

Hip Imaging in ED



Bharti Khurana, MD, MBA, FACR, FASER
National Academy of Medicine Scholar in Diagnostic Excellence
Founder and Director, Trauma Imaging Research and Innovation Center
Department of Radiology and Medicine
Brigham and Women's Hospital
Associate Professor, Harvard Medical School

<https://bhartikhurana.bwh.harvard.edu/>

bkhurana@bwh.harvard.edu

@KhuranaBharti



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GE Healthcare Research Consultant


Learning Objectives

- What not to miss
- How not to miss
- Why not to miss

 Proximal Femoral Fractures: What
 the Orthopedic Surgeon Wants to
 Know¹

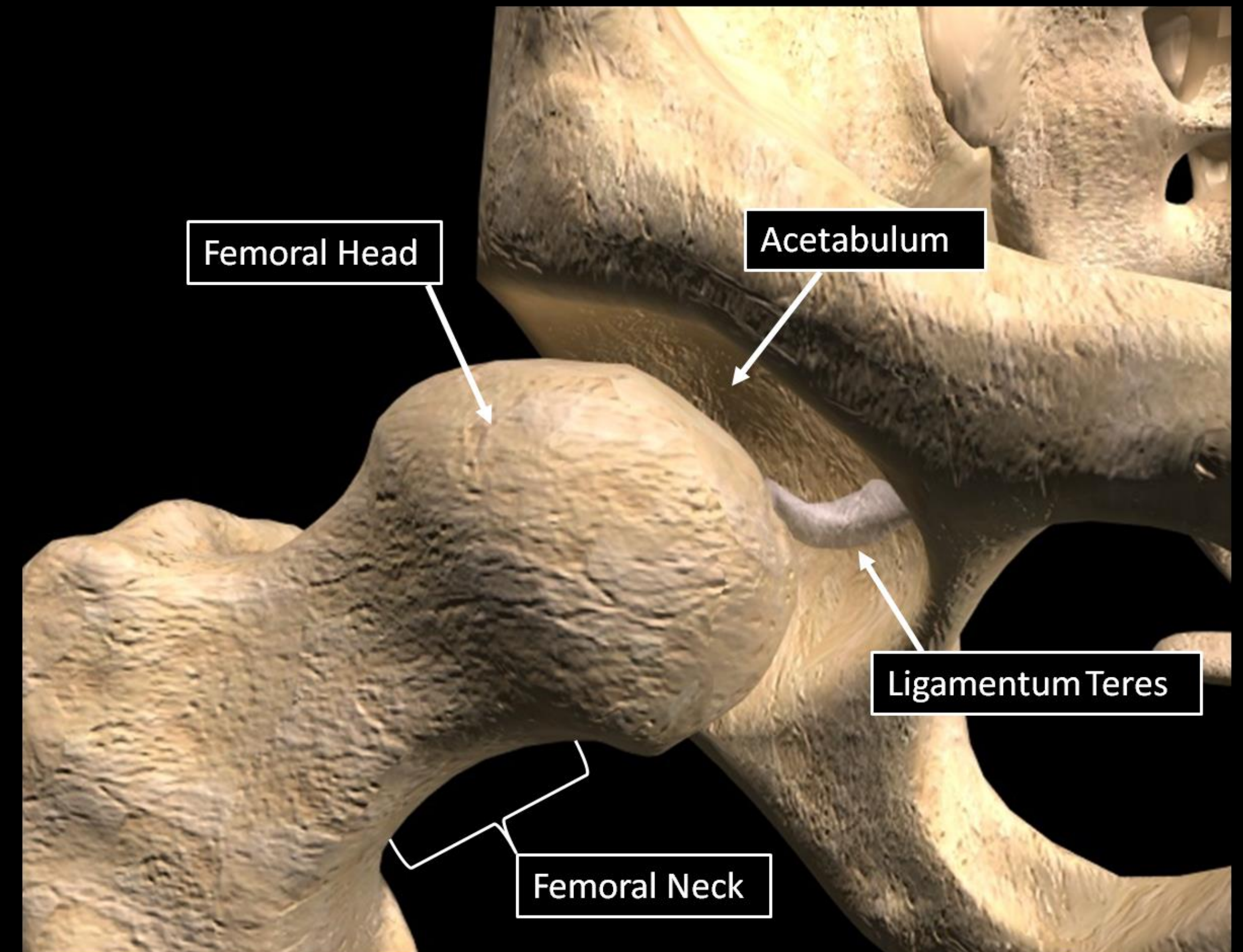
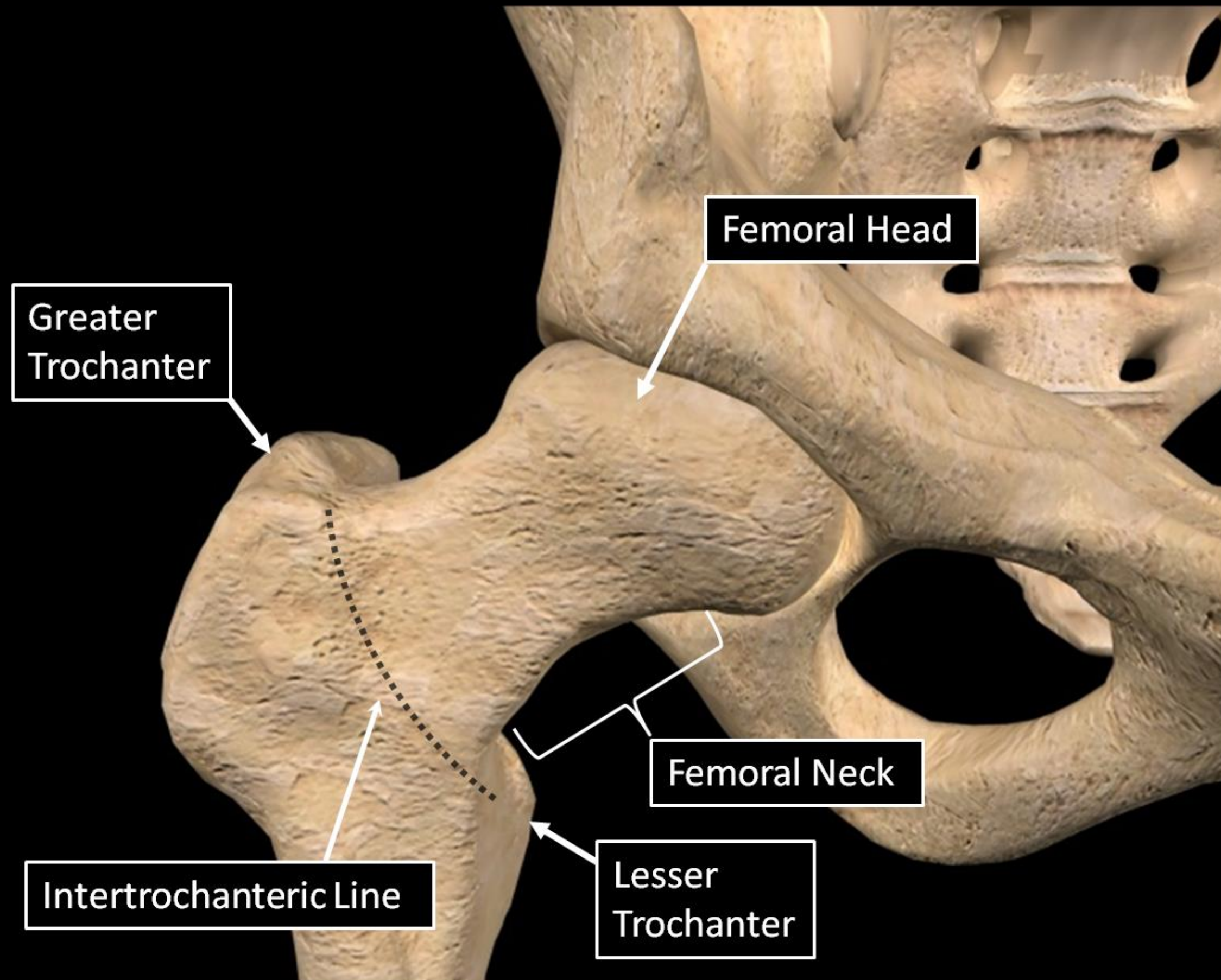
 Traumatic Hip Dislocation: What
 the Orthopedic Surgeon Wants to
 Know¹

 Pelvic Ring Fractures: What the
 Orthopedic Surgeon Wants to
 Know¹

 Imaging Features and Manage-
 ment of Stress, Atypical, and
 Pathologic Fractures

 Bone Marrow Edema at Dual-
 Energy CT: A Game Changer in
 the Emergency Department

Hip Joint



We come into the world under the brim of the pelvis and go out through the neck of FEMUR

Sir John Charnley

Hip Fractures

- **250,000 per year in United States**
- **Rising incidence (500,000 by 2040)**
- **A delay of only two days can double the mortality**
- **Post traumatic osteonecrosis**
 - **Non-displaced Fx: 10-15%**
 - **Displaced Fx: 30-35%**
- **Treatment in 24 hours**

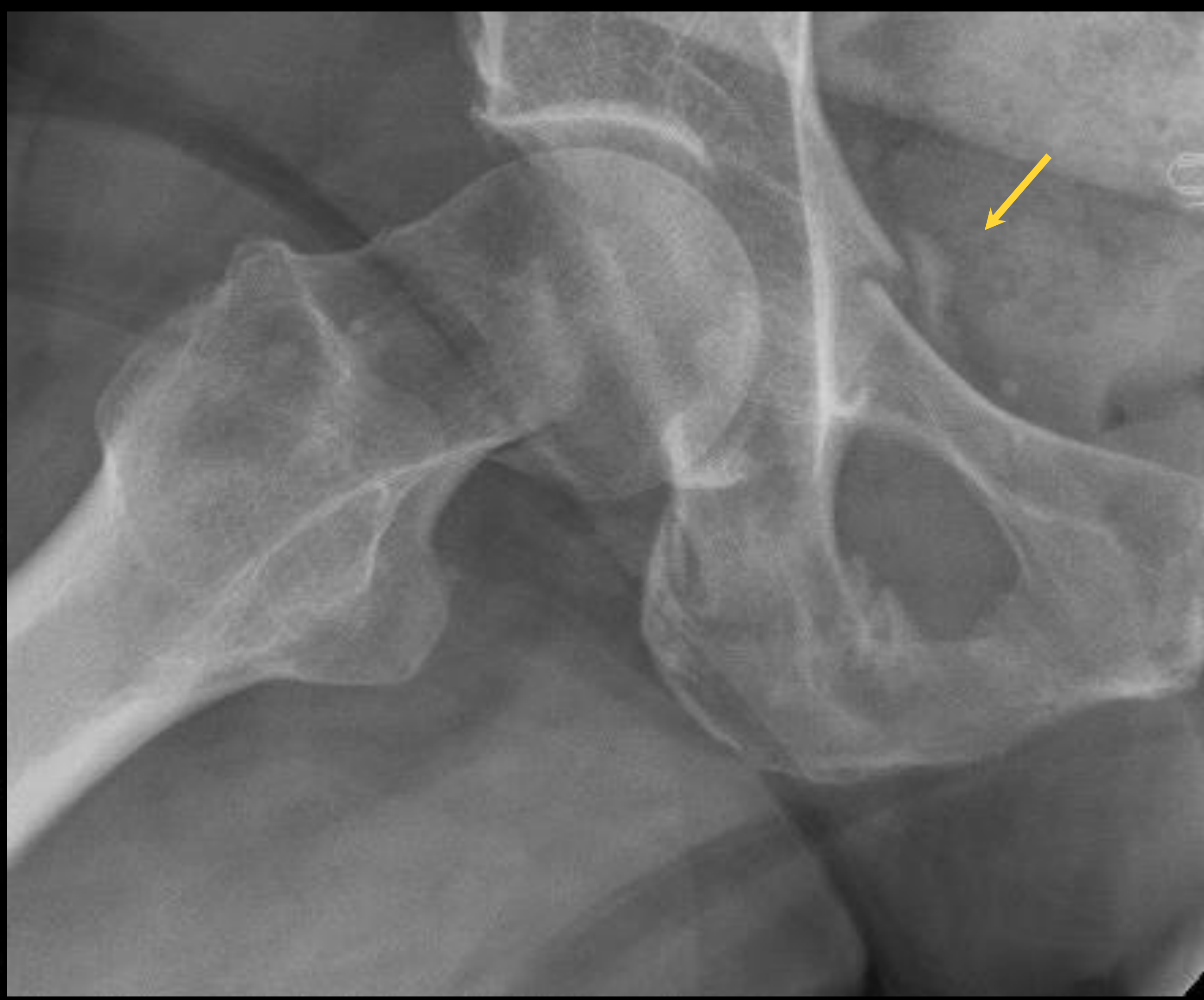


63-year-old woman, s/p fall from standing

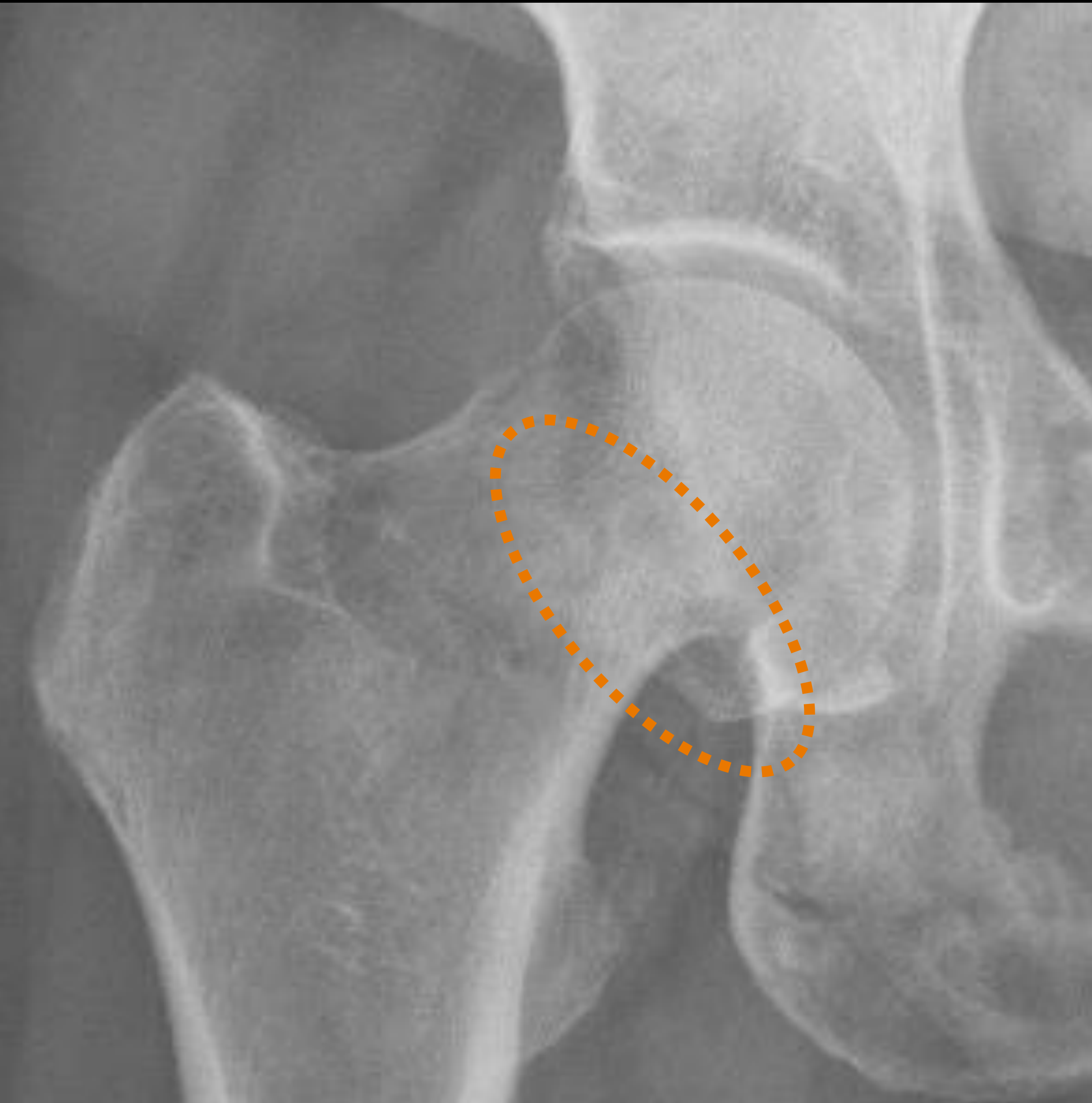


What is the next best step?

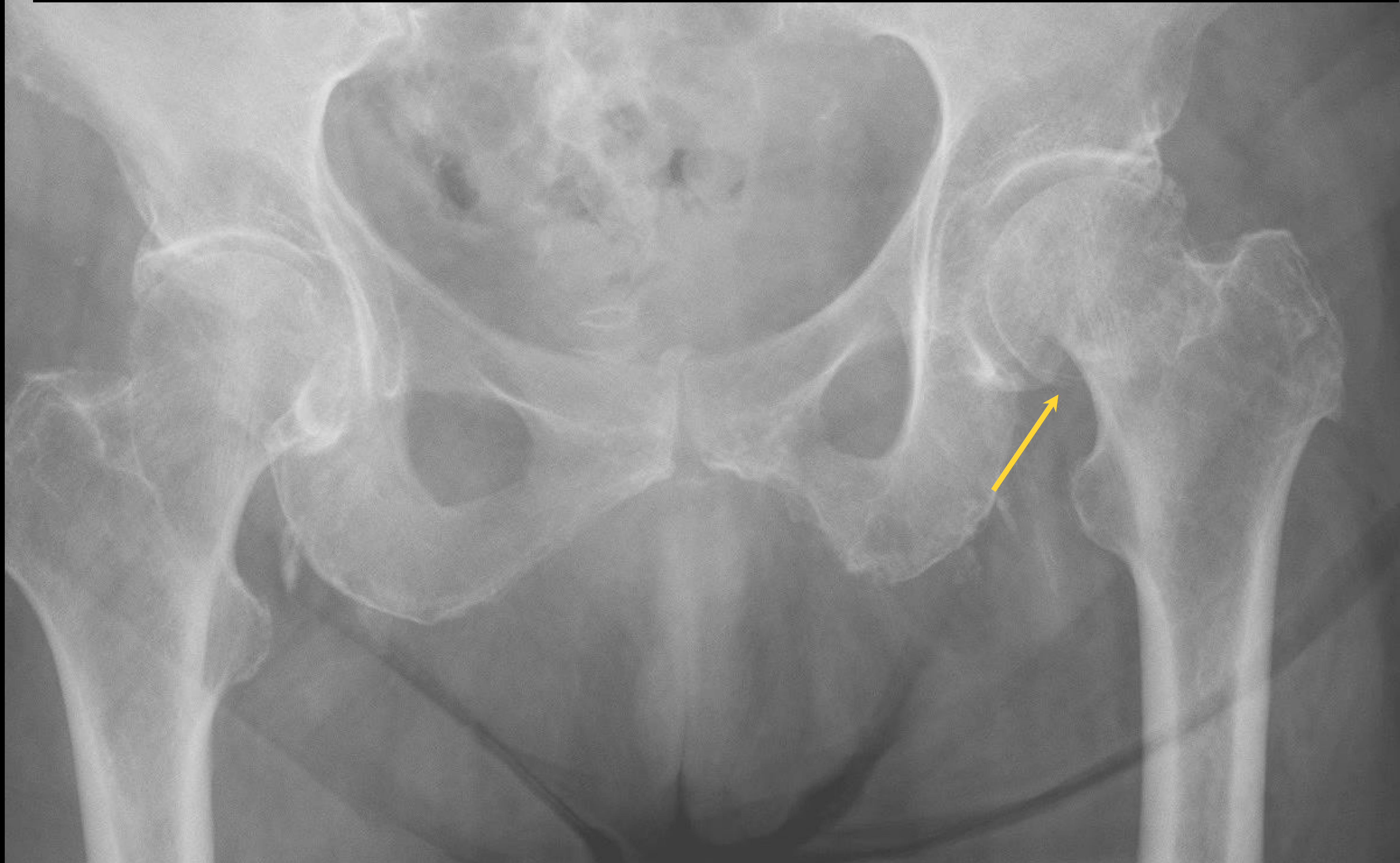
- Further imaging with CT
- Further imaging with MRI
- Surgical consult
- Conservative treatment

