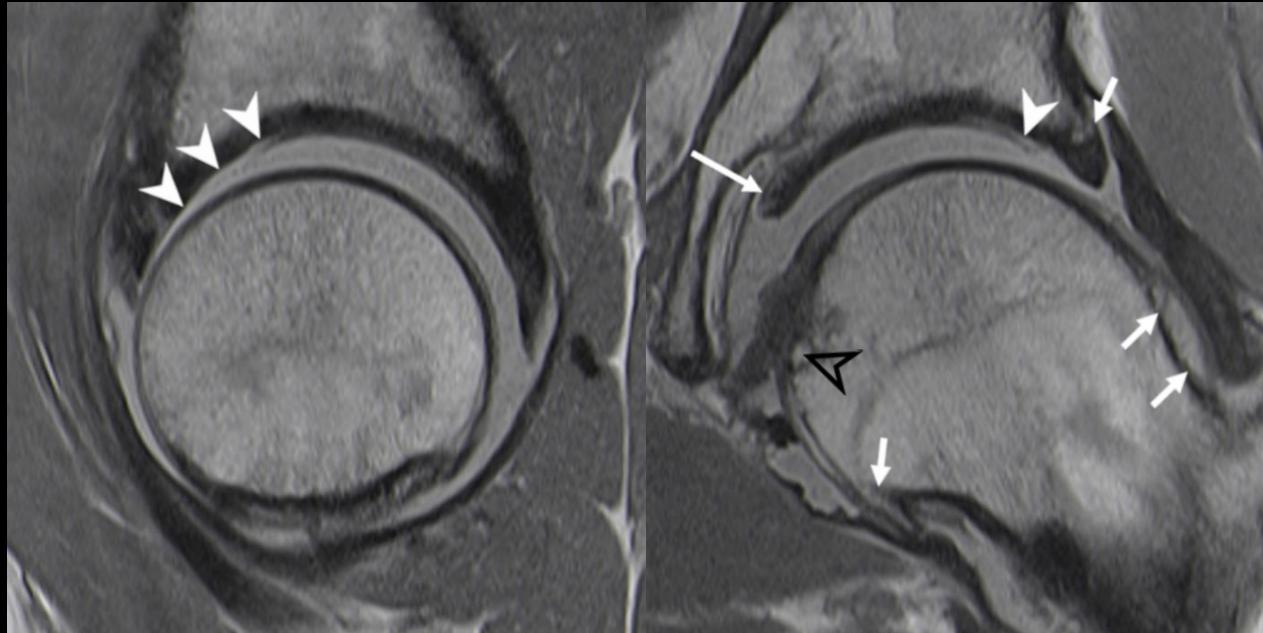
Prognosis?

Preop

Osteophytes + AC rim cysts + Cartilage damage >2 hours

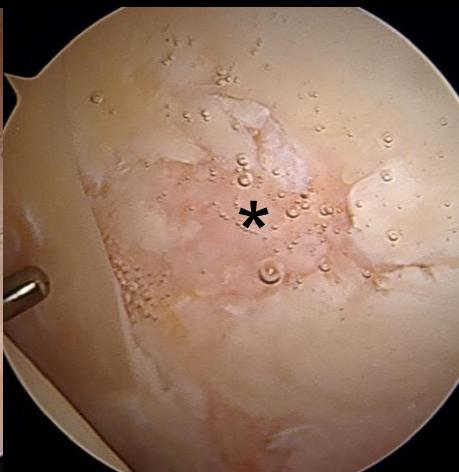
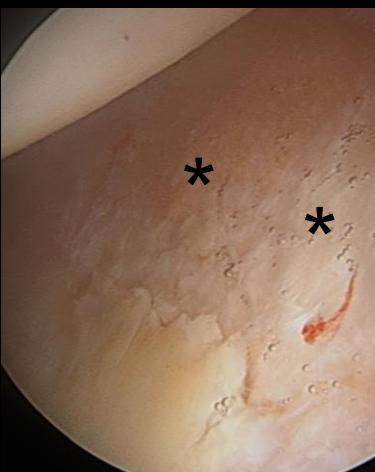
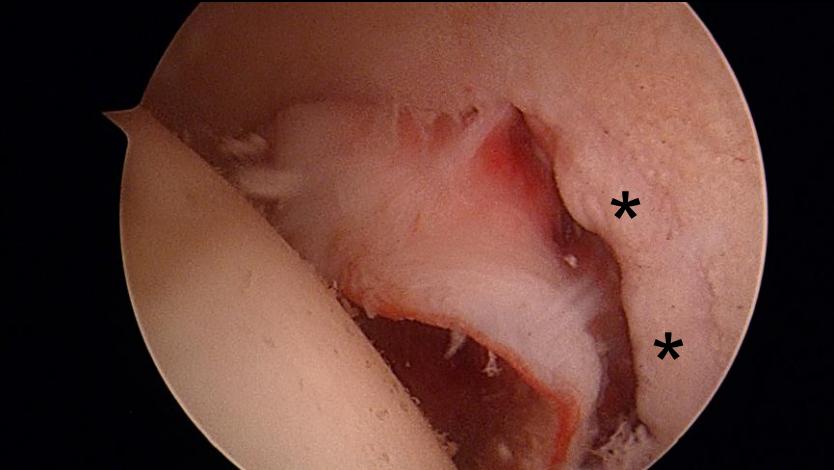