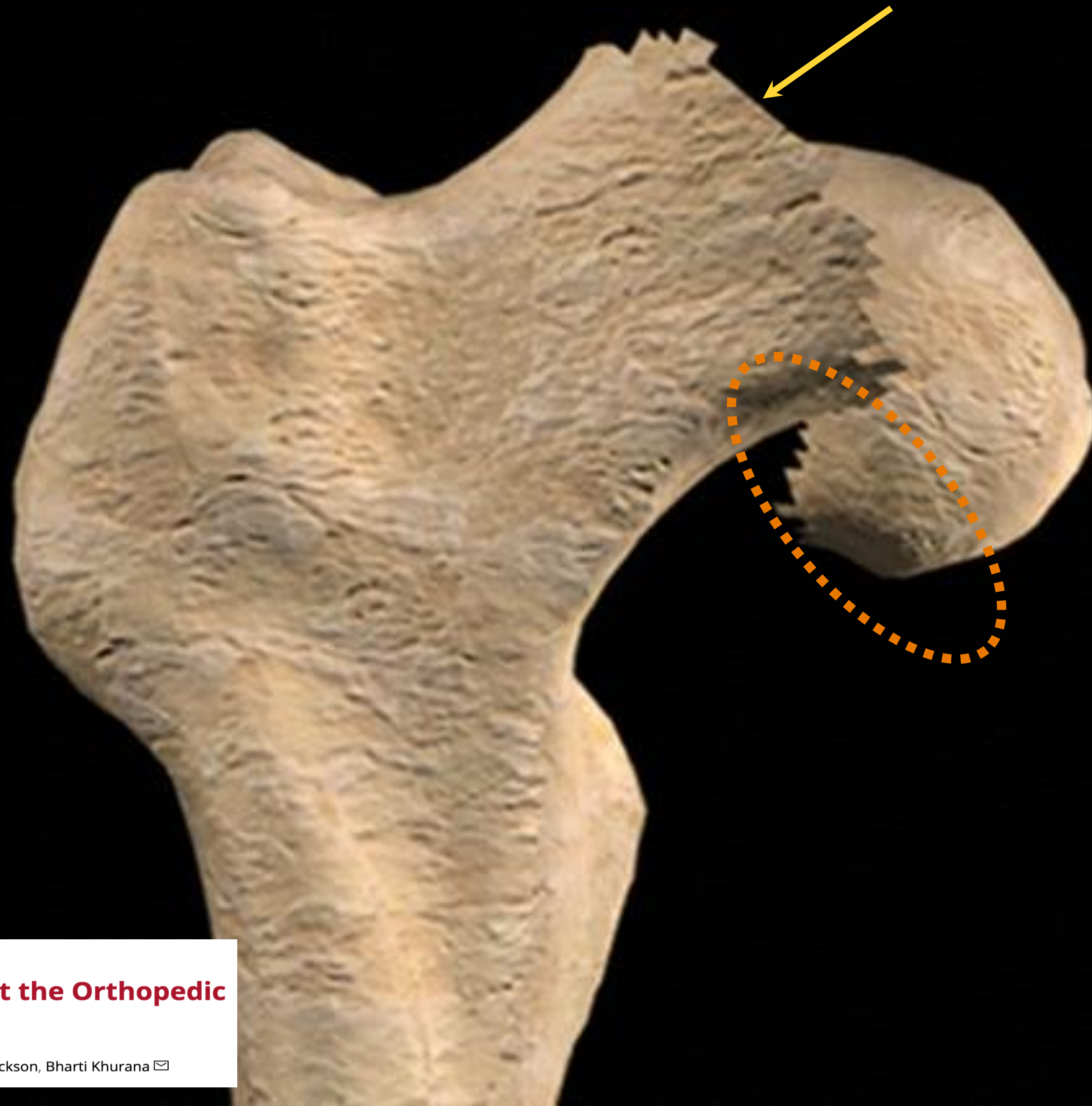


Varus impacted sub-capital femoral neck Fx



Varus impacted sub-capital femoral neck Fx



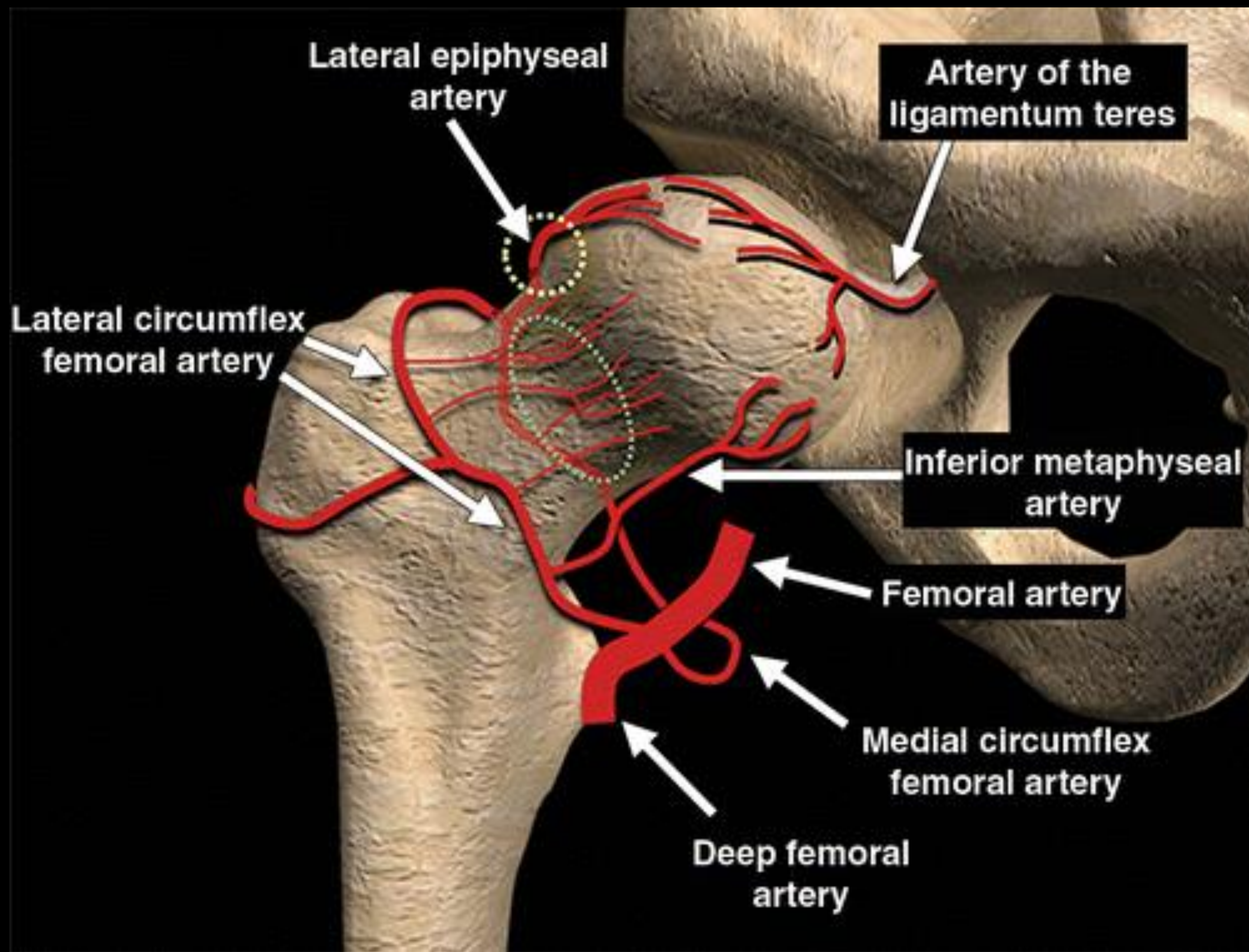


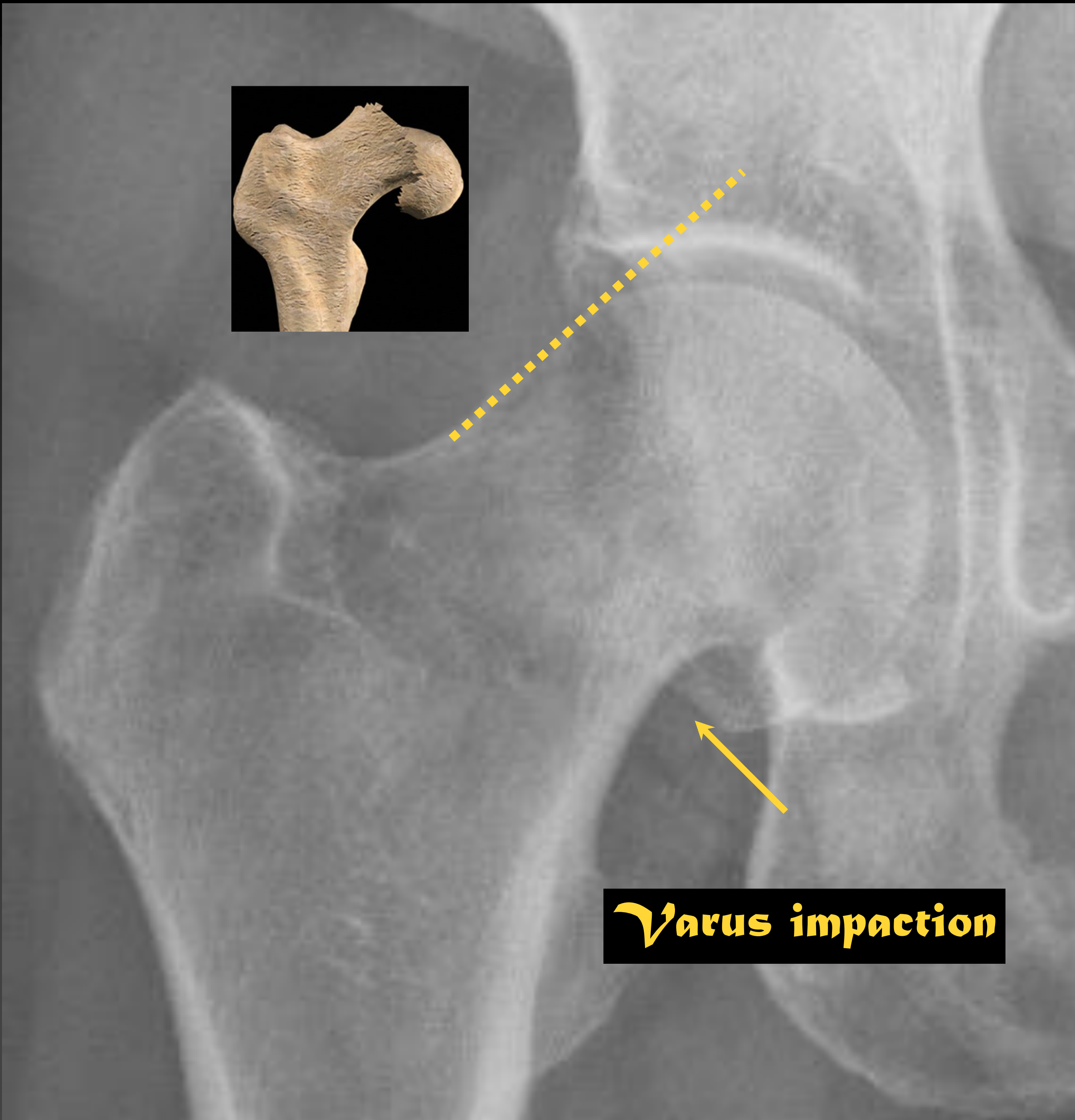
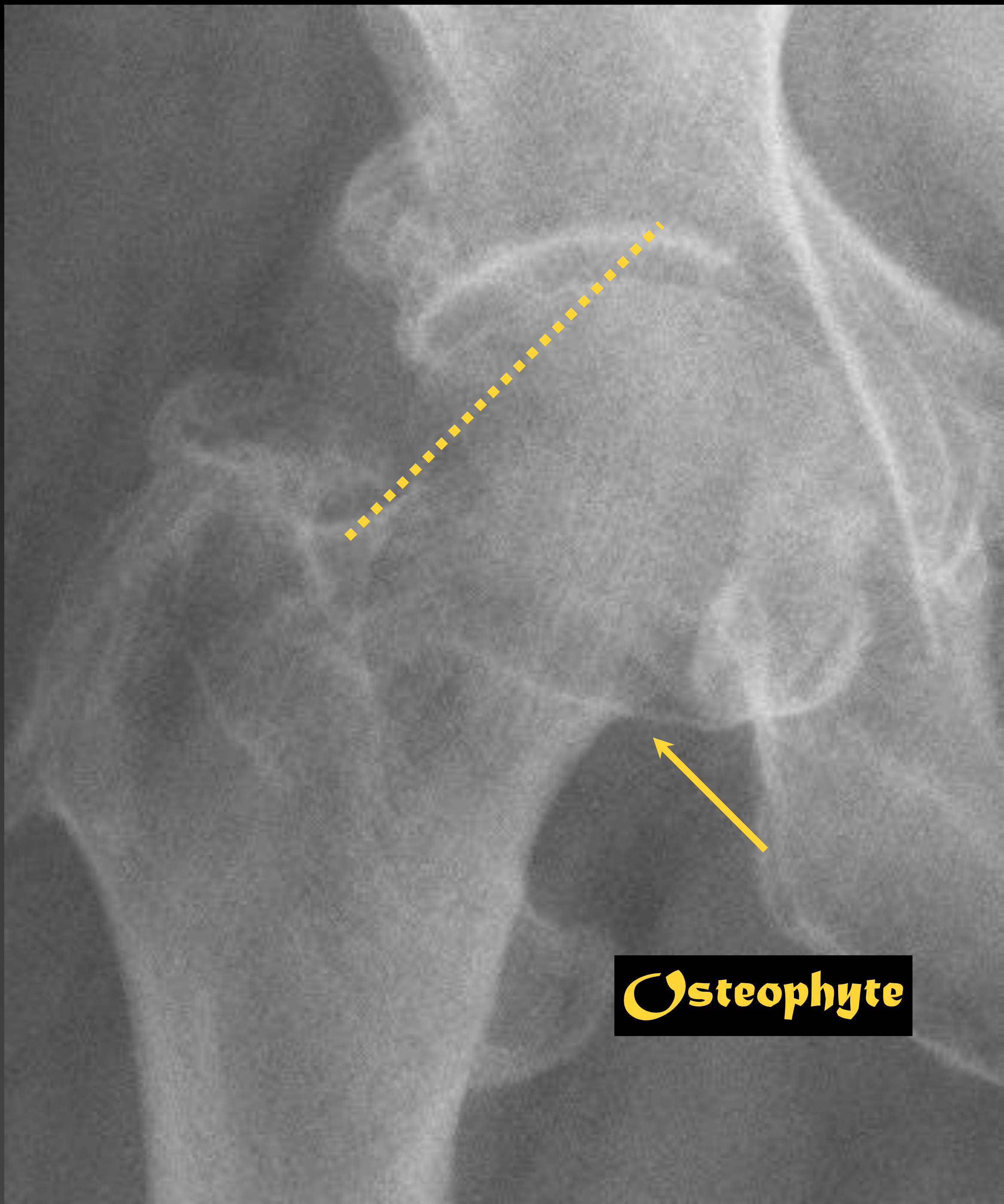
Trauma/Emergency Radiology

Proximal Femoral Fractures: What the Orthopedic Surgeon Wants to Know

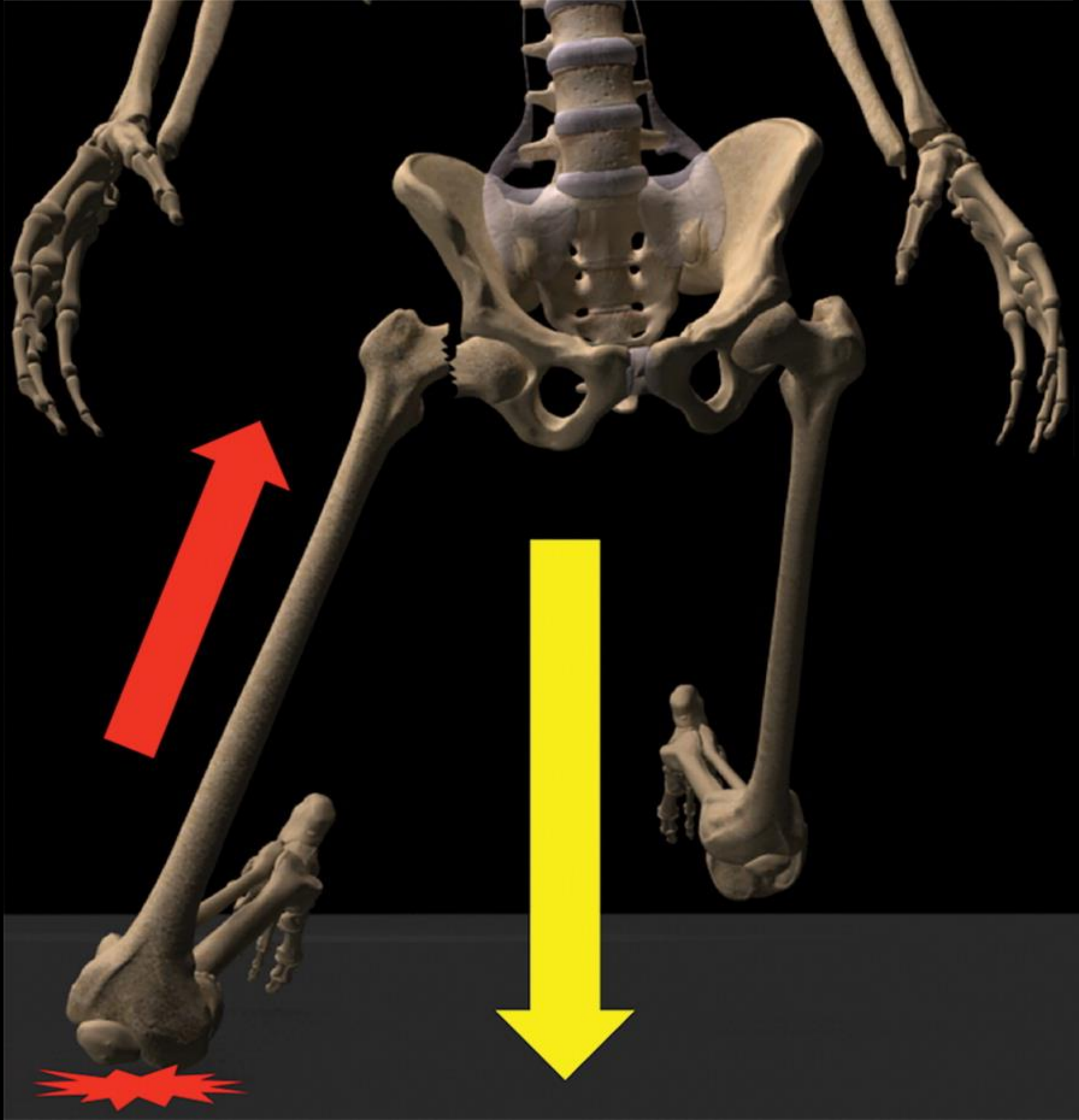
Scott E. Sheehan¹, Jeffrey Y. Shyu, Michael J. Weaver, Aaron D. Sodickson, Bharti Khurana [✉](#)



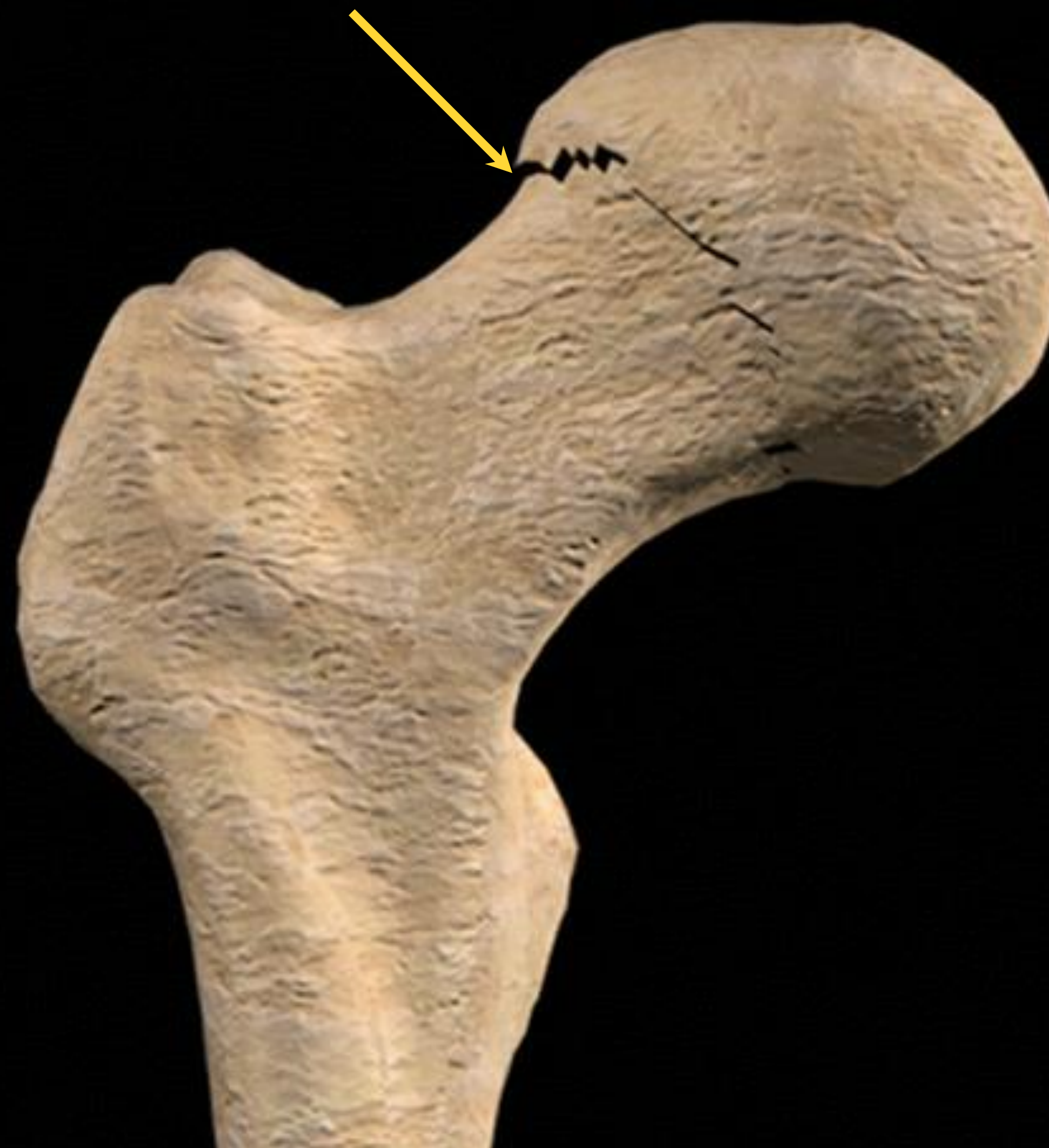








Valgus Impaction



Osteophytes



Valgus Impaction





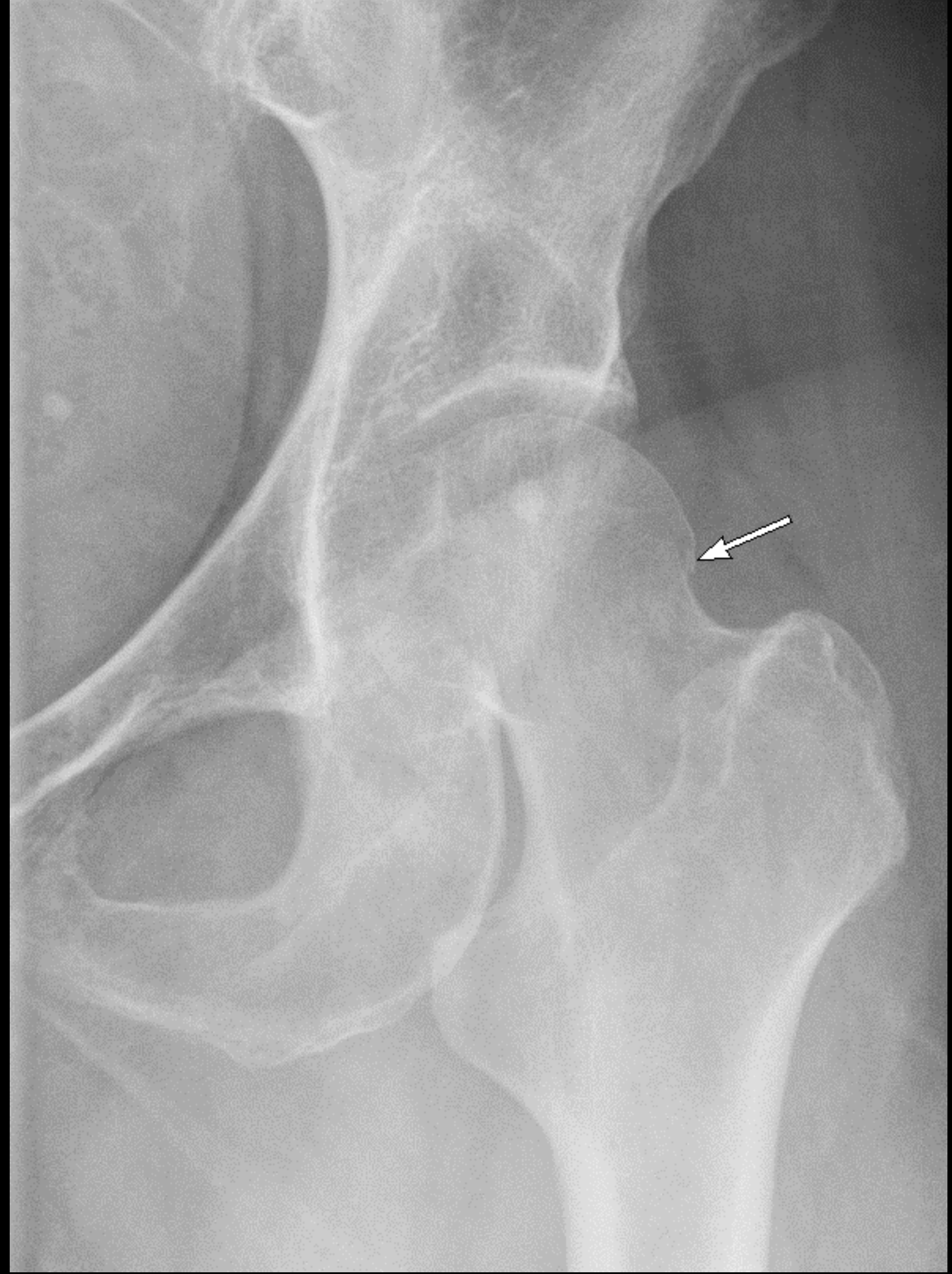
Need Correct View



External Rotation



Internal Rotation



Femoral neck Fx

Non displaced

Displaced



Young (<65) and/or active

Goal: Preserve femoral head, avoid osteonecrosis, achieve union



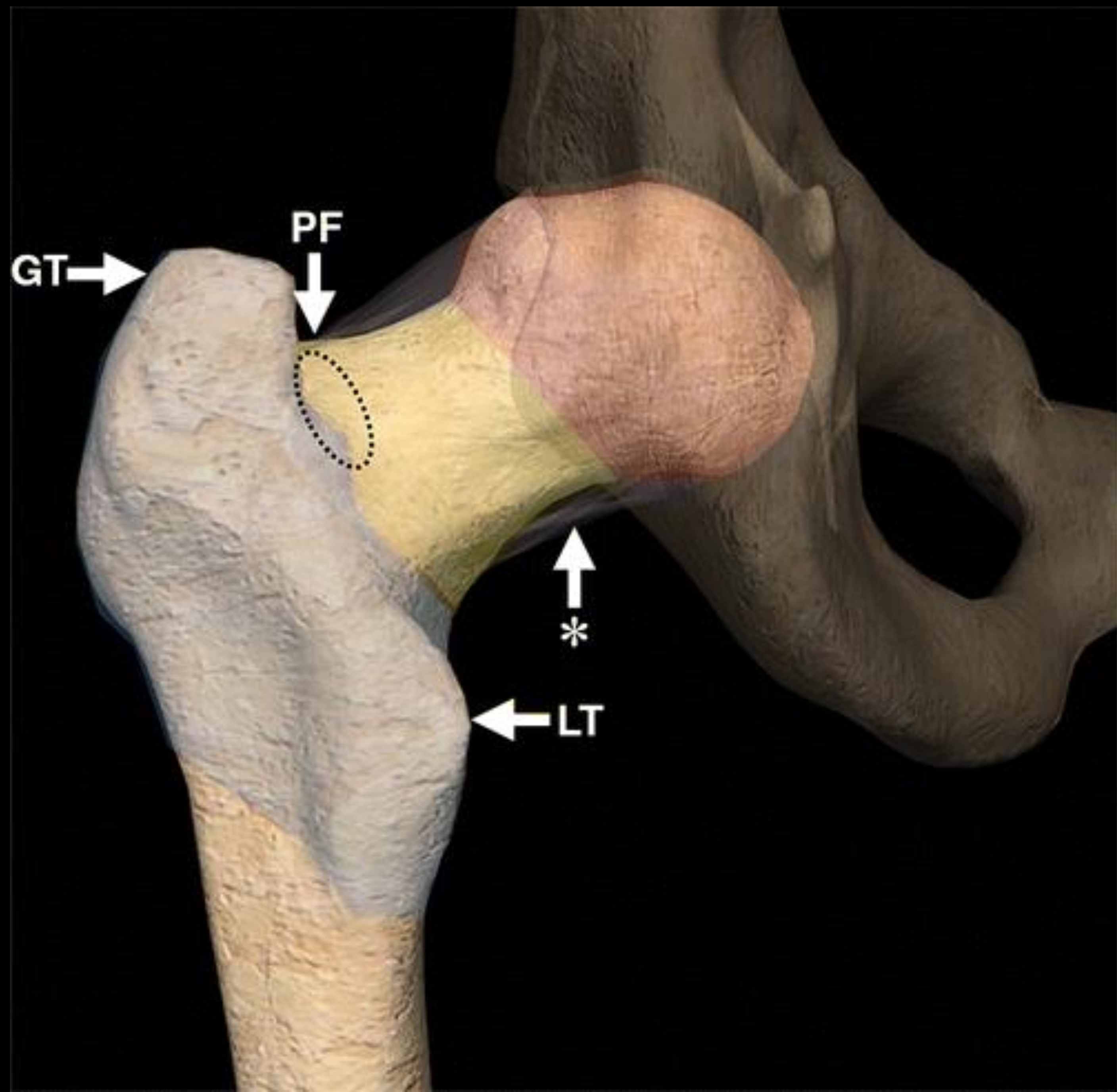
Old (>75) and/or immobile

Goal: Restore mobility and minimize complications



Basiccervical Fx





Femoral neck Fx



Treated as intracapsular

A photograph of a human femur with a subcapital fracture. The fracture line is located just below the femoral head, within the capsule of the hip joint. The bone is shown in a lateral view against a black background.



Treated as Extracapsular

A photograph of a human femur with a basicervical fracture. The fracture line is located below the femoral head, extending into the shaft of the femur, outside the capsule of the hip joint. The bone is shown in a lateral view against a black background.

Sub capital

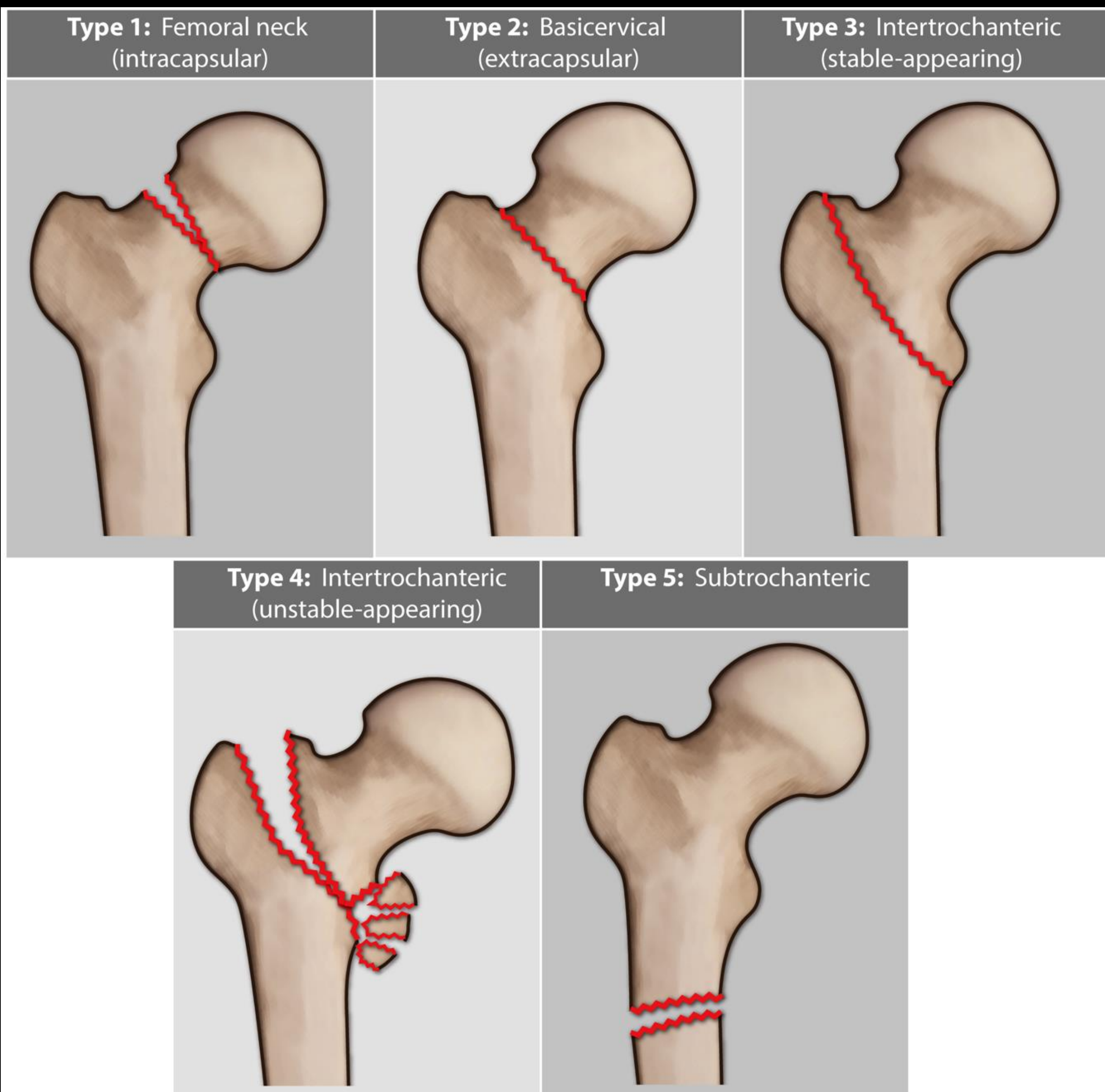
Transcervical

Basicervical





What Really Matters



Internal Rotation Traction Radiograph Improves Proximal Femoral Fracture Classification Accuracy and Agreement

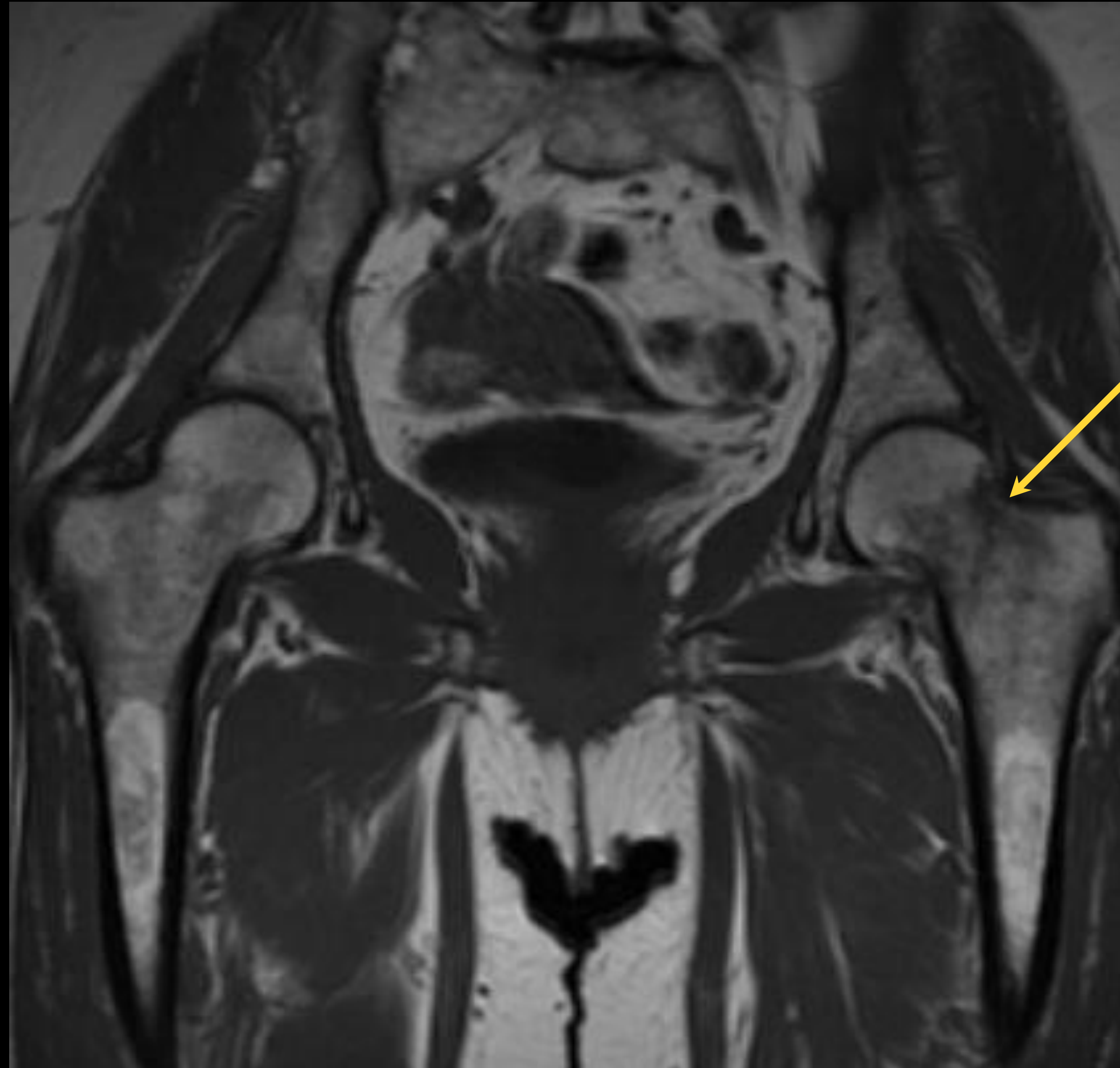
Khurana B, Mandell JC, Rocha TC, Duran-Mendicuti MA, Jimale H, Rosner B, Harris MB, Sodickson AD, Weaver MJ.

AJR Am J Roentgenol. 2018 Aug;211(2):409-15.

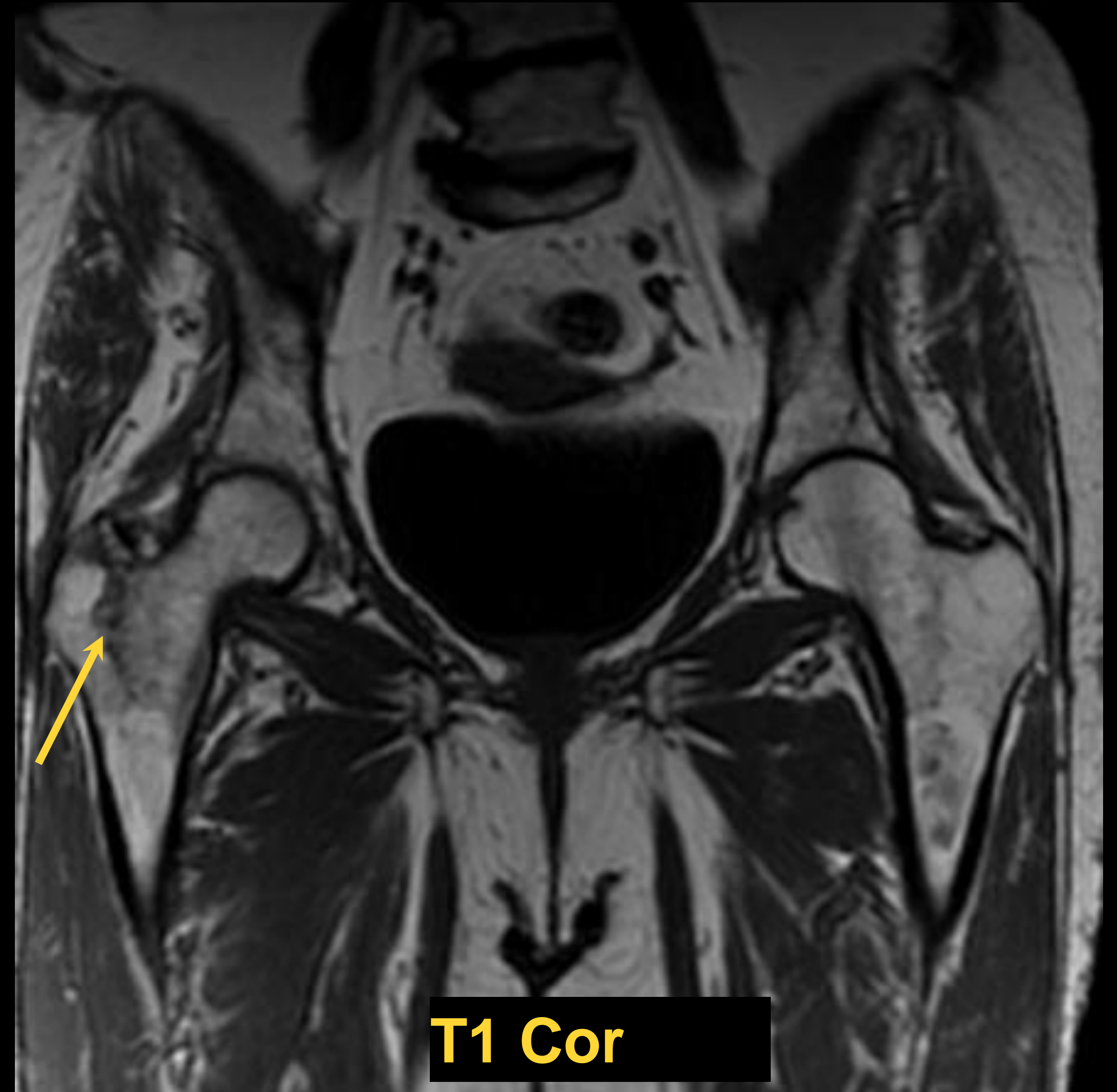
Where is the Fx?



Occult Hip Fx



Occult Hip Fx



Occult Hip Fx

- Incomplete Fx or complete Fx without displacement
- Micro-trabecular stress Fx with intact medial and lateral cortices
- More common in elderly with osteoporosis and minor trauma
- 28% of MR studies performed in BWH ED (64% pelvis, 36% femur)
- 39% of patients; 44% >80 years; 58% equivocal reports; 41% with history of trauma

Khurana B et al: Abbreviated MRI for Patients Presenting to the Emergency Department with Hip Pain. AJR 2012

Haj Mirzaian et al: Use of Advanced Imaging for Radiographically Occult Hip Fracture in Elderly Patients: A systematic review and meta-analysis. Radiology 2020

Fx on MRI

- Does not rely on cortical or trabecular displacement
- Based on presence of edema around the fracture site
- Linear pattern edema favors fracture over contusion



MR protocols

- **Bilateral hip**

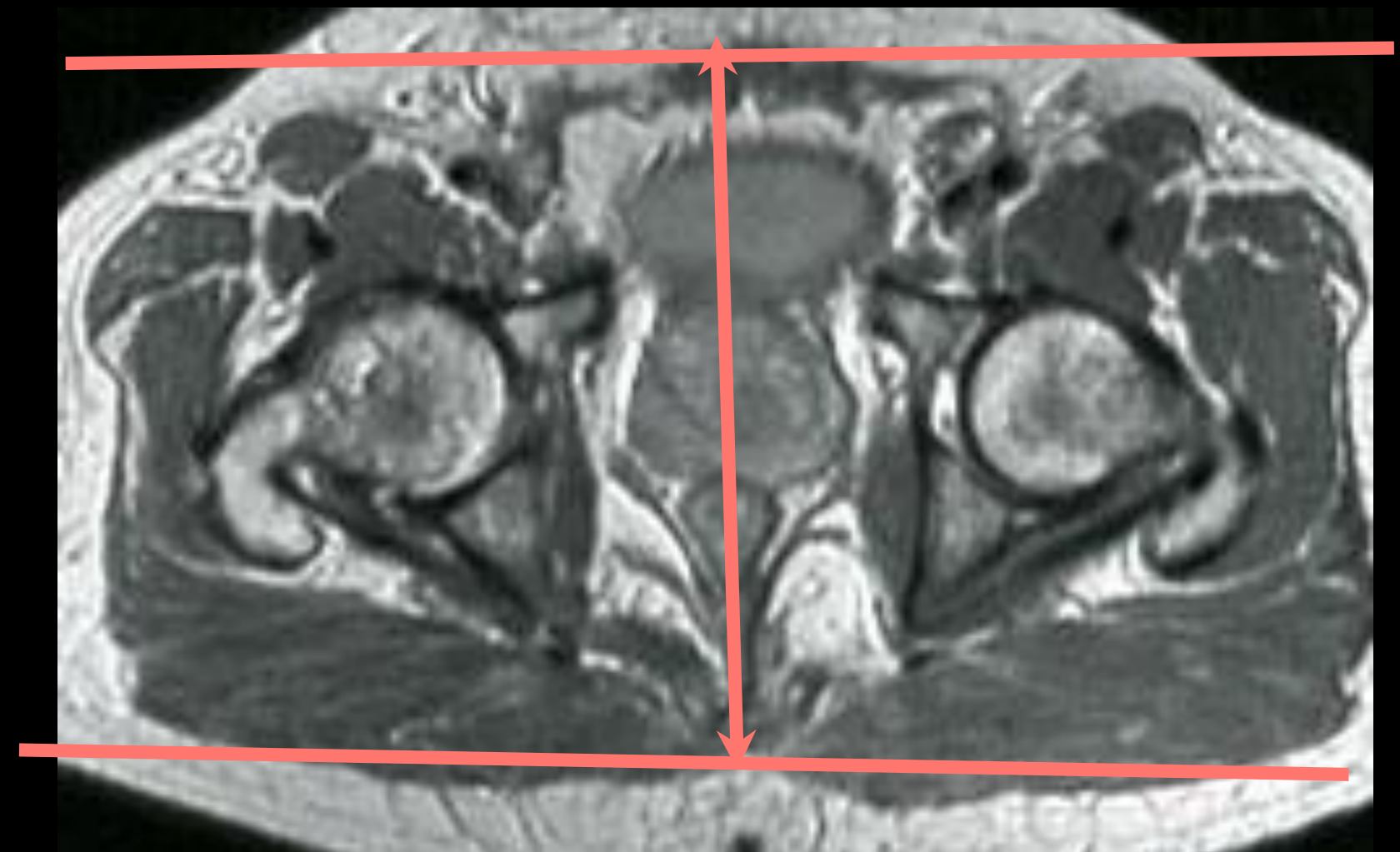
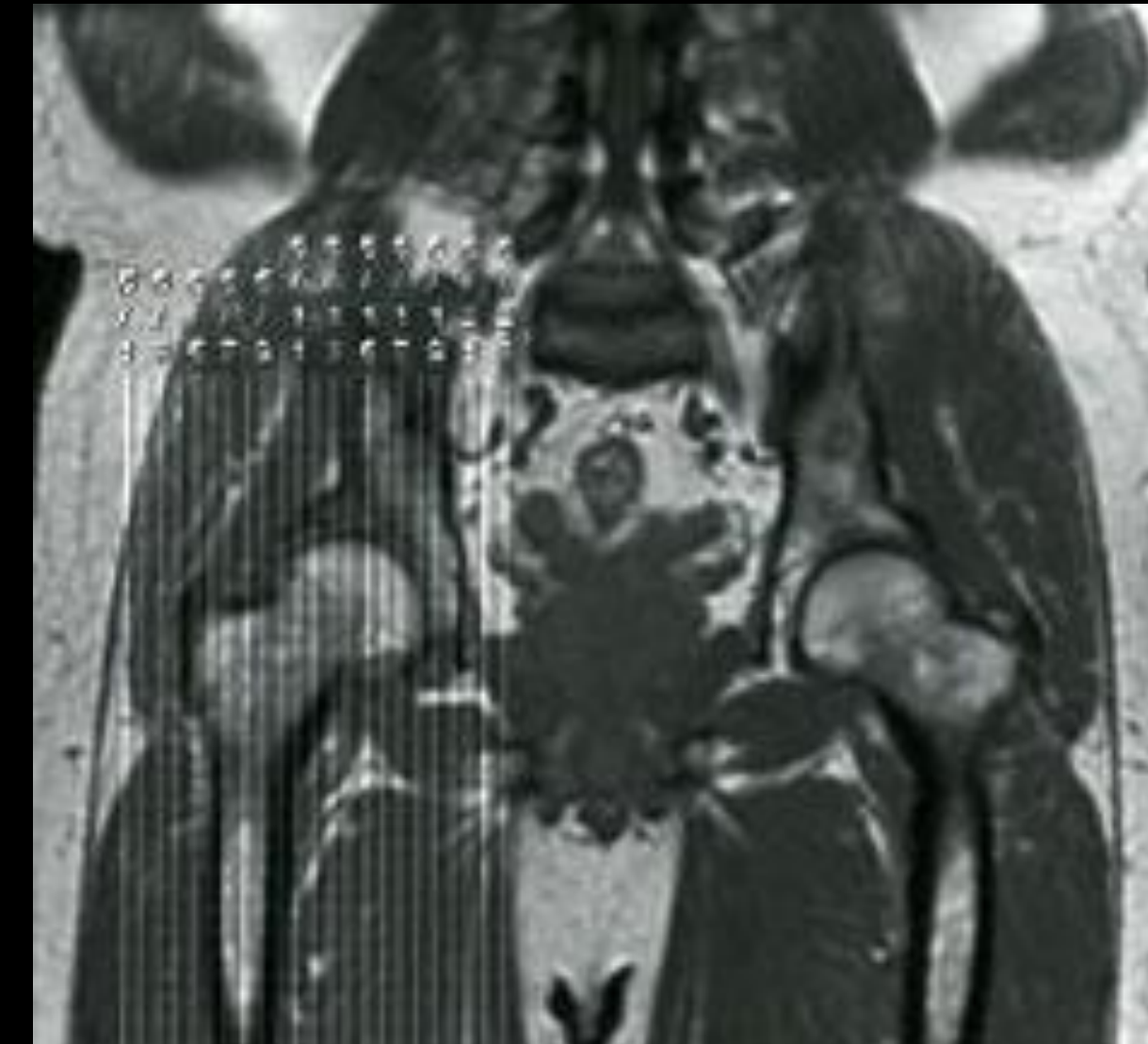
- STIR, T1 coronal
- PD FS, T2 FS axial
- T1, PD FS Sag

- **Unilateral hip**

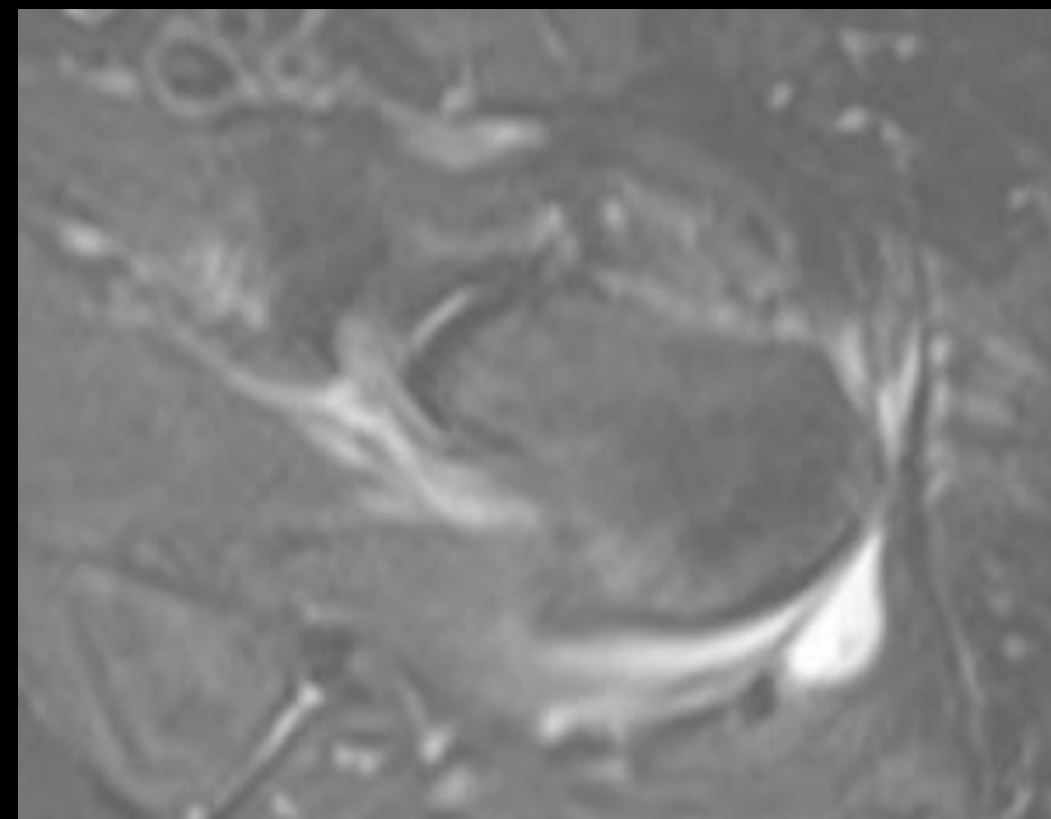
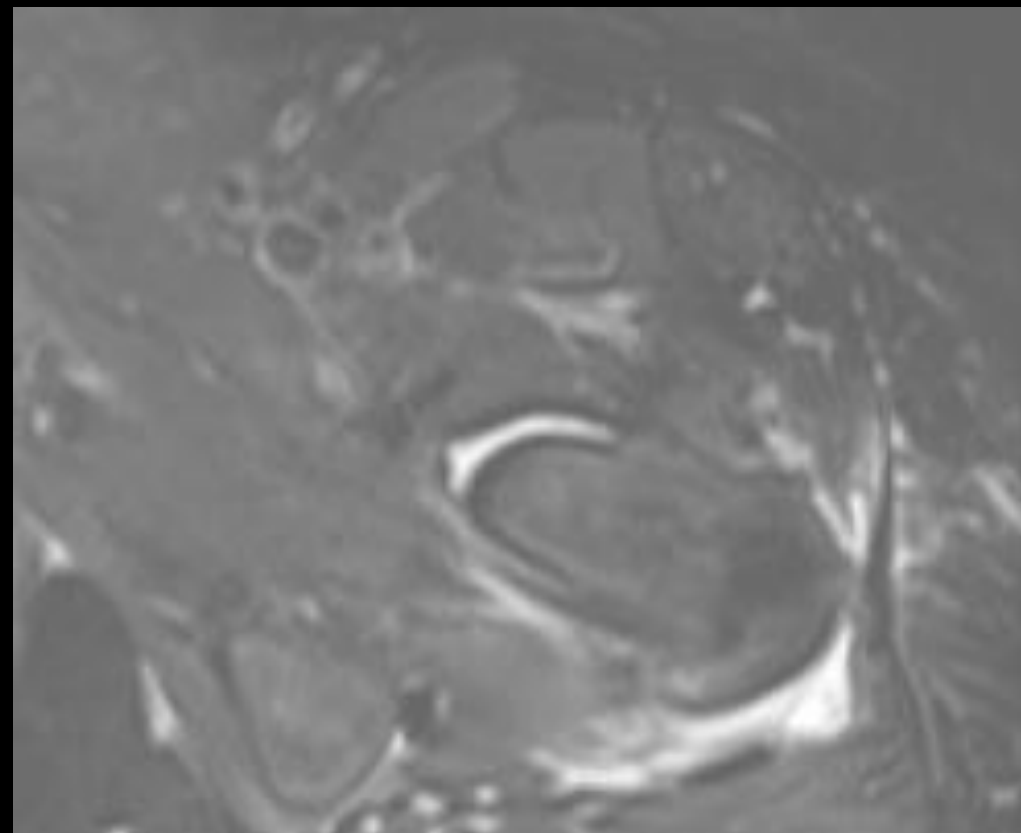
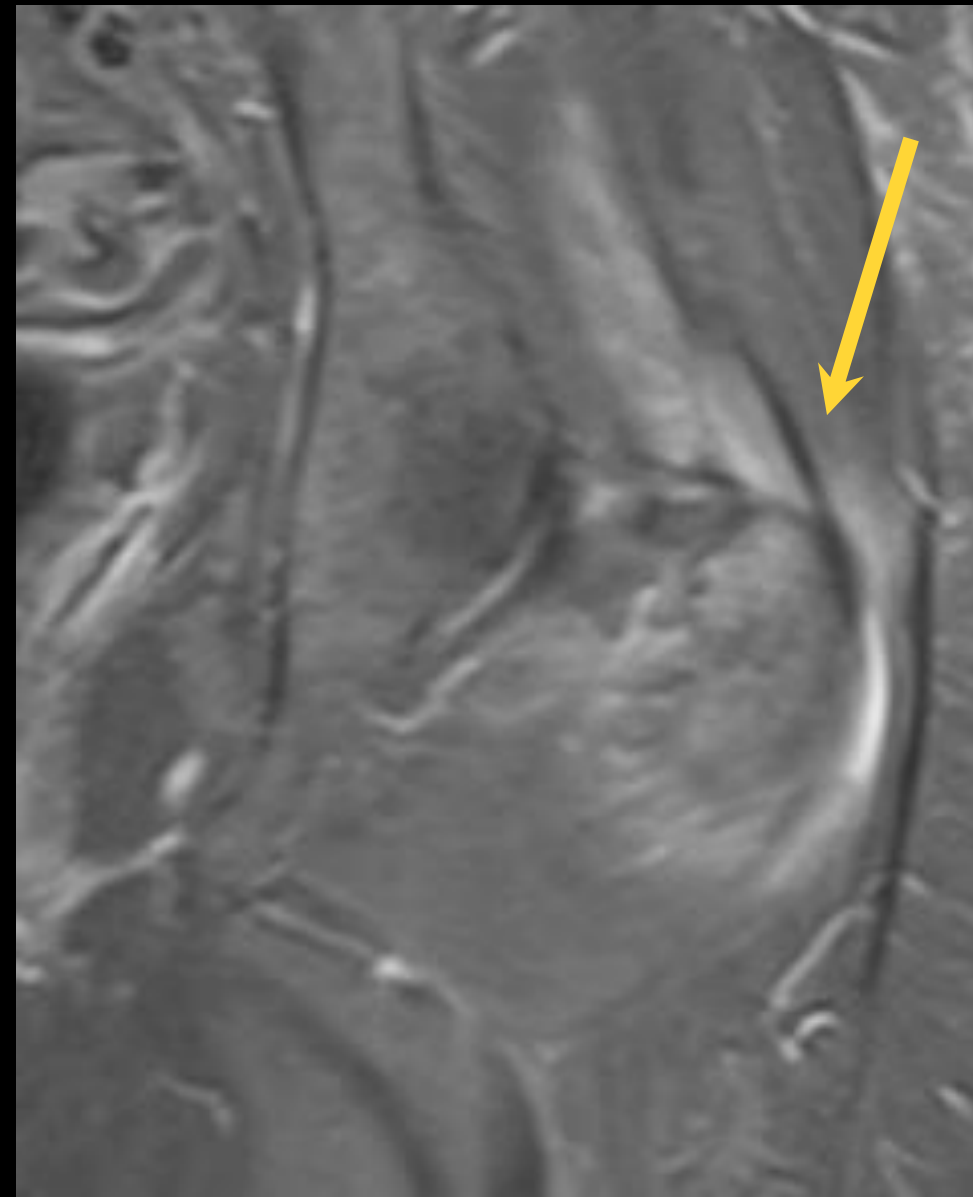
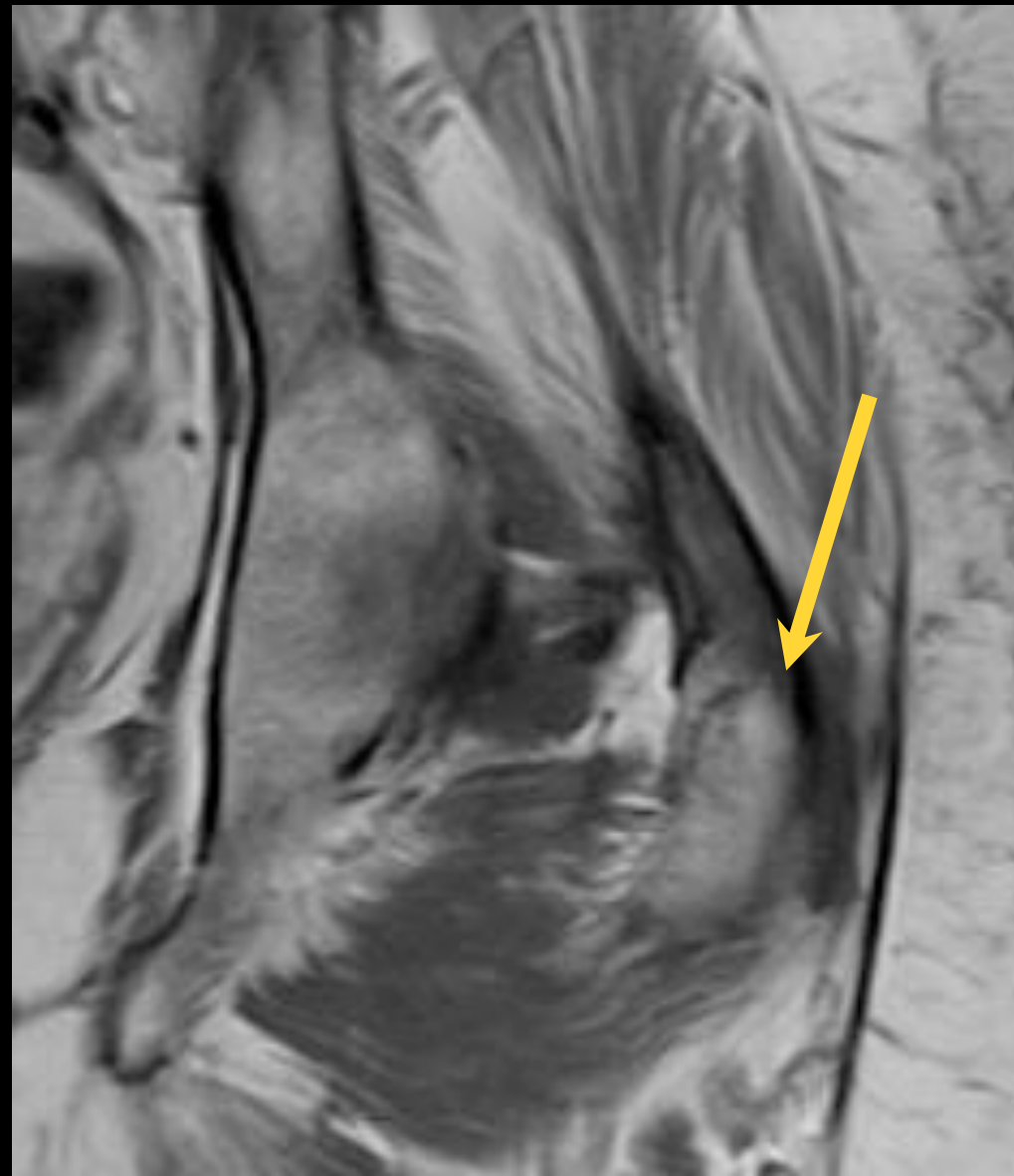
- STIR, T1 coronal (large FOV)
- PD, PD FS coronal and axial
- PD FS sag