Osteophytes + AC rim cysts + Cartilage damage >2 hours





Preop



Postop



28 y



Postop

3 y

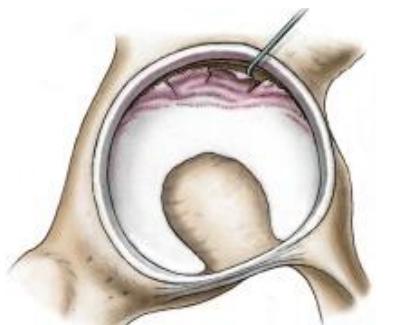


31 y

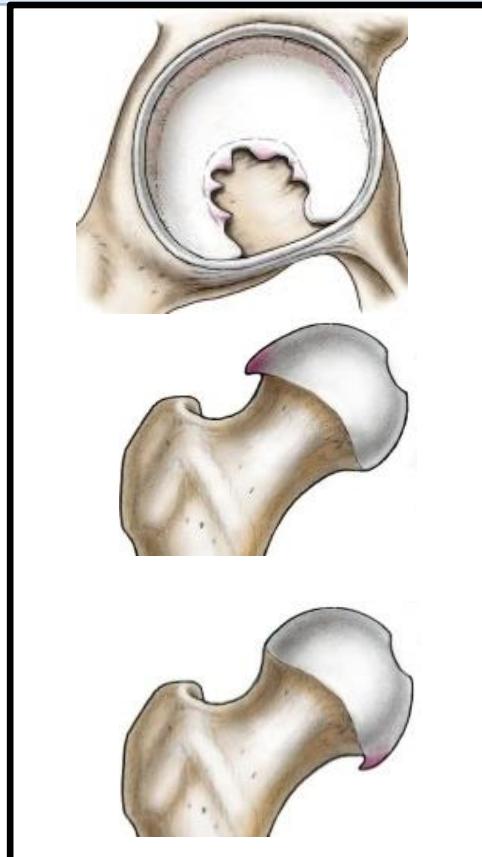
Preop

MRI predictors for worse outcome of hip surgery

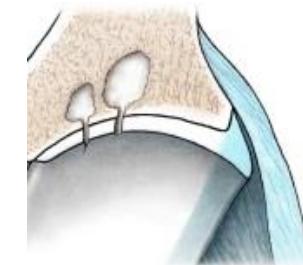
Red Flags



+



Red Flags



+

Diagnostic imaging of the hip

Radiographs

- AC coverage/ version
- Osteoarthritis
- Screen cam deformity

AP pelvis view

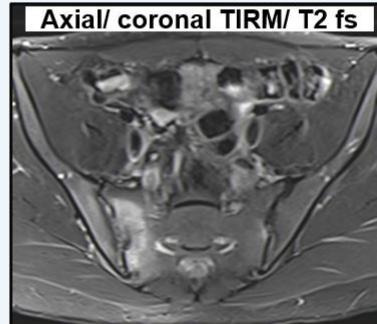


Axial view

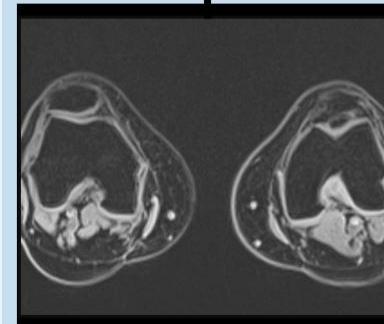
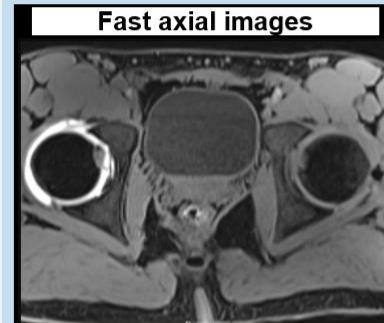


Large Field of View

- Bone-/ soft tissue edema

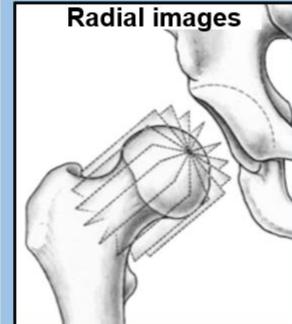


- Femoral torsion



Small Field of View

- Cam deformity



- Intra-art. lesions
- Extensive damage