- **Abbreviated hip MRI**

- STIR and T1 coronal (large FOV)
- STIR coronal, T1 coronal, T2 FS axial (large FOV)



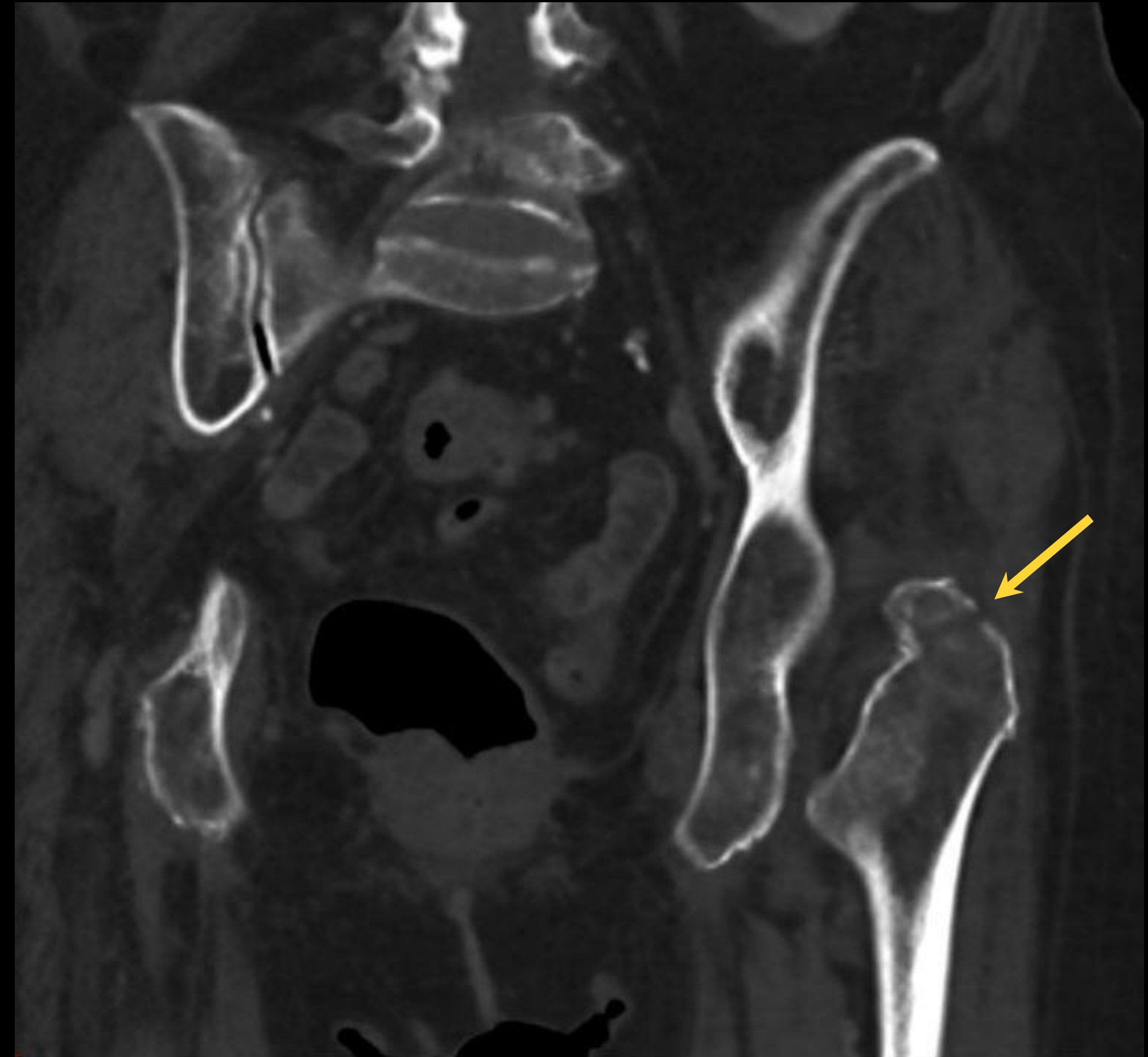
Fx on MRI



Greater Trochanter Fx



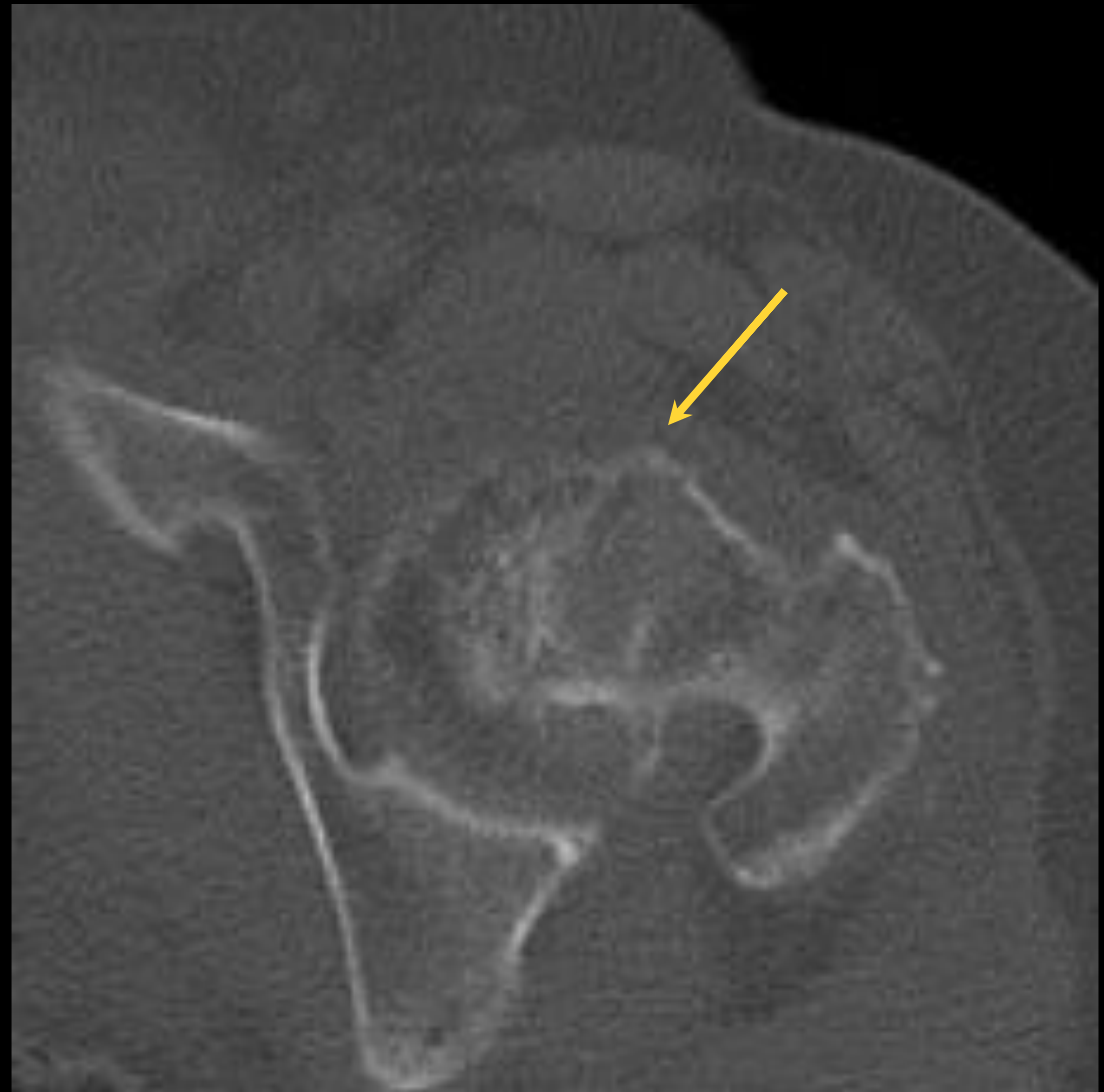
Greater Trochanter Fx



To CT or not to CT...

Study/year	Cases	Sensitivity for fracture	Remarks
Dunker (2012)	193	107/109 (98.2%)	MRI in 2 cases
Hakkarinen (2012)	24	20/24 (83%)	All patients included had fractures; 3/4 CT false negatives hip fractures
Gill (2013)	61	23/23 (100%)	None of the patients with negative CT had follow-up MR
Heikal (2014)	65	38/38 (100%)	None of the patients with negative CT had follow-up MR
Haubro (2015)	67	13/15 (87%)	All patients received MRI
Collin (2016)	44	11/20 (55%)	All patients had MRI subsequent to CT
Rehman (2016)	77	44/44 (100%)	MRI not performed in any patients who received CT
Sadozai (2016)	78	25/29 (86.2%)	2 patients had MRI
Thomas (2016)	199	106/106 (100%)	A total of 4 patients received MRI (3 confirming negative CT and 1 confirming femoral neck fracture)

Sub capital Fx on CT



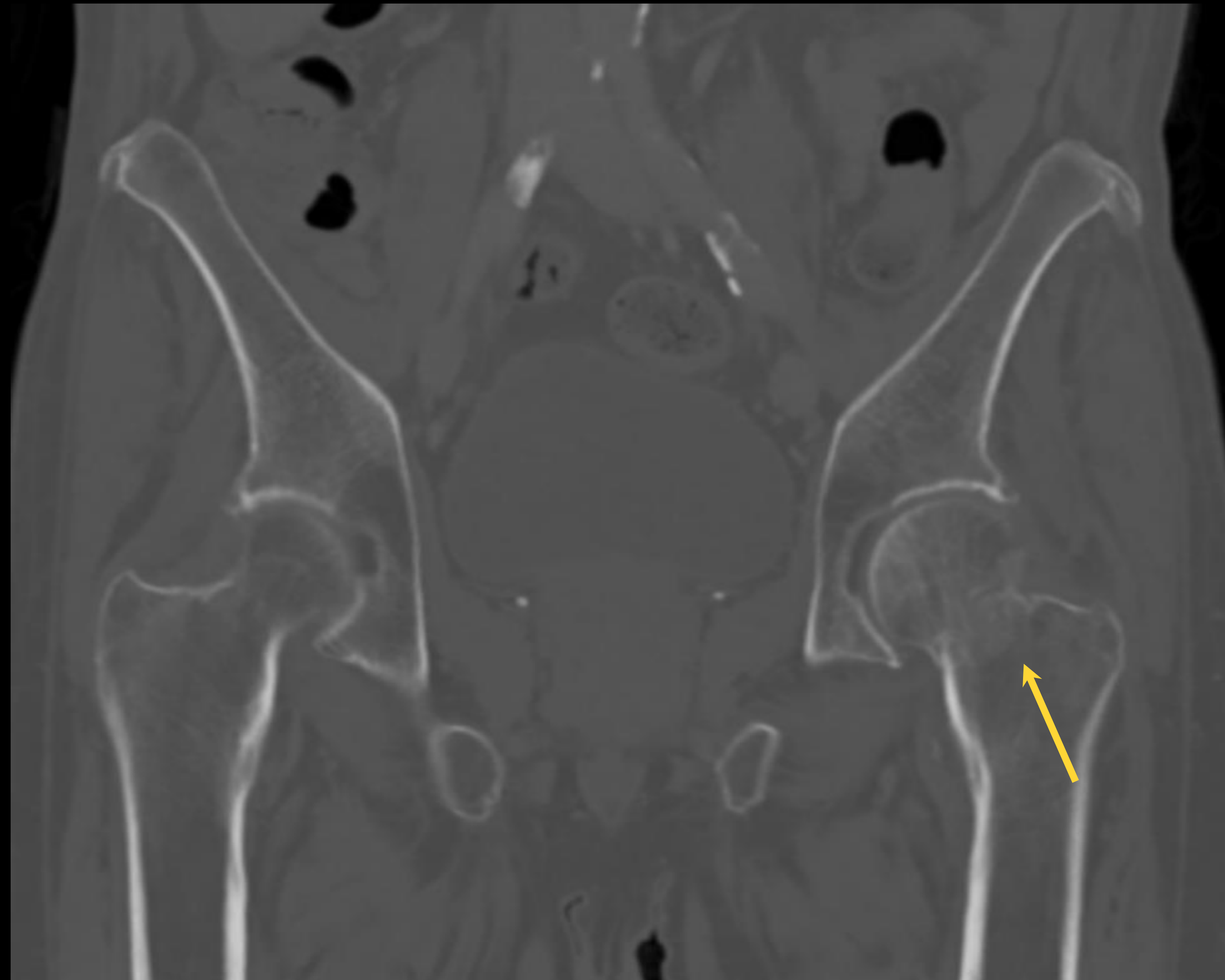
Femoral Fx on CT



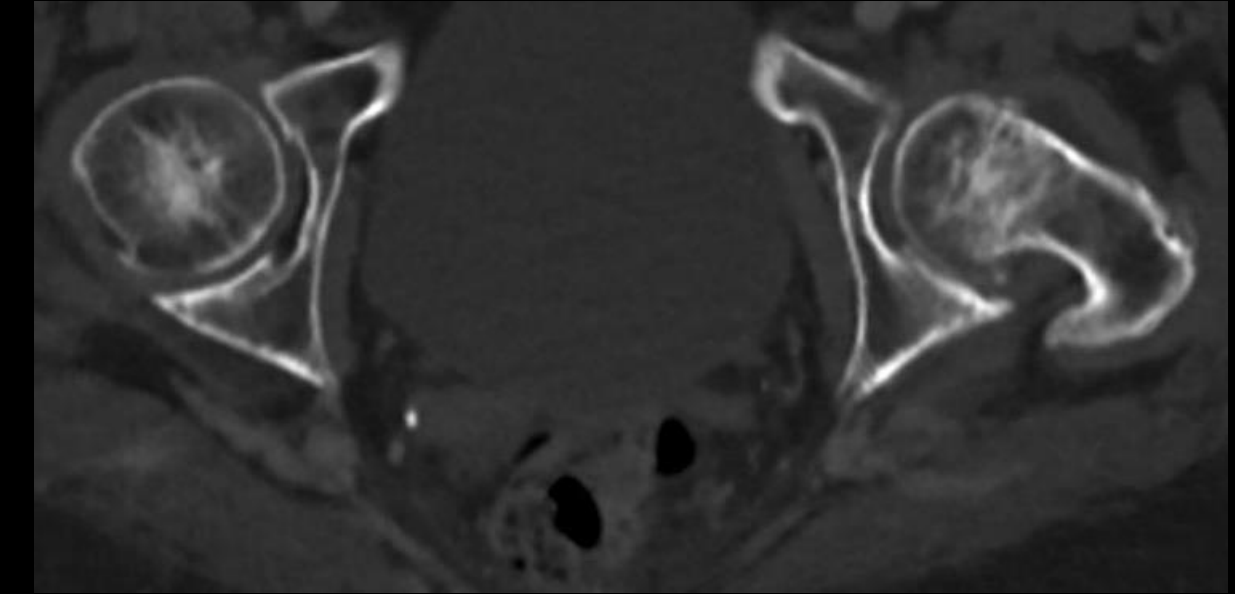
Femoral Fx on CT



Femoral Fx on CT

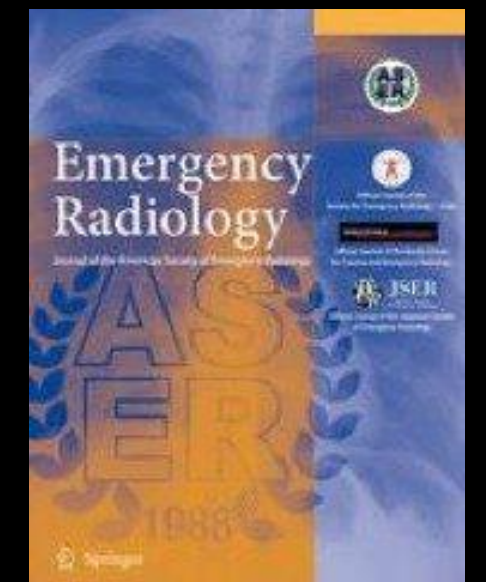


Femoral Fx on CT



Hip CT: Our Experience

CT positive for fracture	Standard of Reference	Treatment
Pelvic/sacral fracture: 15 patients (including 1 patient with a femoral head fracture)	Pelvic/sacral fracture (MRI in 2 patients confirming no other injuries)	Conservative in all cases
Nondisplaced subtrochanteric fracture: 1 patient	Nondisplaced subtrochanteric fracture	ORIF with intramedullary nail
Femoral neck fracture: 2 patients	Impacted femoral neck fracture (1)	ORIF with dynamic hip screw
	No fracture (CT false positive)	Conservative
Greater trochanteric fracture: 4 patients	Intertrochanteric fracture (MRI same day): 1	ORIF with dynamic hip screw
	Greater trochanter fracture (3)	Conservative
Intertrochanteric fracture: 1 patient	Intertrochanteric fracture	ORIF with dynamic hip screw



Computed tomography for occult fractures of the proximal femur, pelvis, and sacrum in clinical practice: single institution, dual-site experience
Mandell JC, Weaver MJ, Harris MB, Khurana B.

Emerg Radiol. 2018 Jun;25(3):265-73.

Hip CT: BWH Experience last 2 years

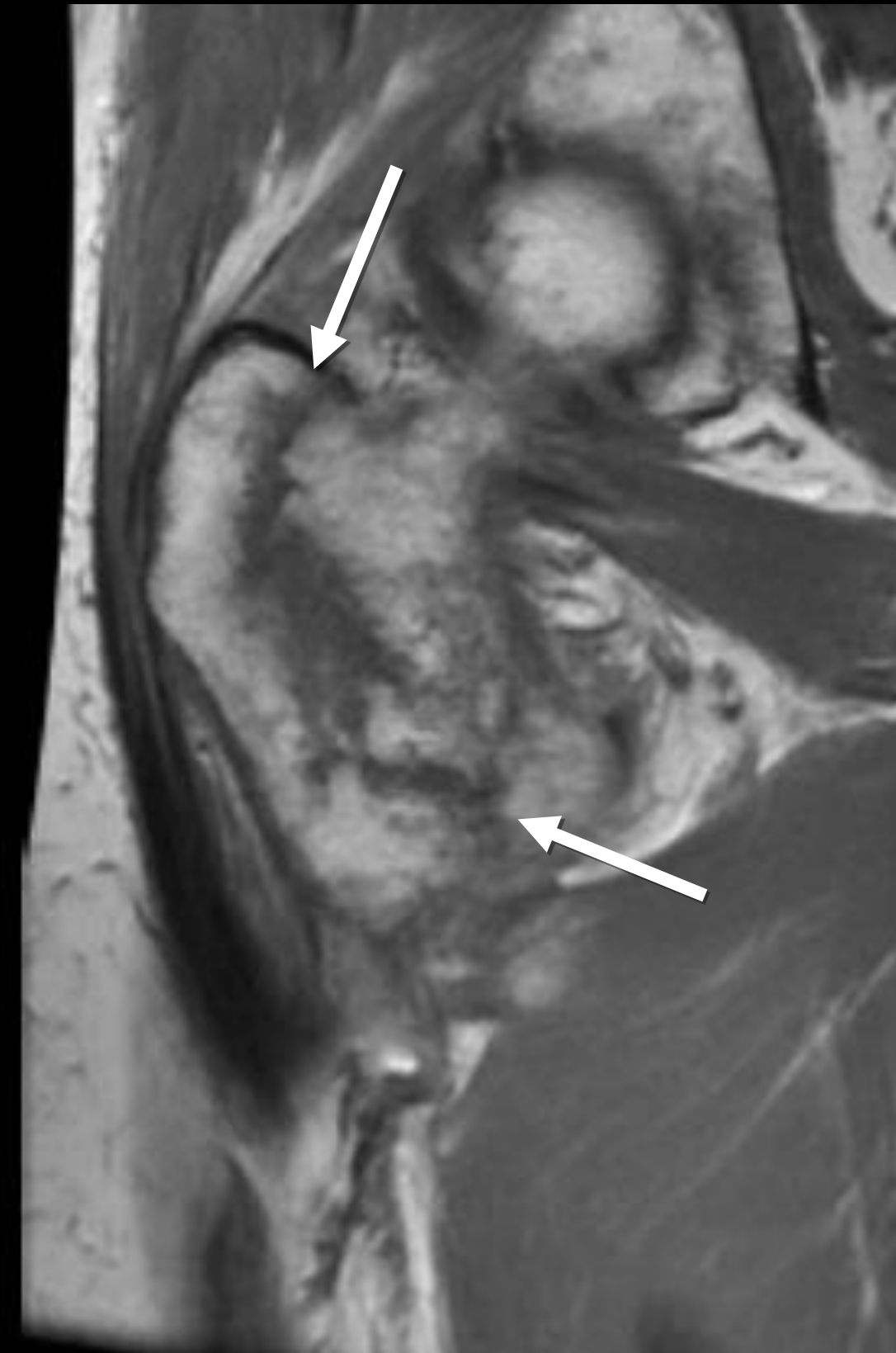
- Sensitivity: 88% (22/25)
- Specificity: 98% (48/49)
- PPV: 96%
- NPV: 94%

Sensitivity to detect femoral neck fracture requiring operative fixation was 60% (3/5)

False Negative CT



CT: Incomplete Information

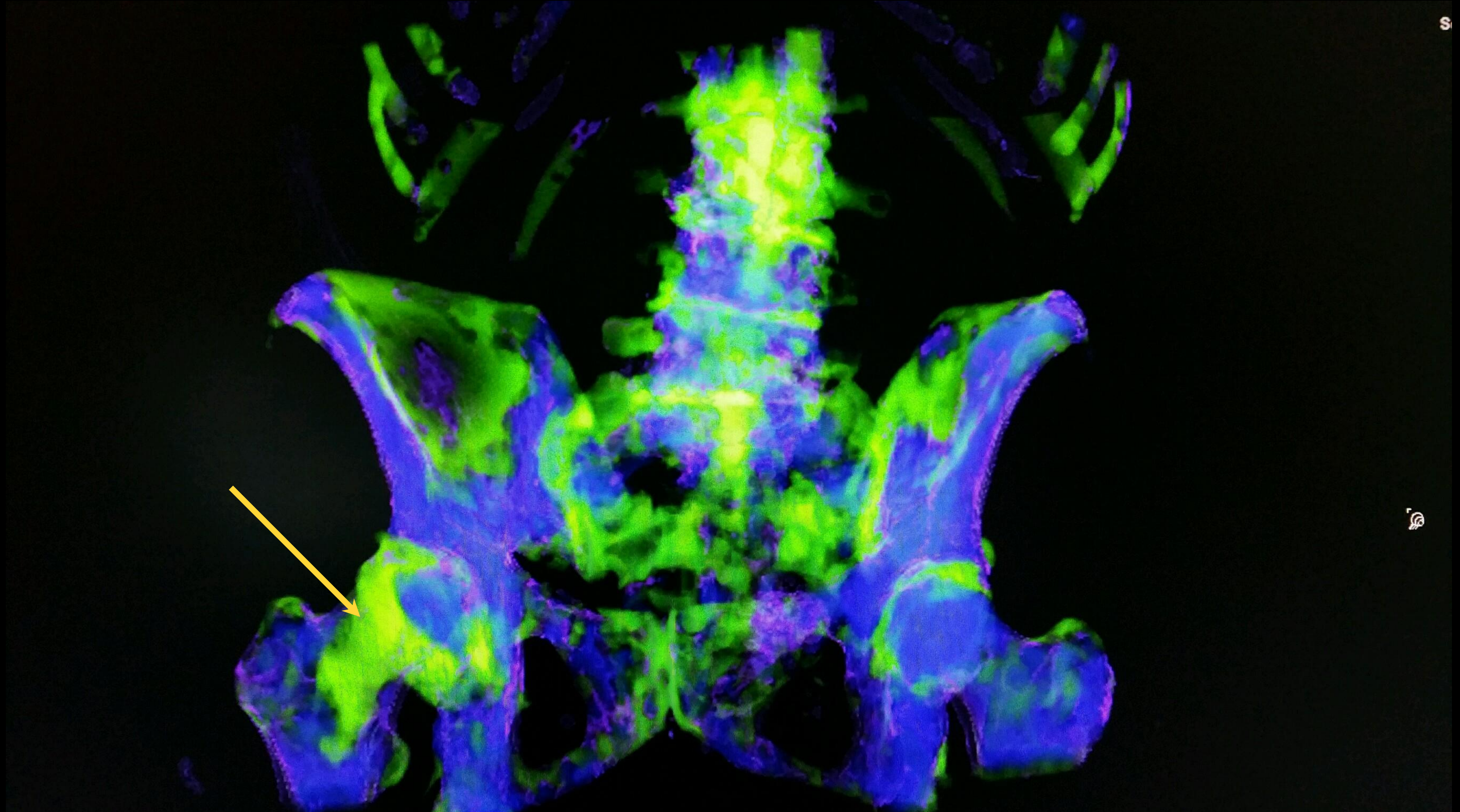


Diagnostic performance of CT for Occult Femoral Fractures

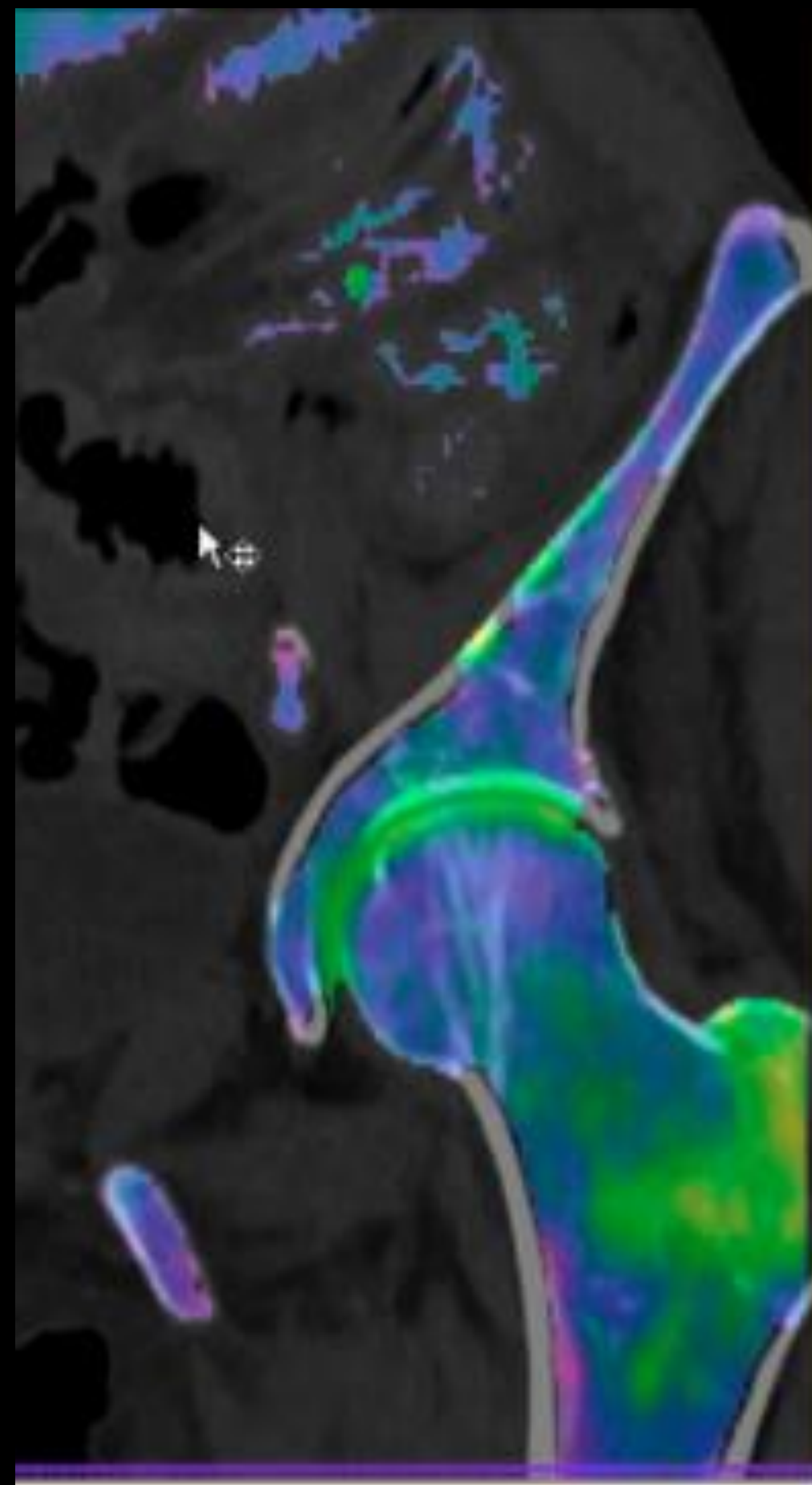
- Thirteen heterogeneously reported studies were assessed that included 1248 patients (496 with a hip fracture and 752 without) with MRI or clinical follow-up as the reference standard.
- There were 50 false-negative examinations.

Sensitivity to detect femoral neck fracture was 94% with 100% specificity

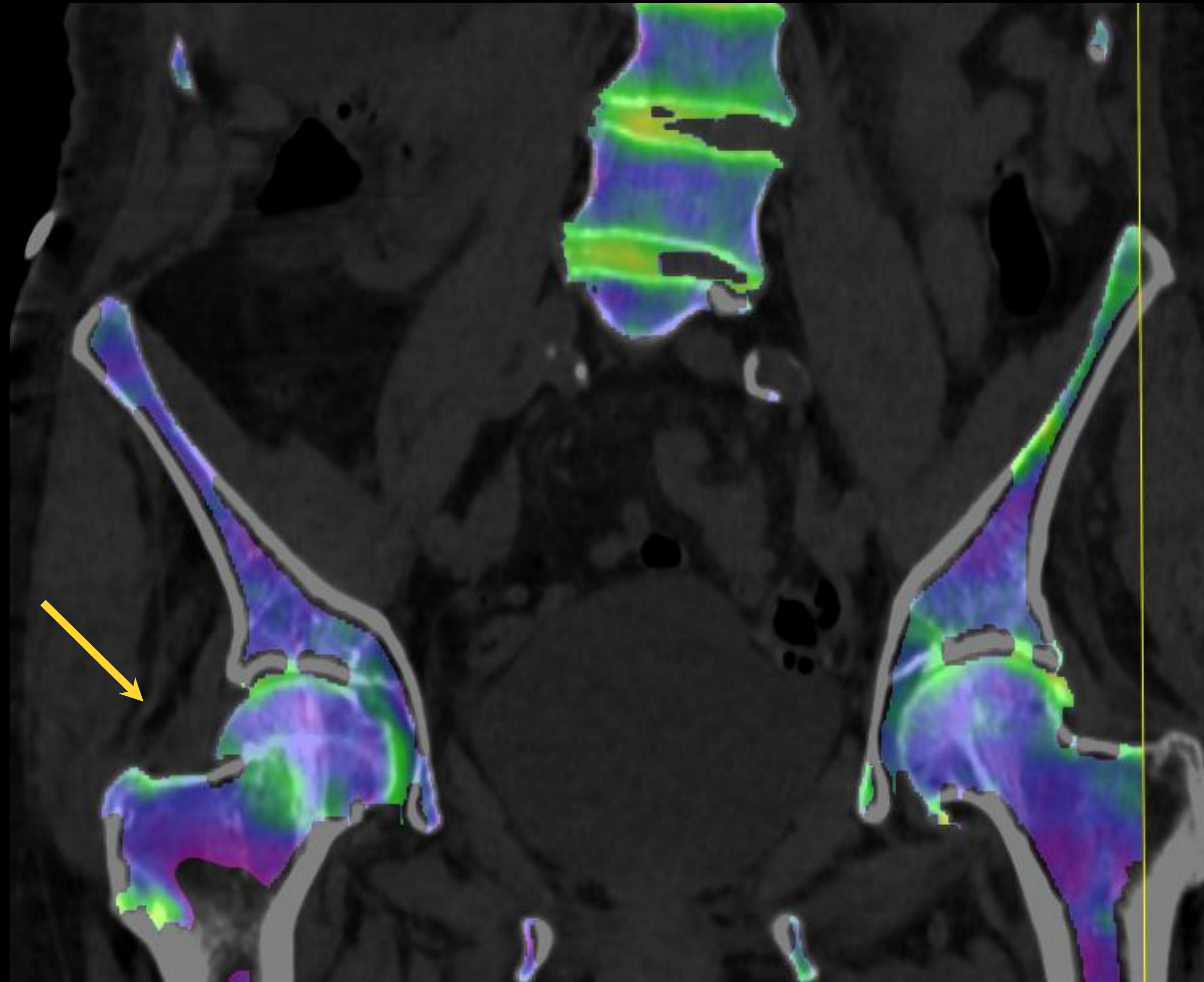
DECT in Hip Fx



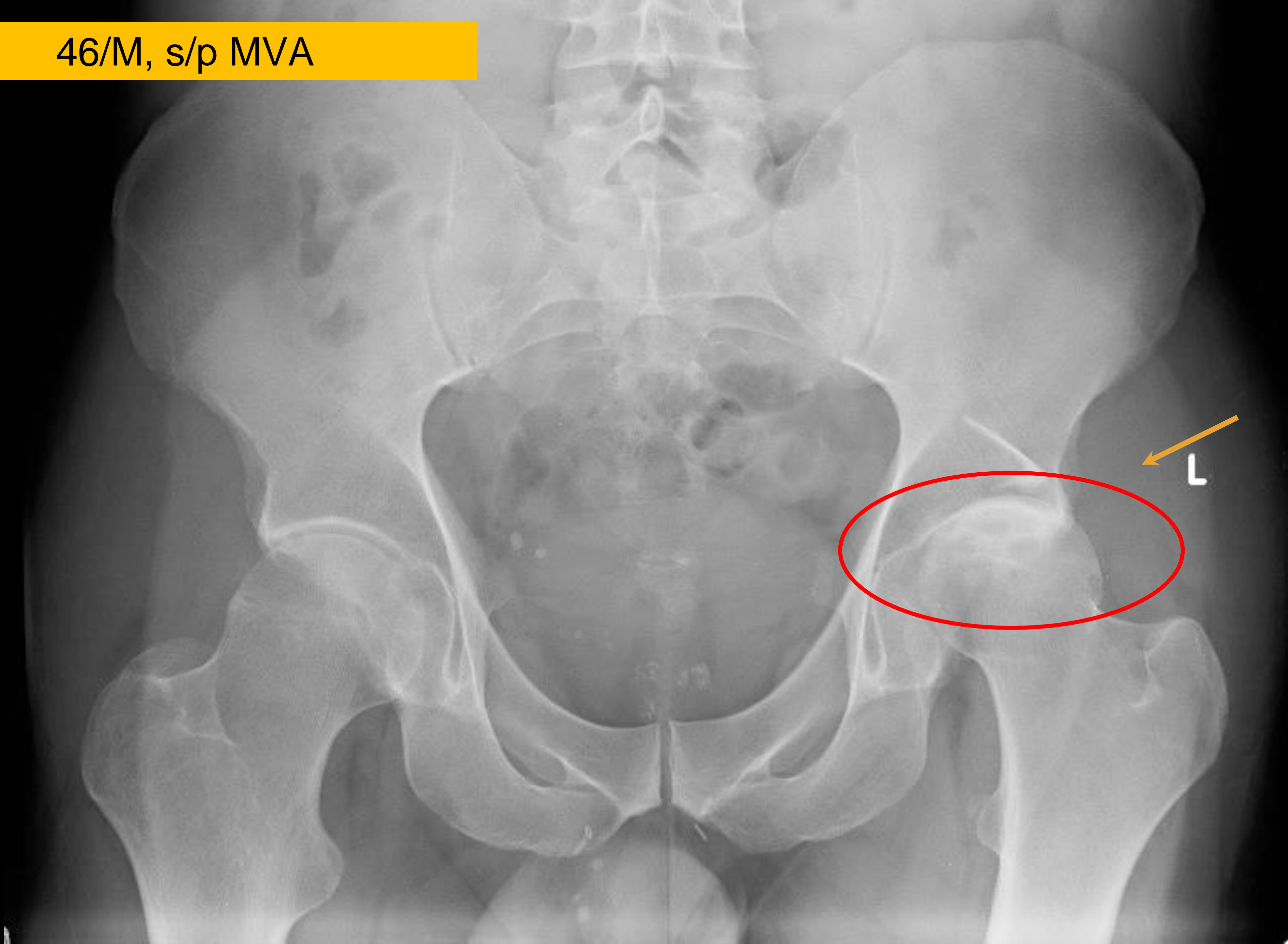
Role of DECT in Hip Fx

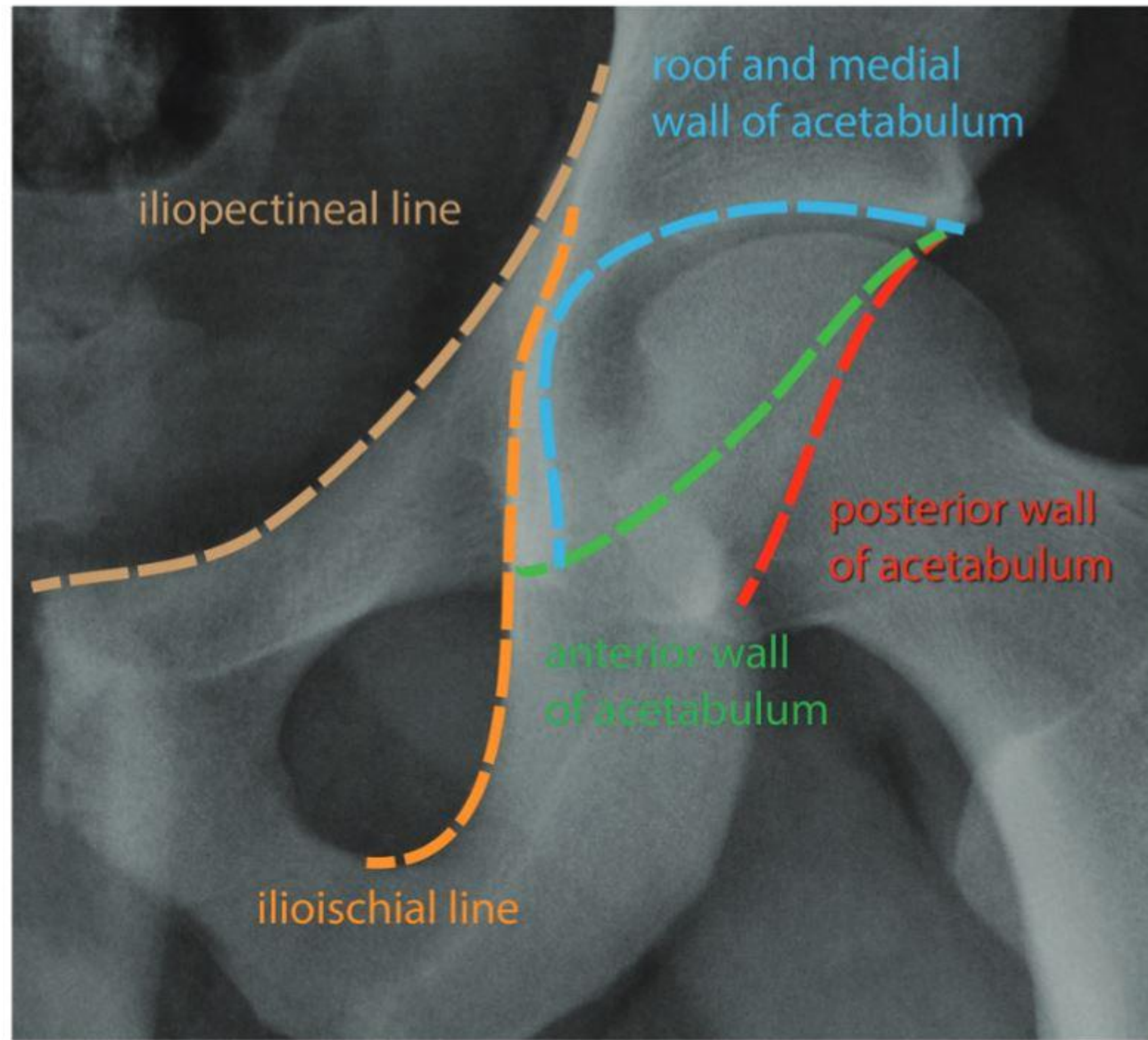


Role of DECT in Hip Fx

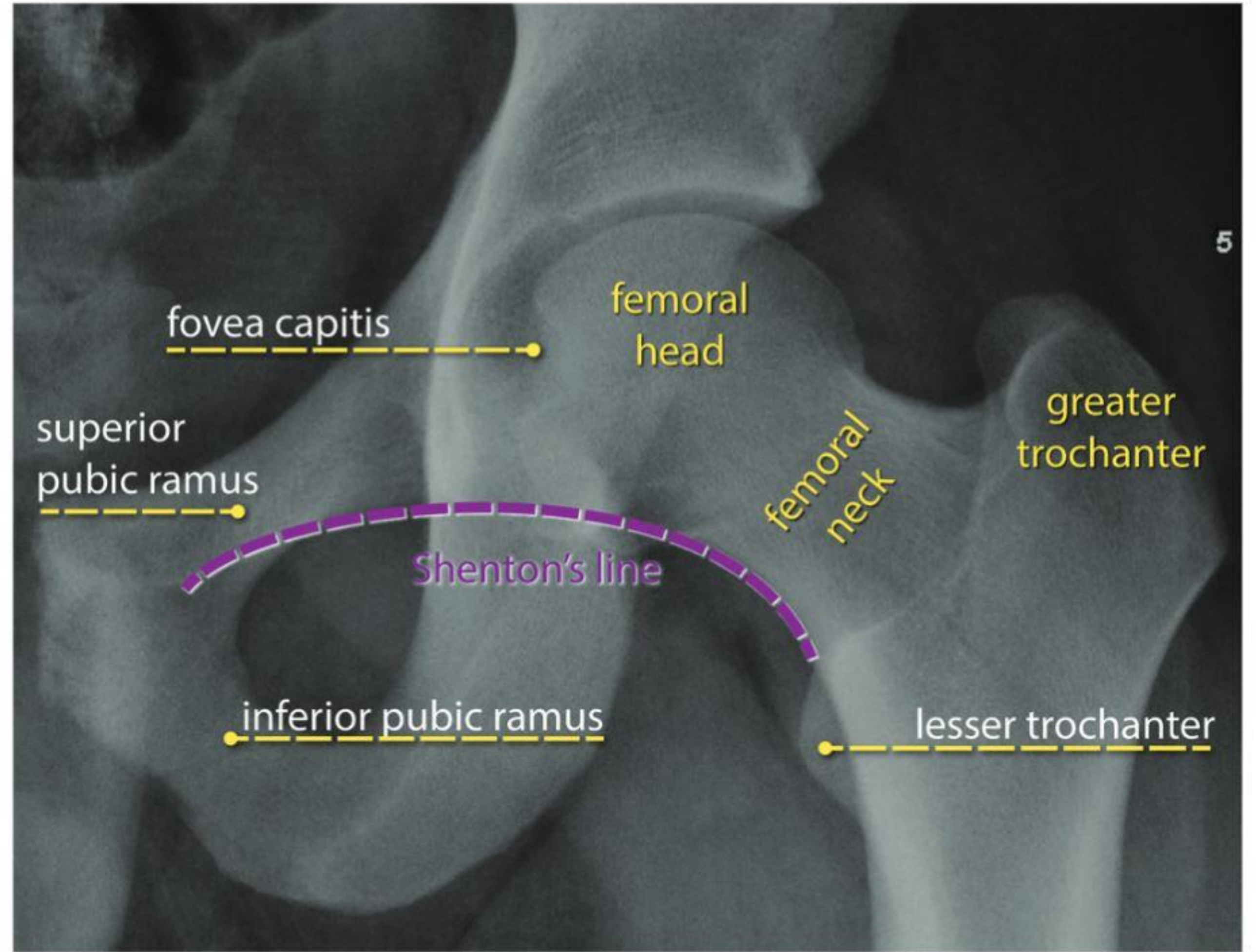


46/M, s/p MVA

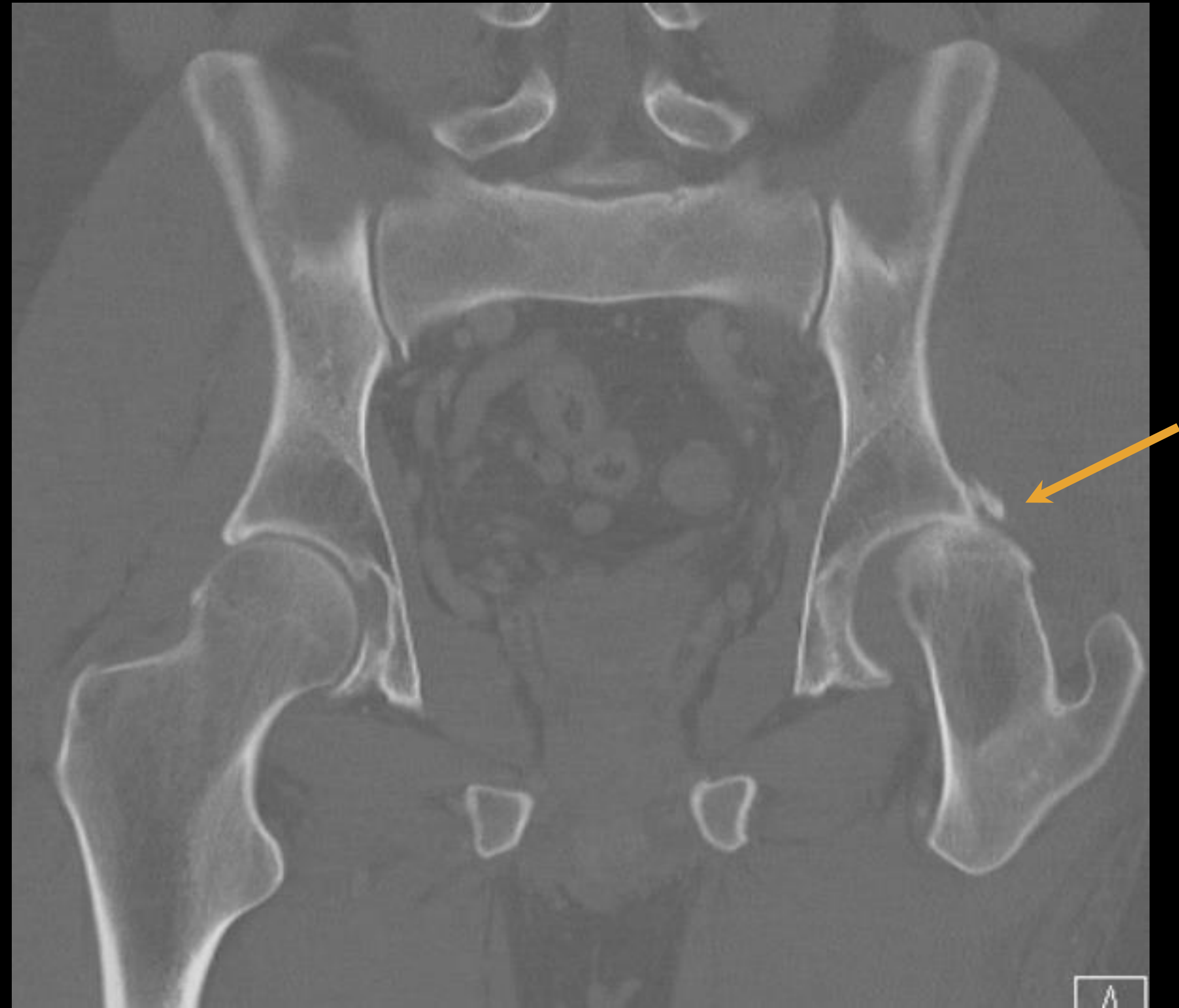




a.



b.





Posterior Hip Dx



Anterior Hip Dx

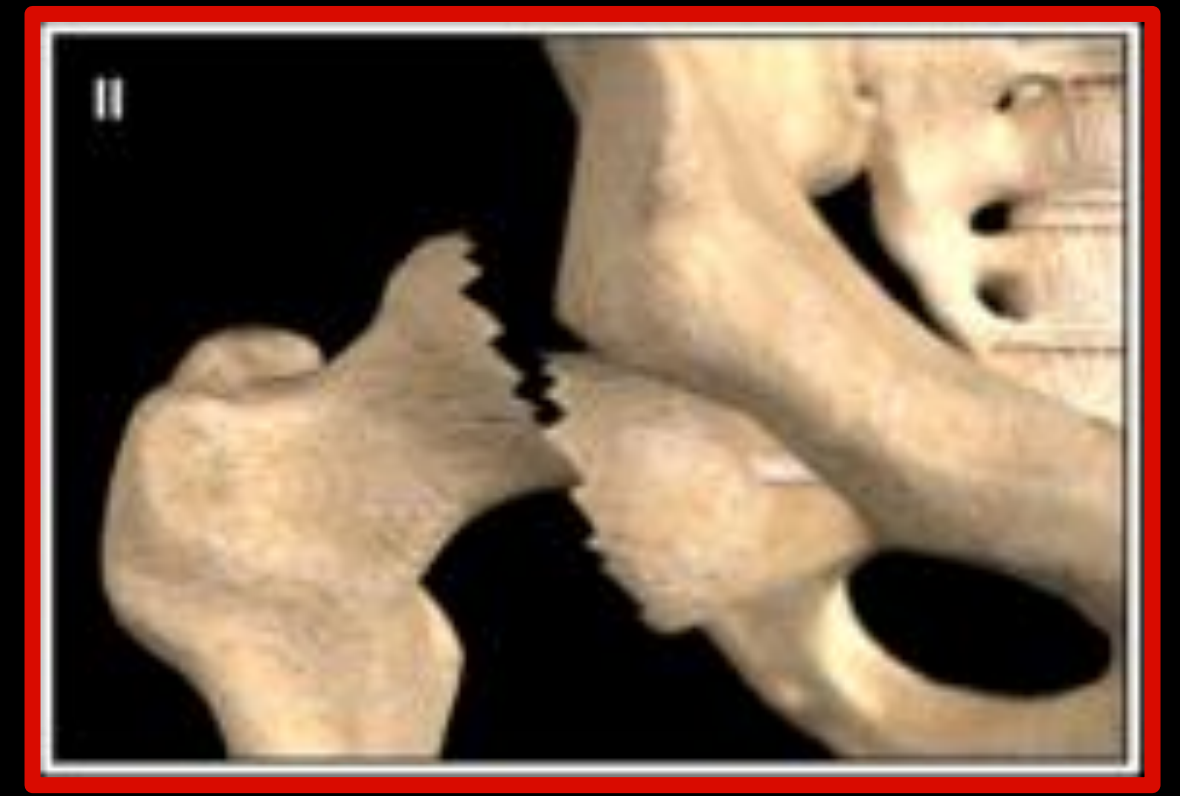


Femoral Head Fx

- Associated with posterior hip dislocations
- Pipkin classification
- Surgical considerations
 - **Reduction:**
 - Emergent reduction ASAP (within 6 hours)
 - If irreducible, or with femoral neck fracture, then ORIF
 - **Above or below fovea**
 - **Traction**
 - Flipped fraction fragment
 - **Congruency**
 - Non congruent: Surgical Rx



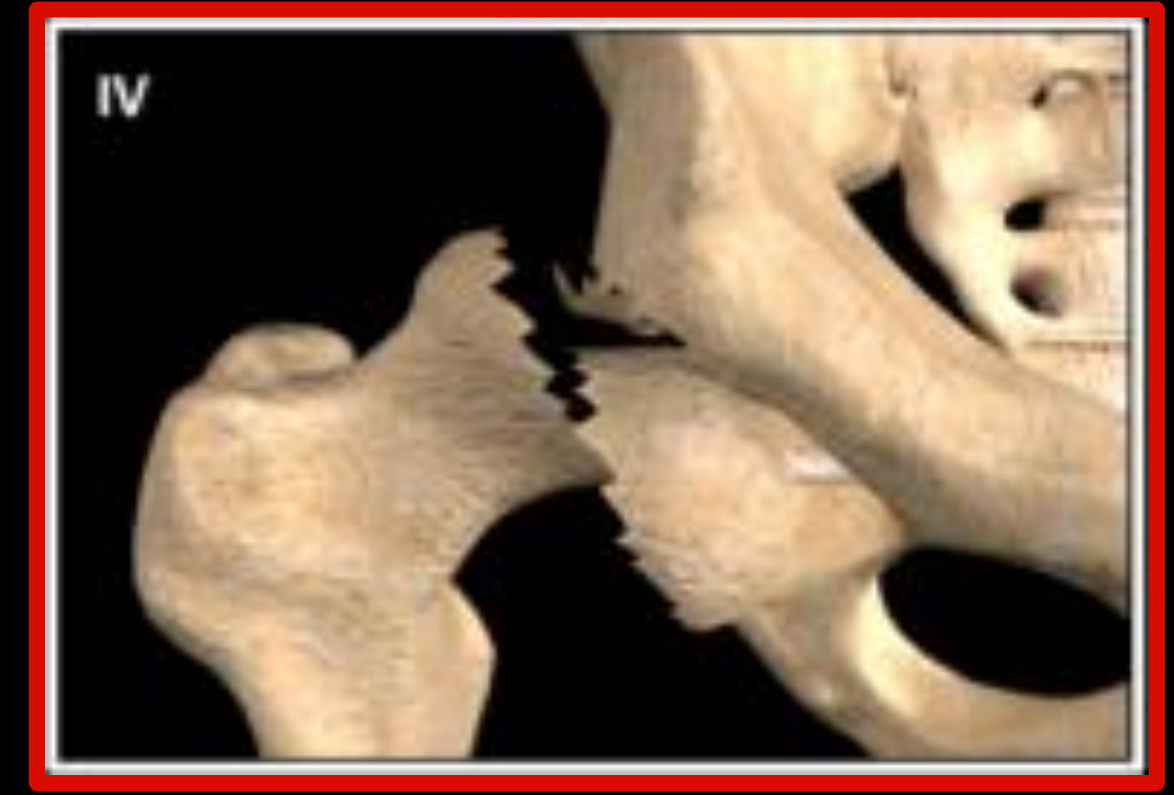
Fracture below fovea
(non weight bearing)



Fracture above fovea
(weight bearing)



Associated femoral neck Fx



Associated acetabular Fx

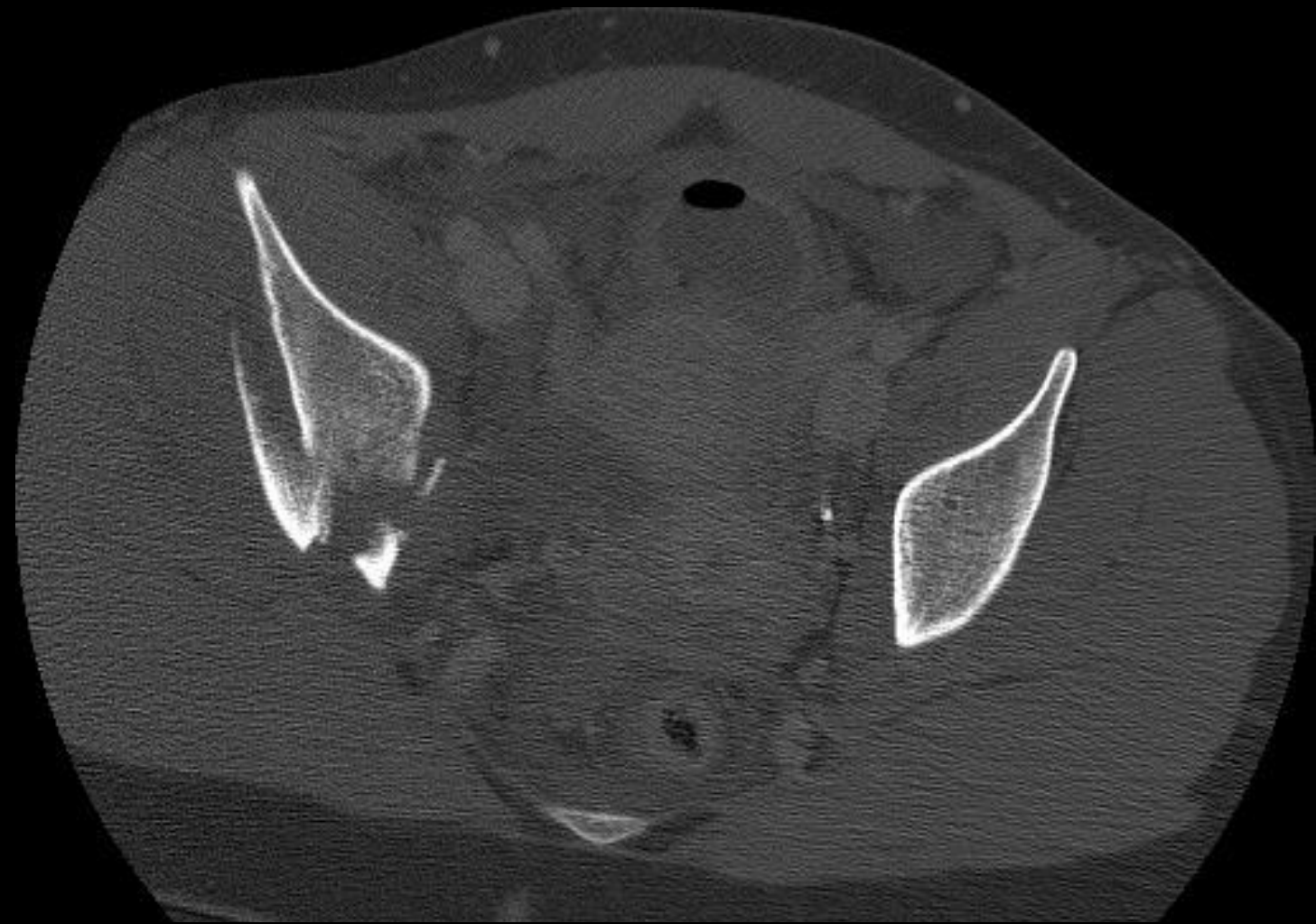
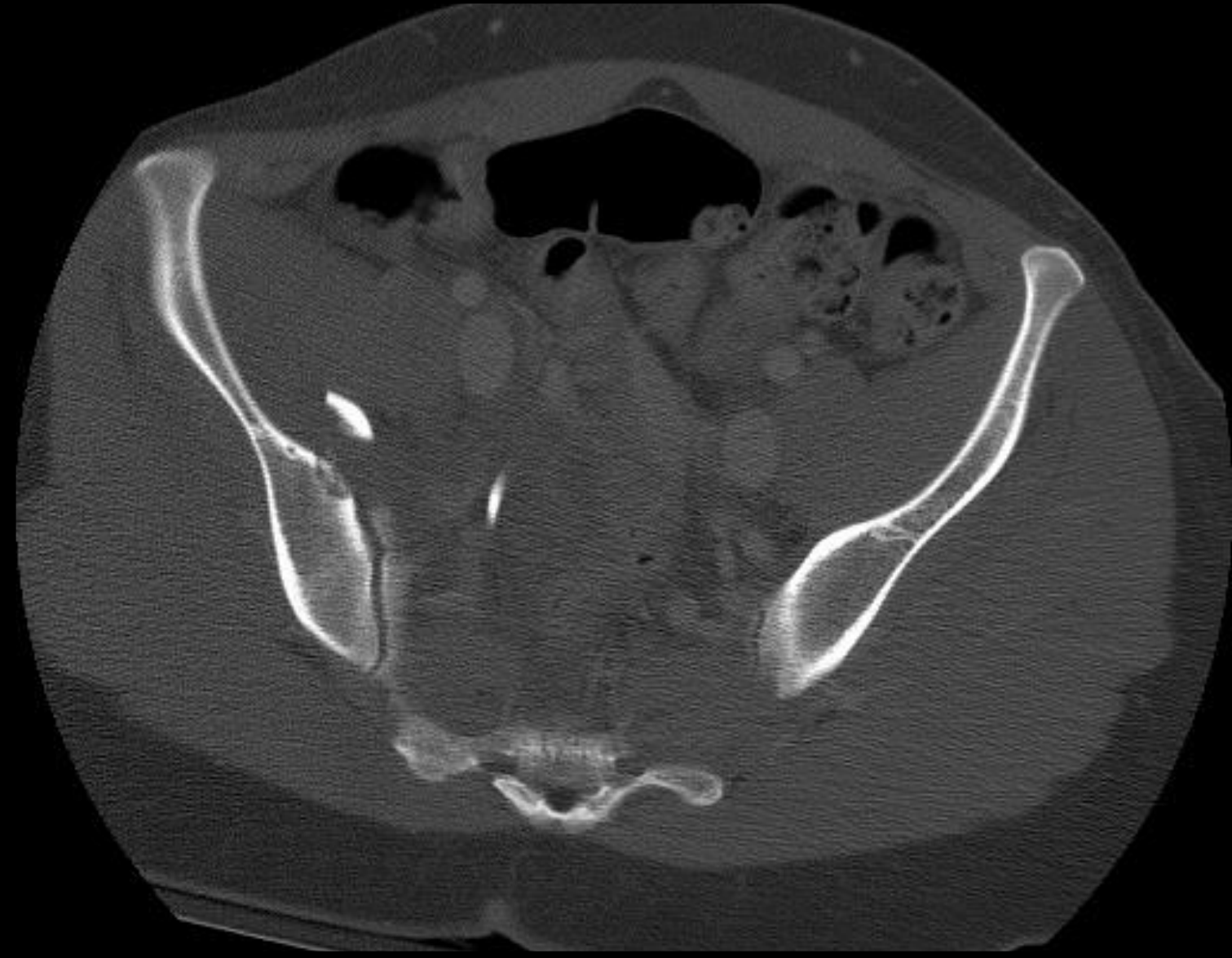
Posterior femoral head Fx



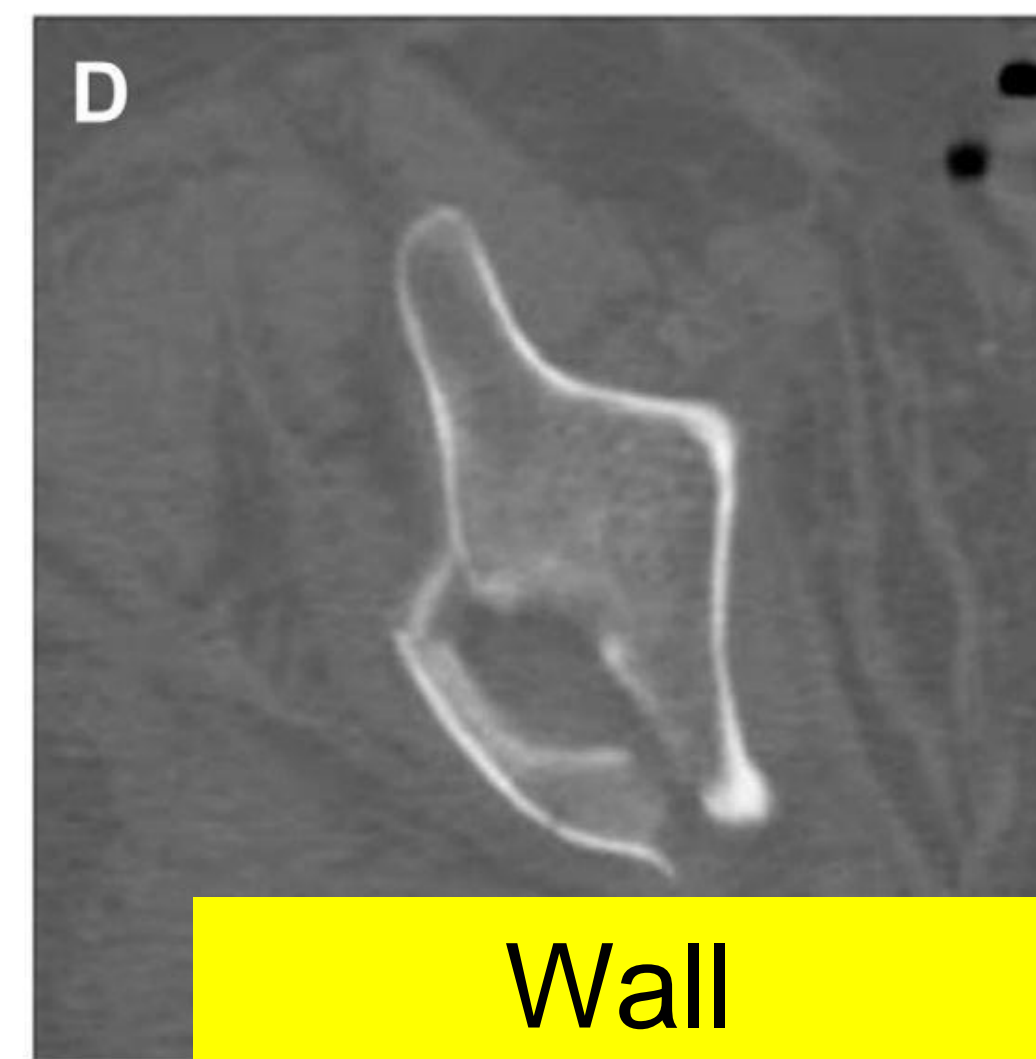
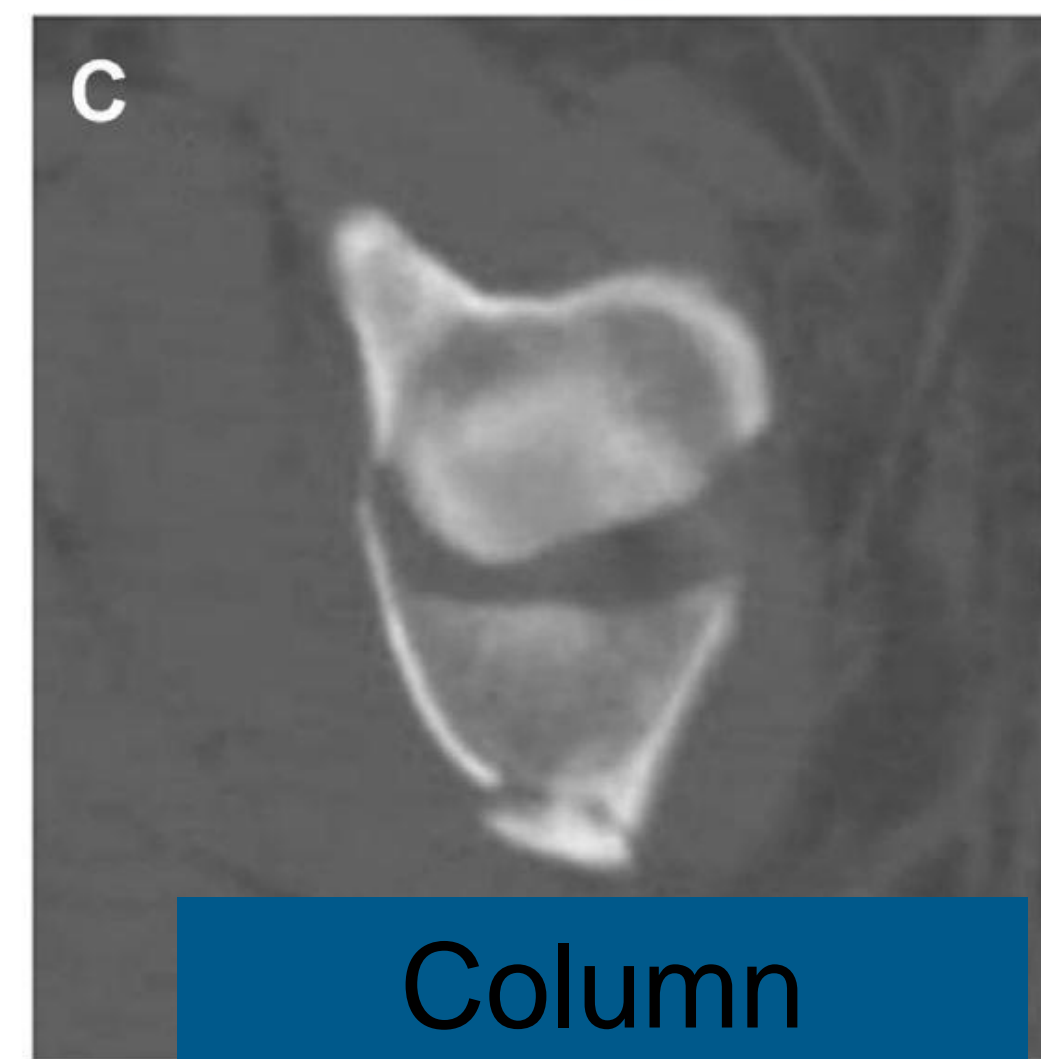
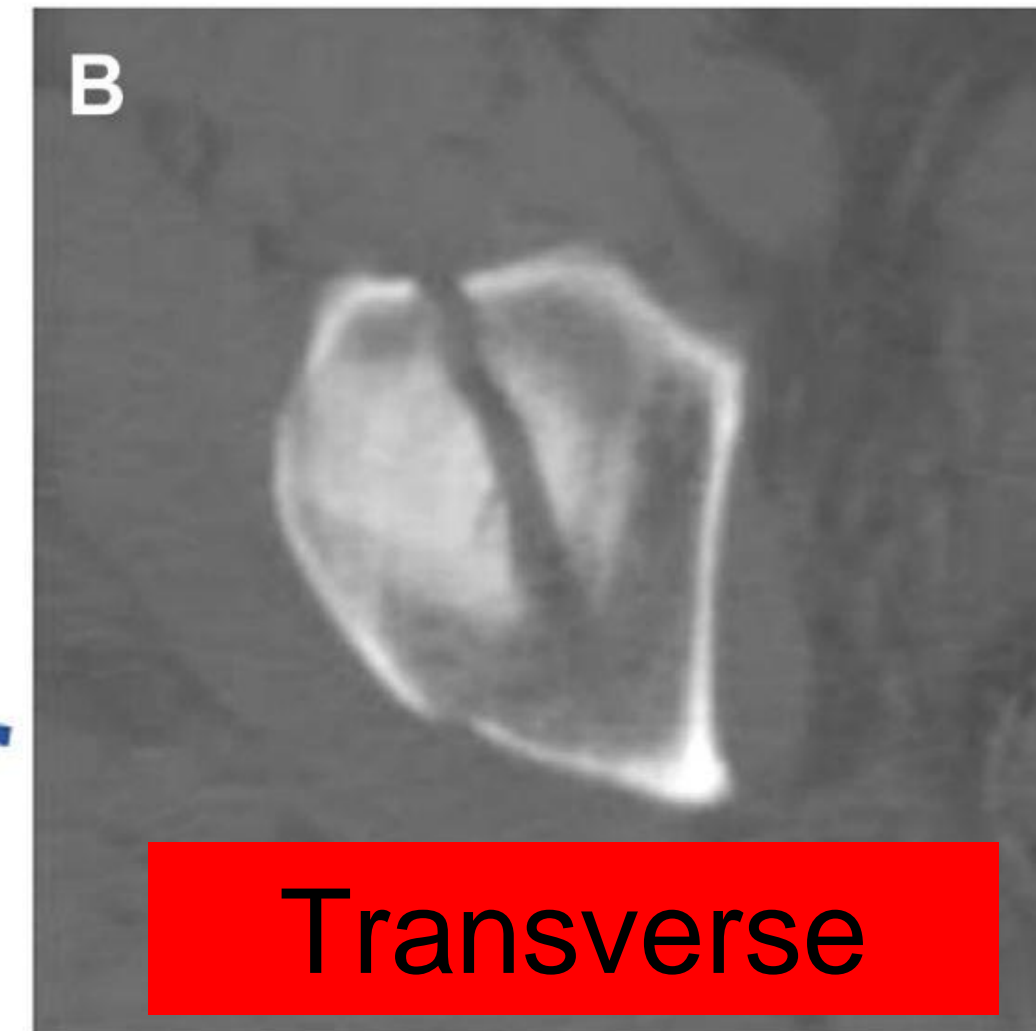
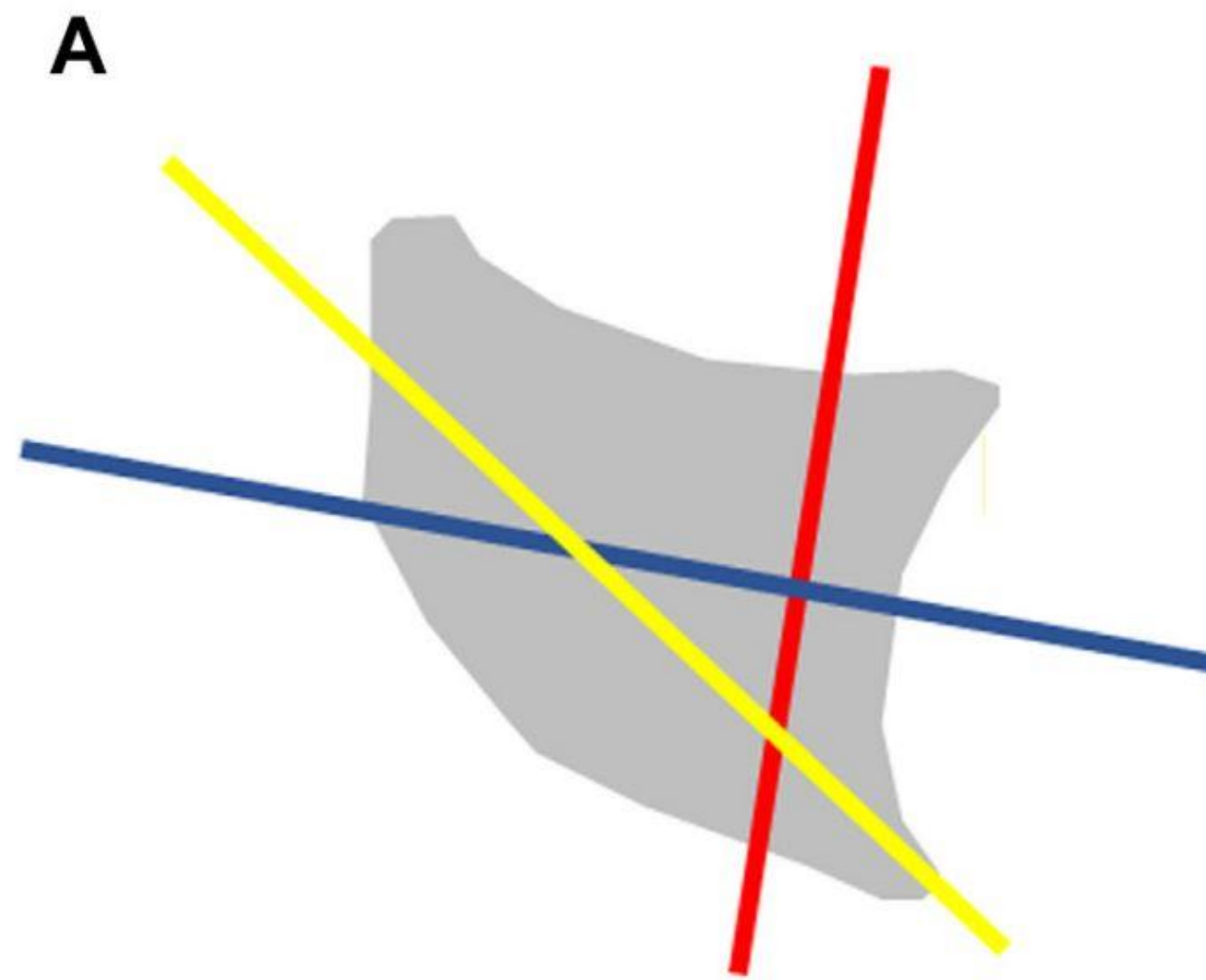
Case 1: s/p MVA



Case 2: s/p MVA

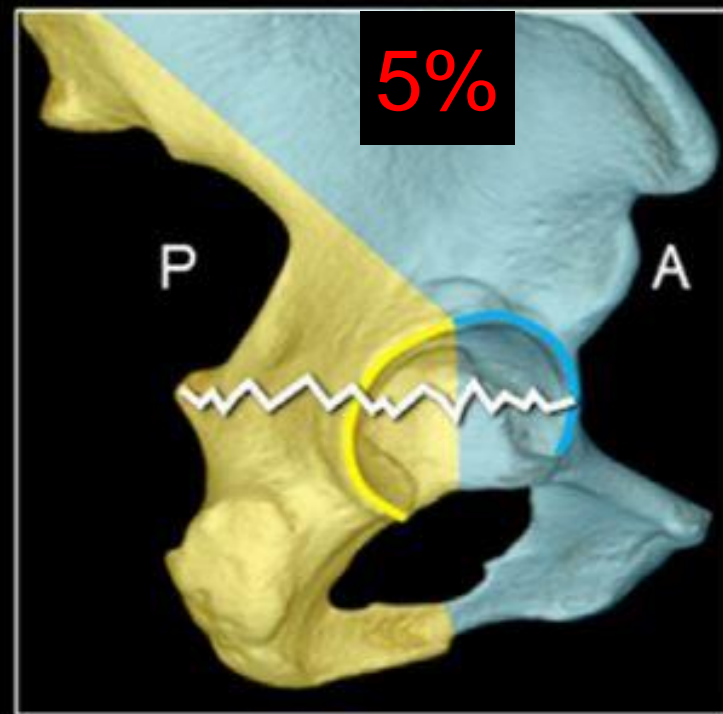


Acetabular Fracture



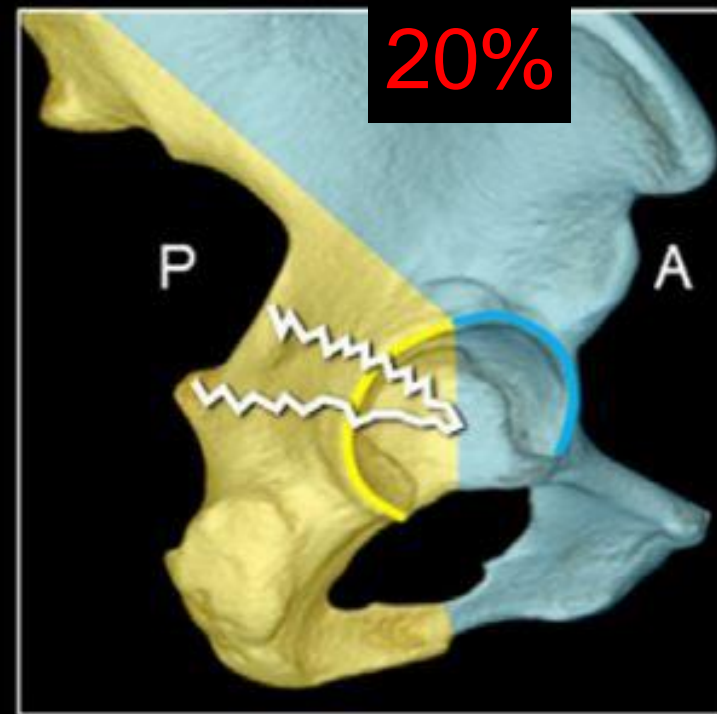
Acetabular Fx

Elementary fractures



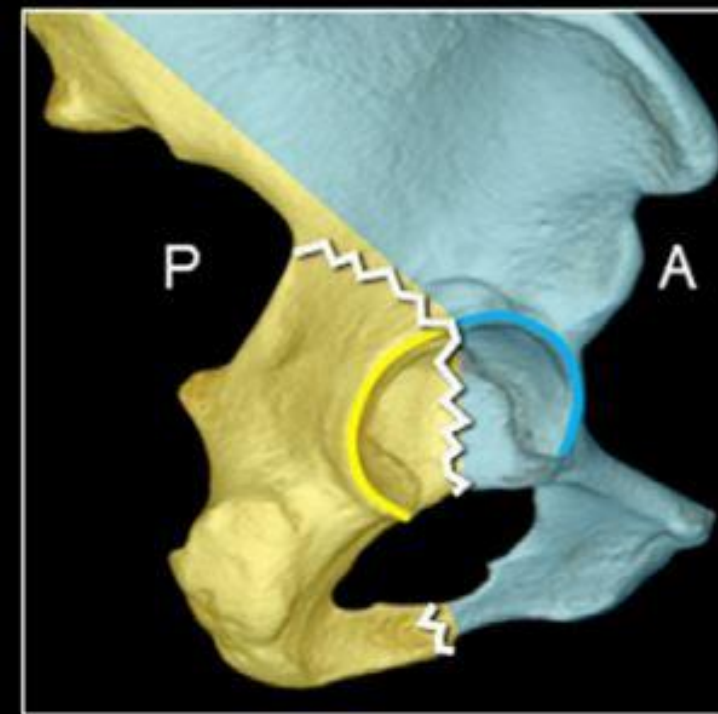
5%

Transverse

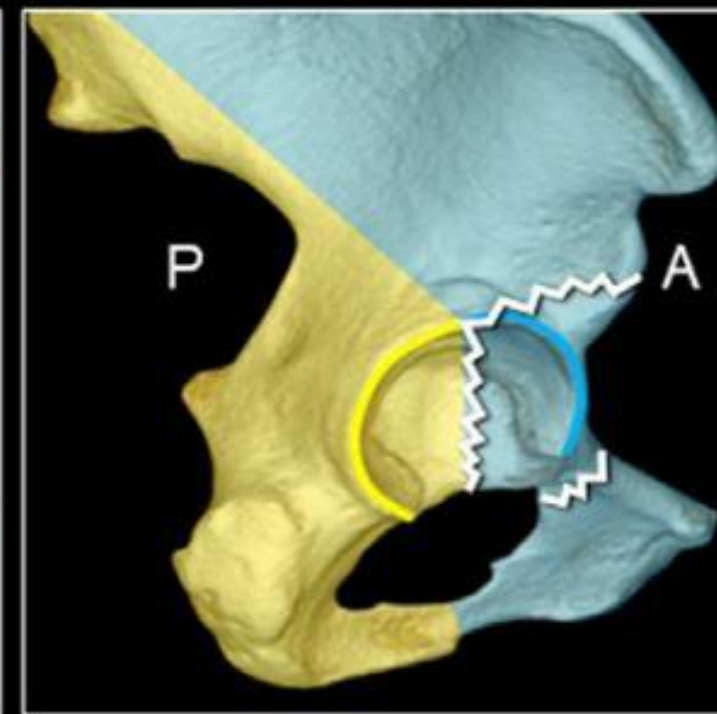


20%

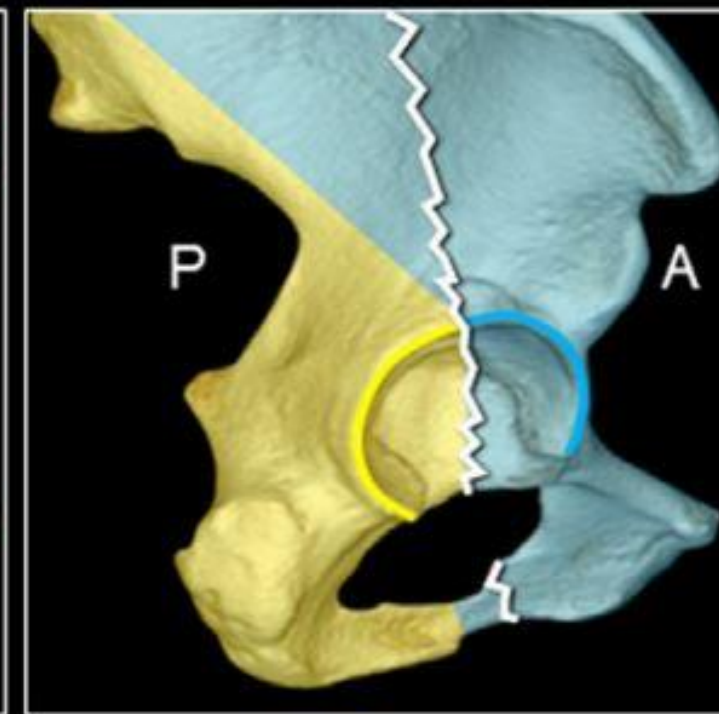
Posterior wall



Posterior column

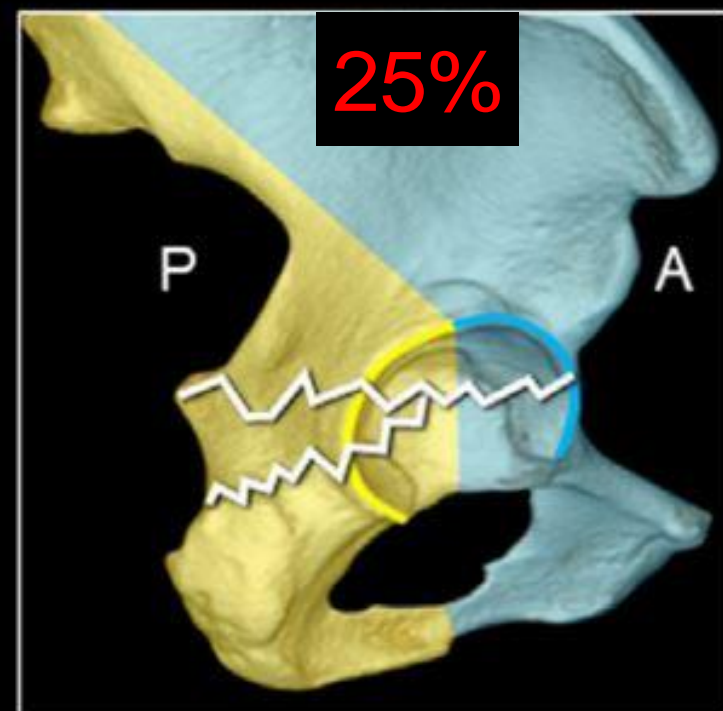


Anterior wall



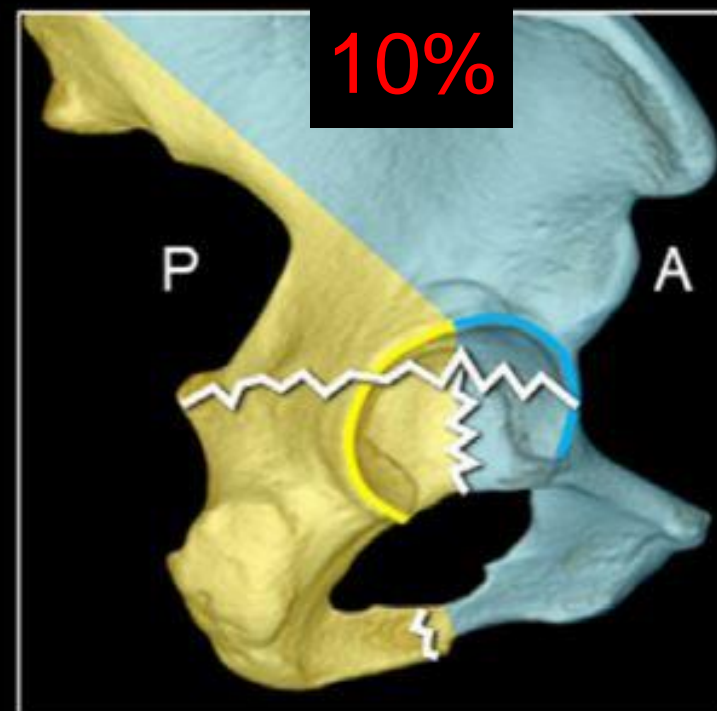
Anterior column

Associated fractures



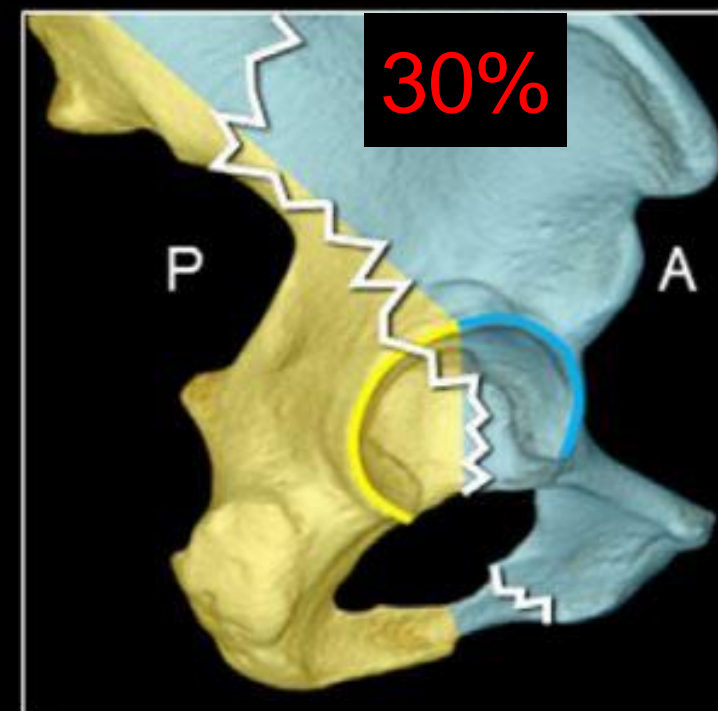
25%

Transverse with posterior wall



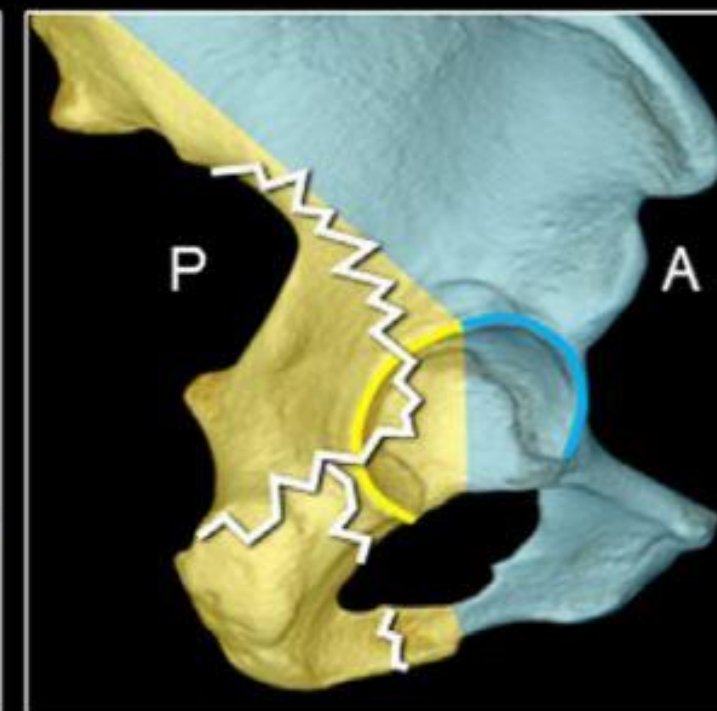
10%

T-shaped

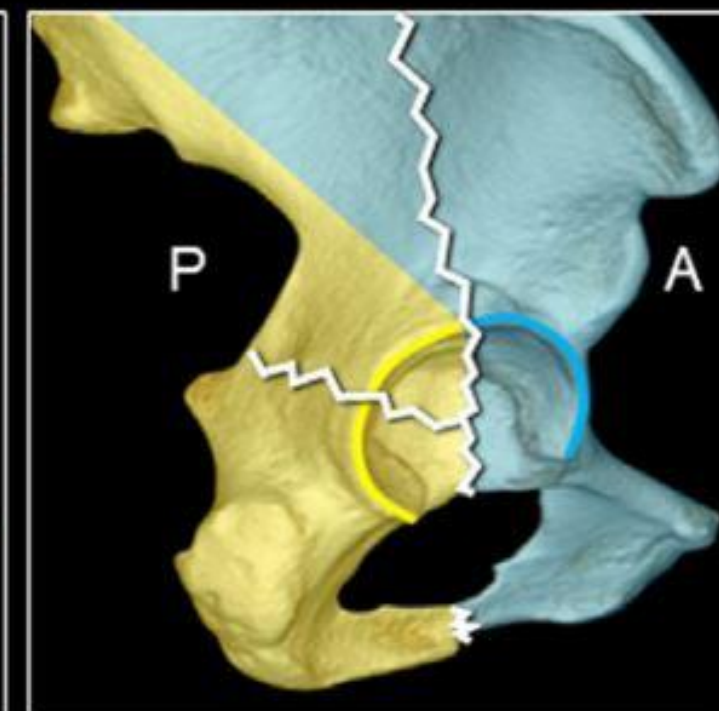


30%

Both column

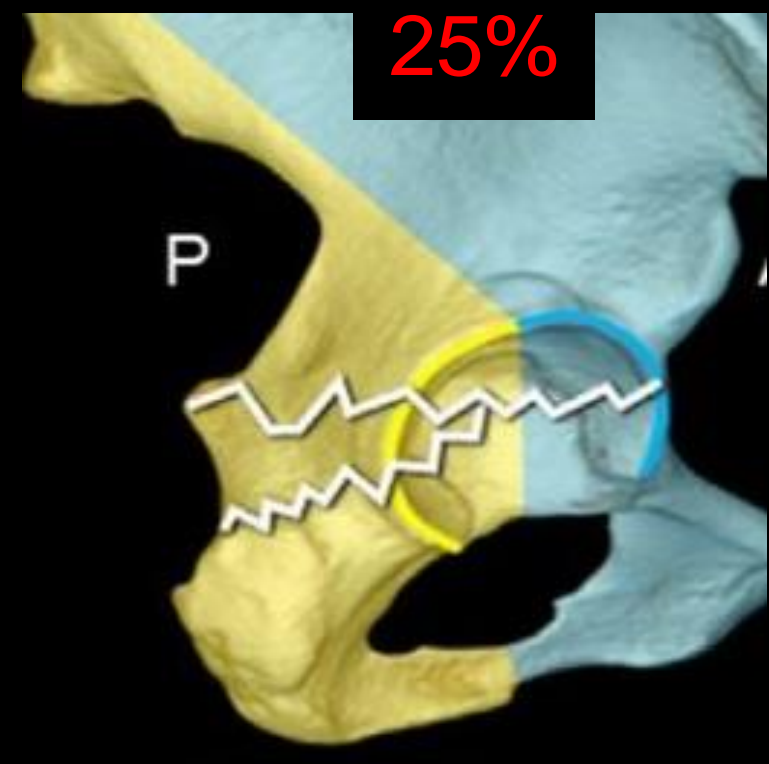
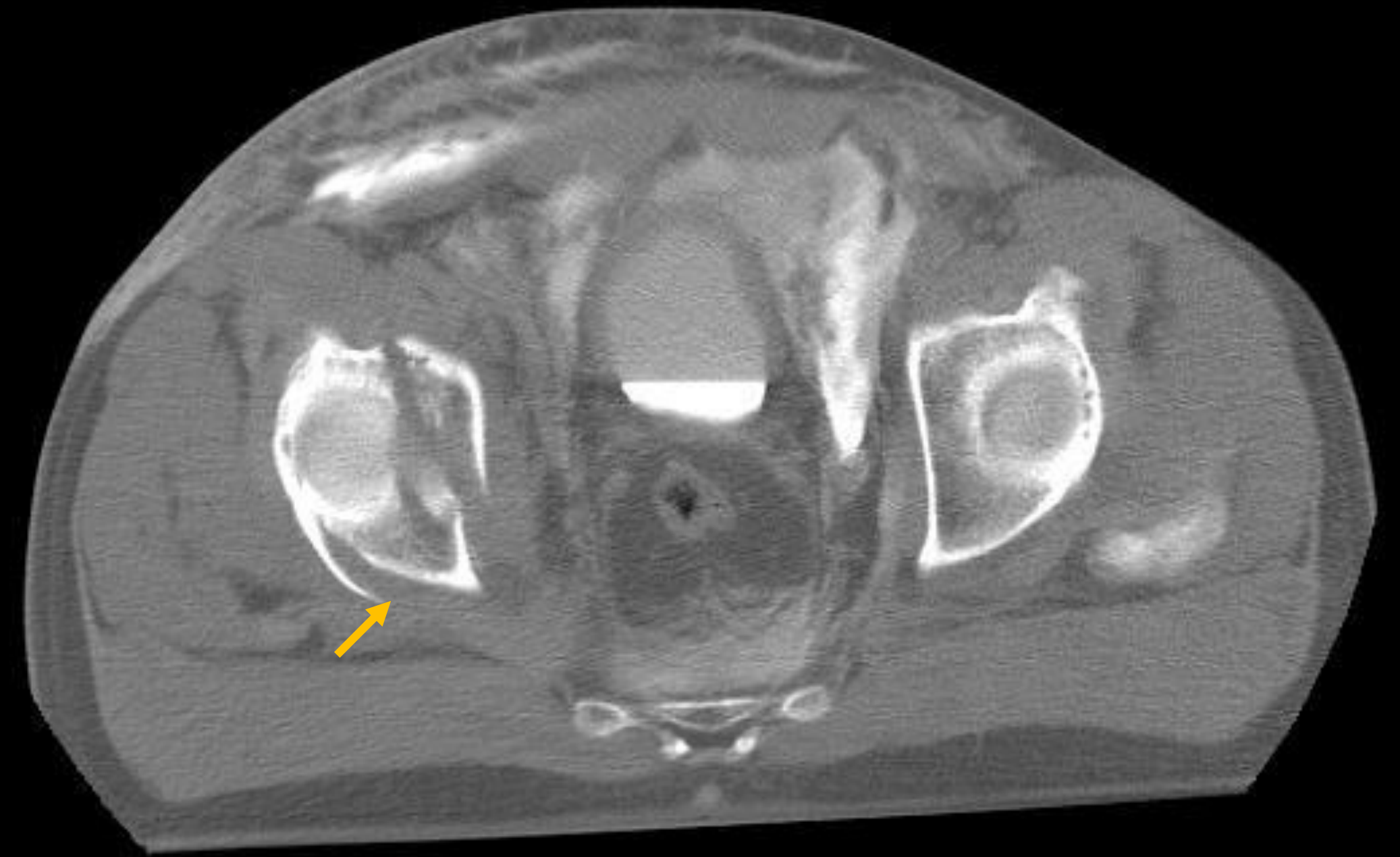


Posterior column with posterior wall



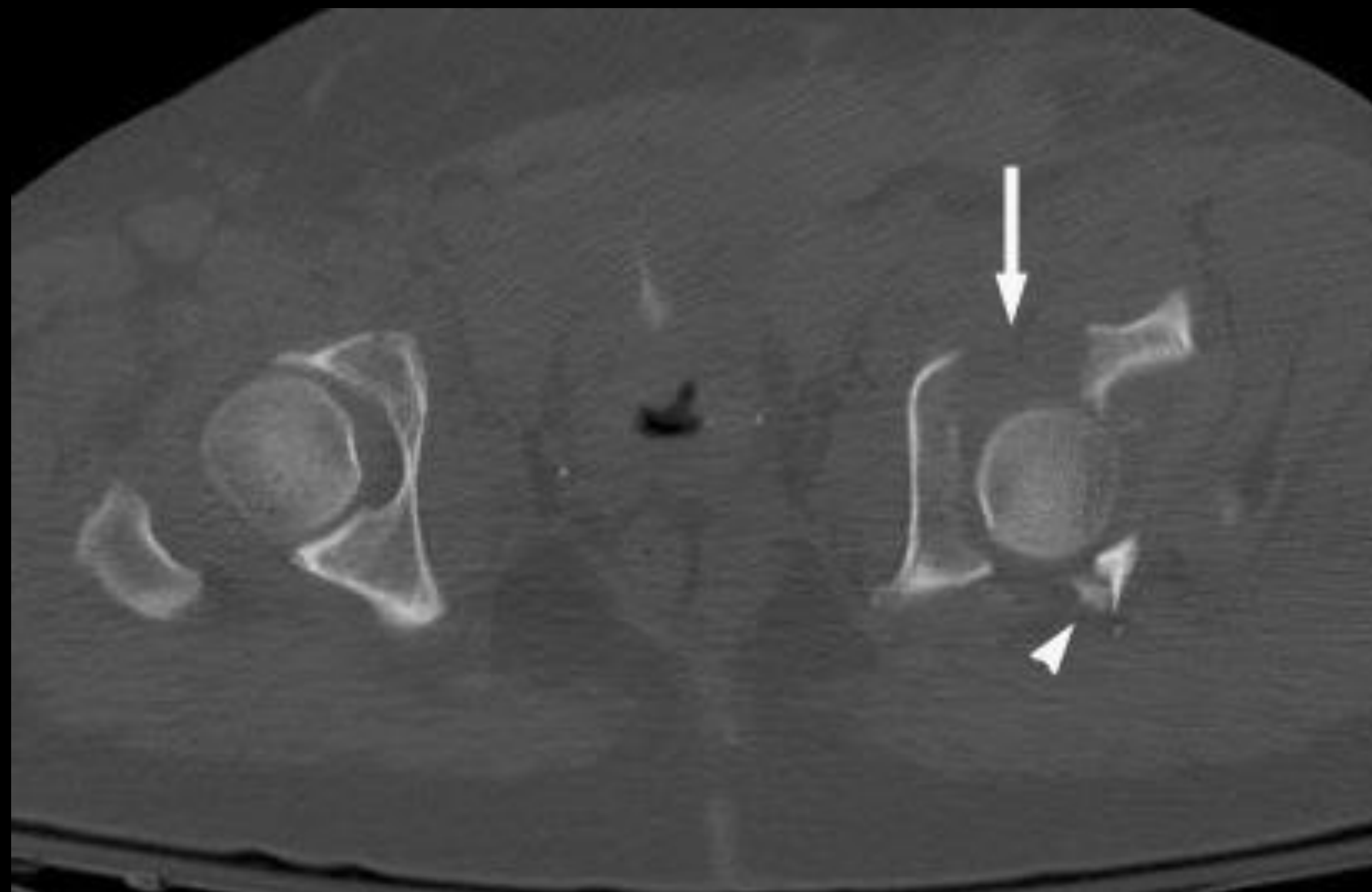
Anterior column with hemitransverse

Case 1

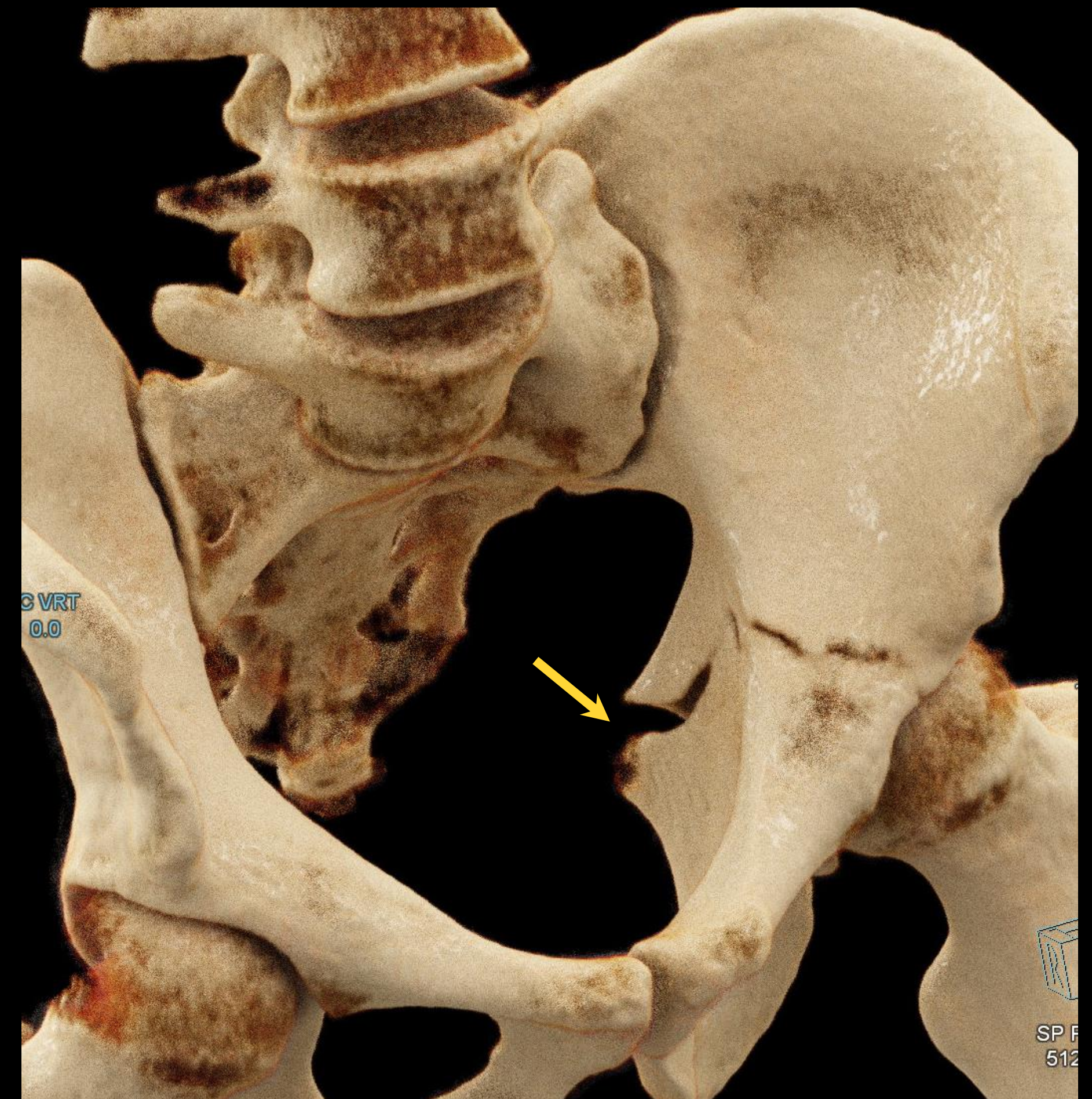
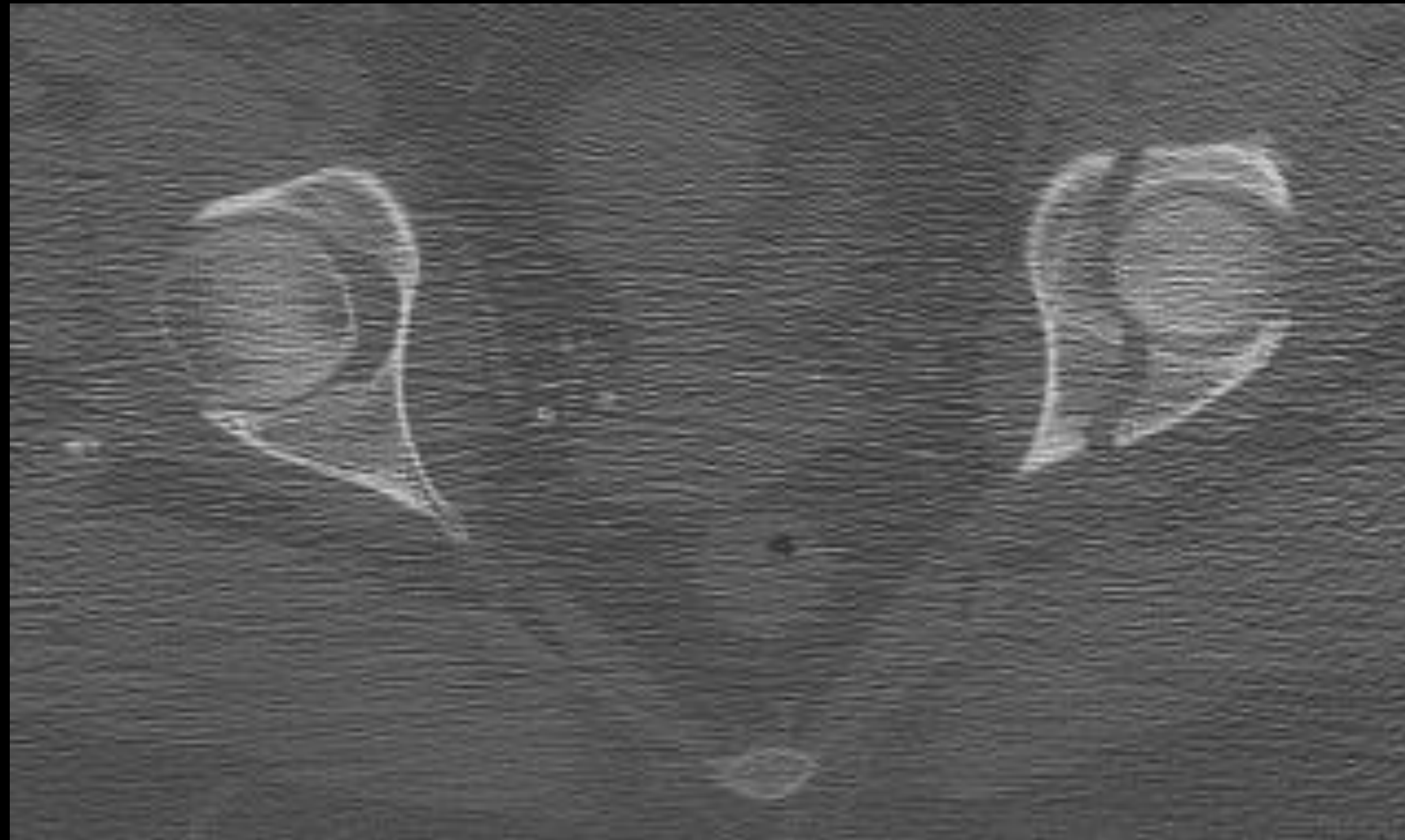


Transverse with posterior wall

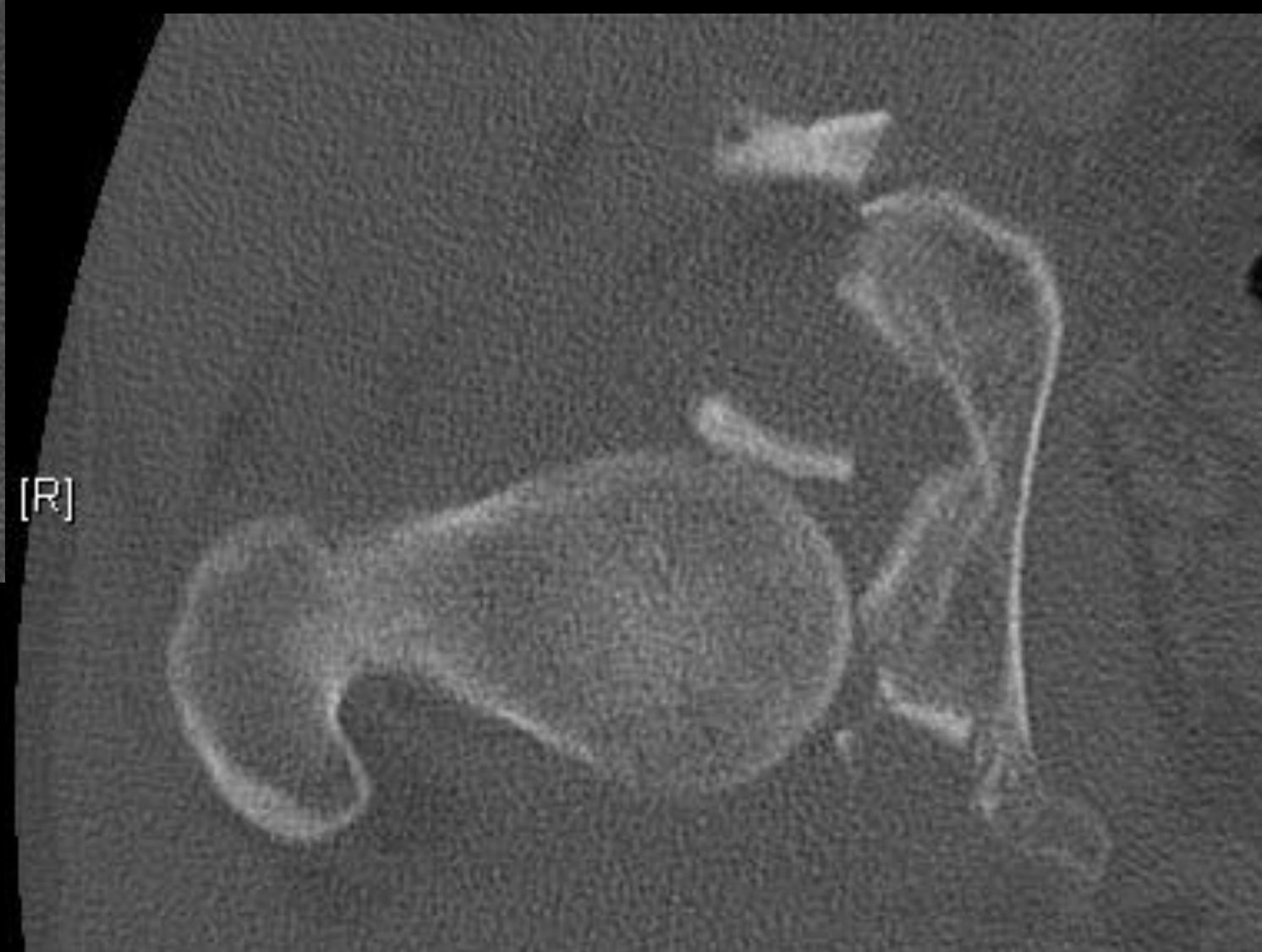
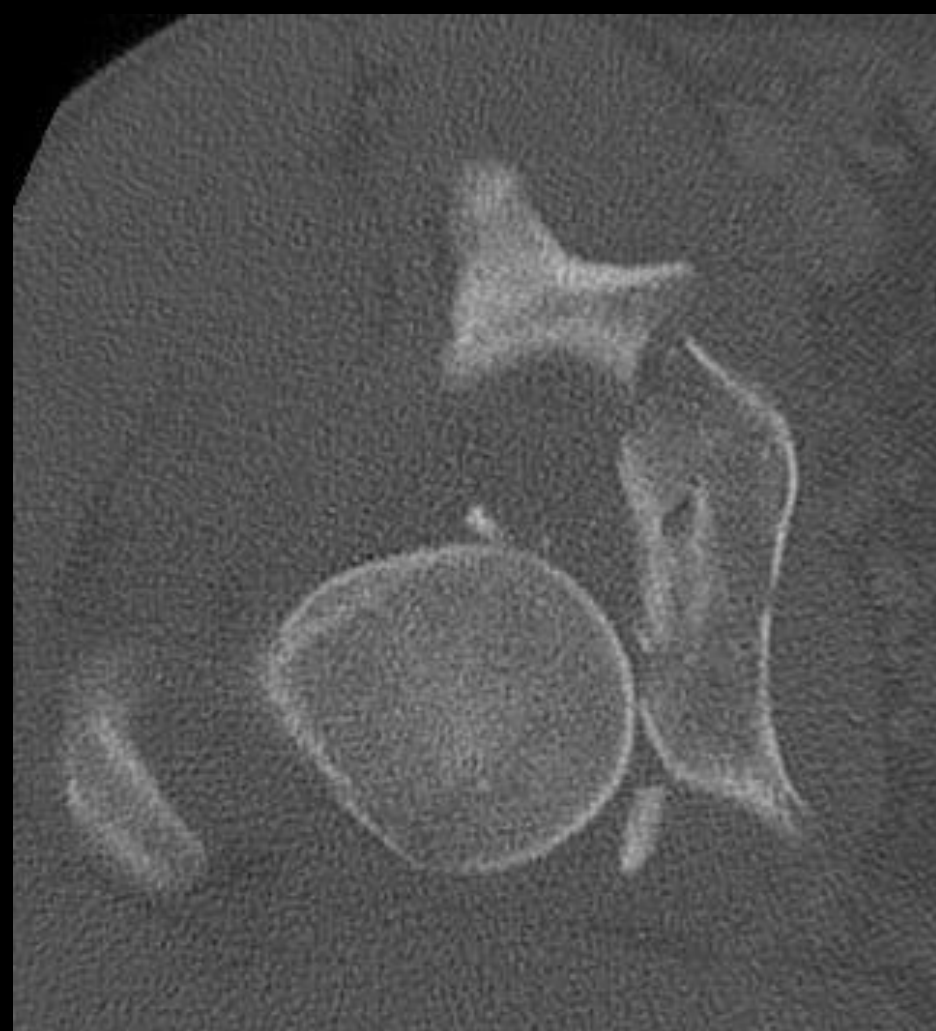
Transverse with Posterior Wall



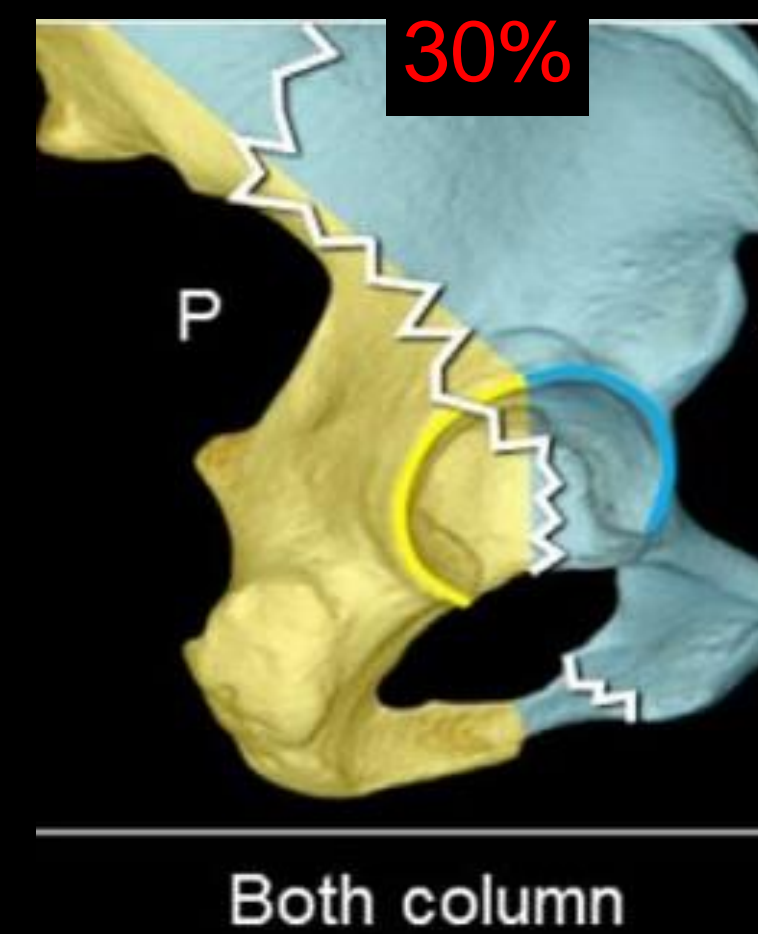
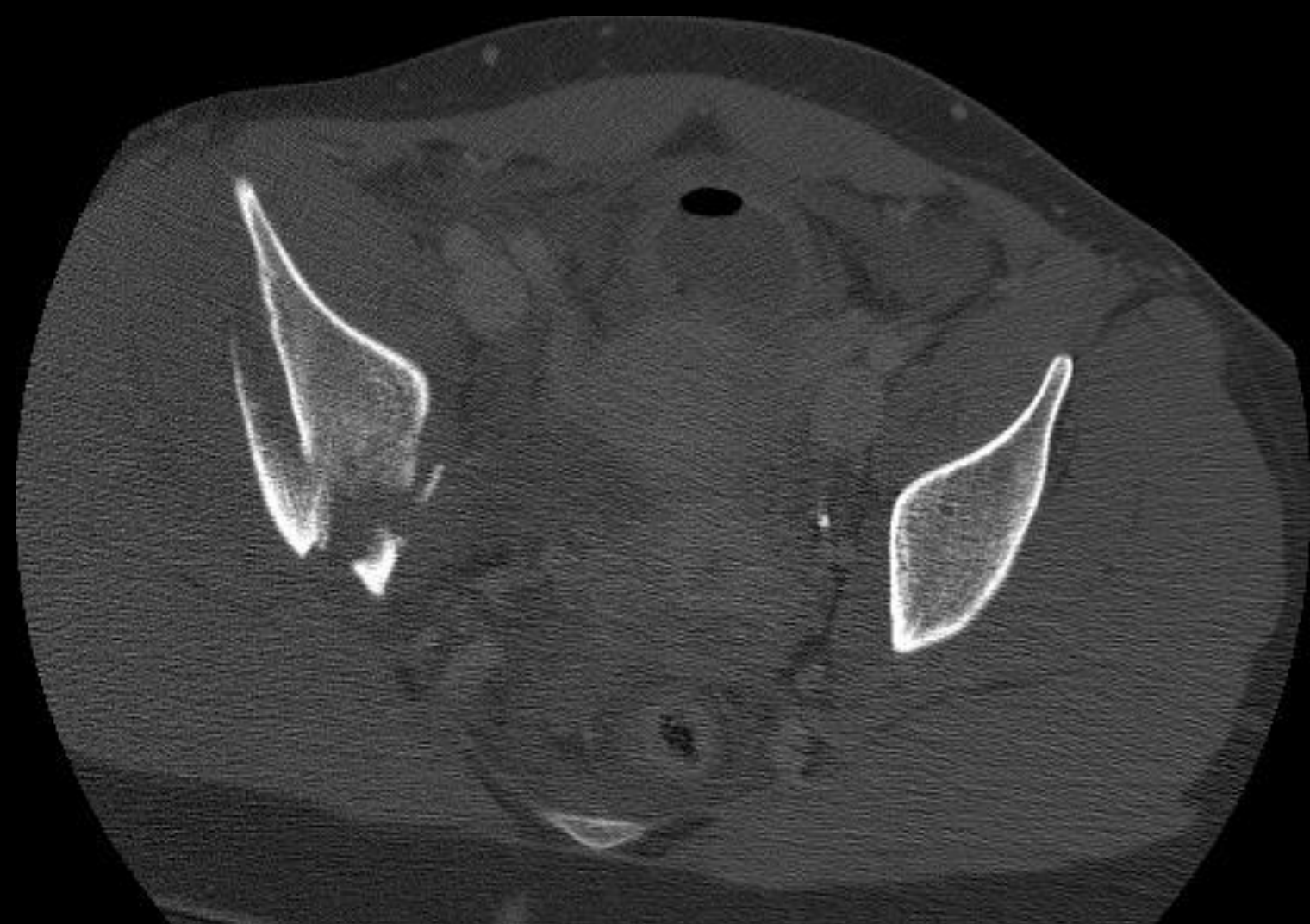
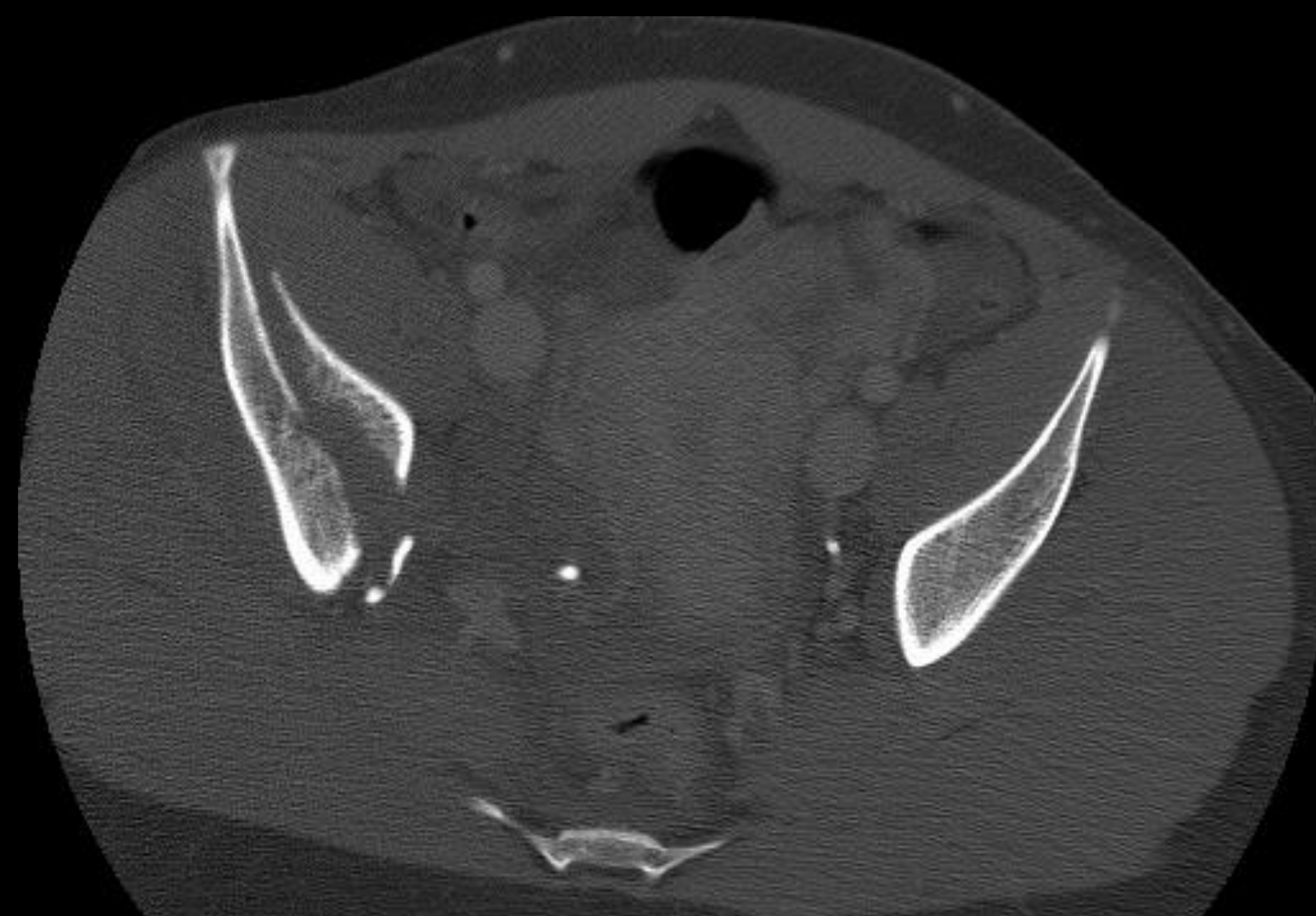
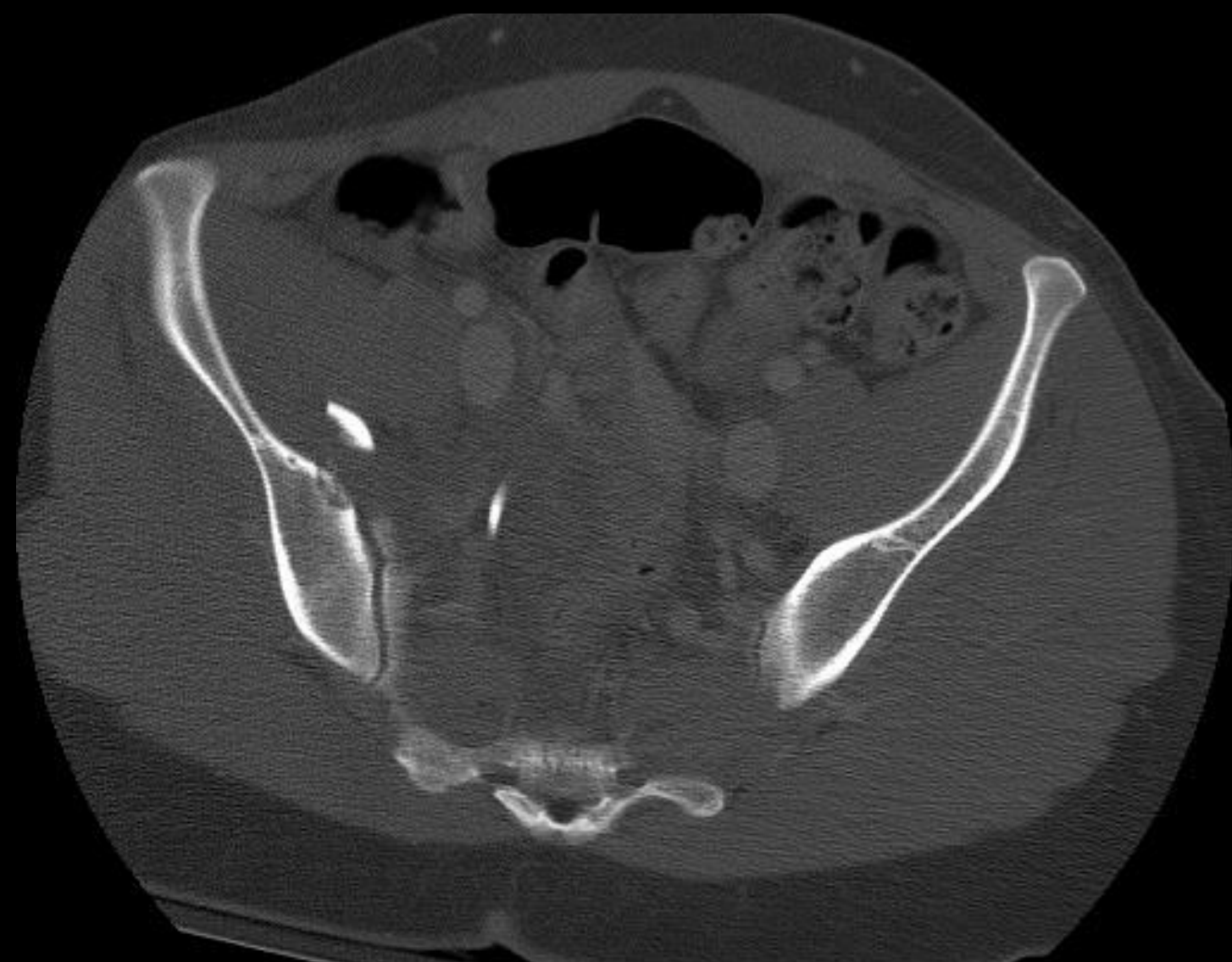
Transverse Fracture



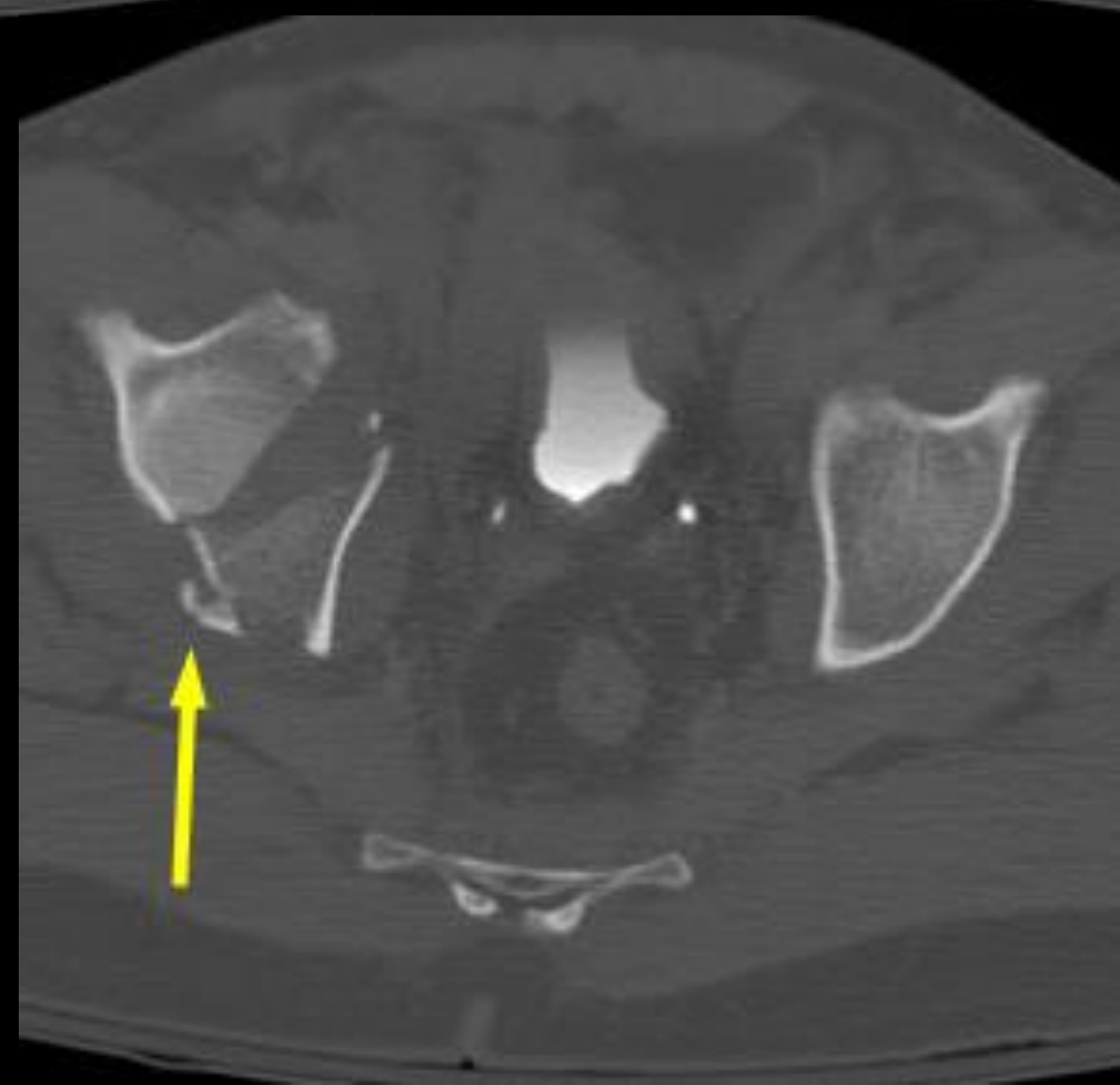
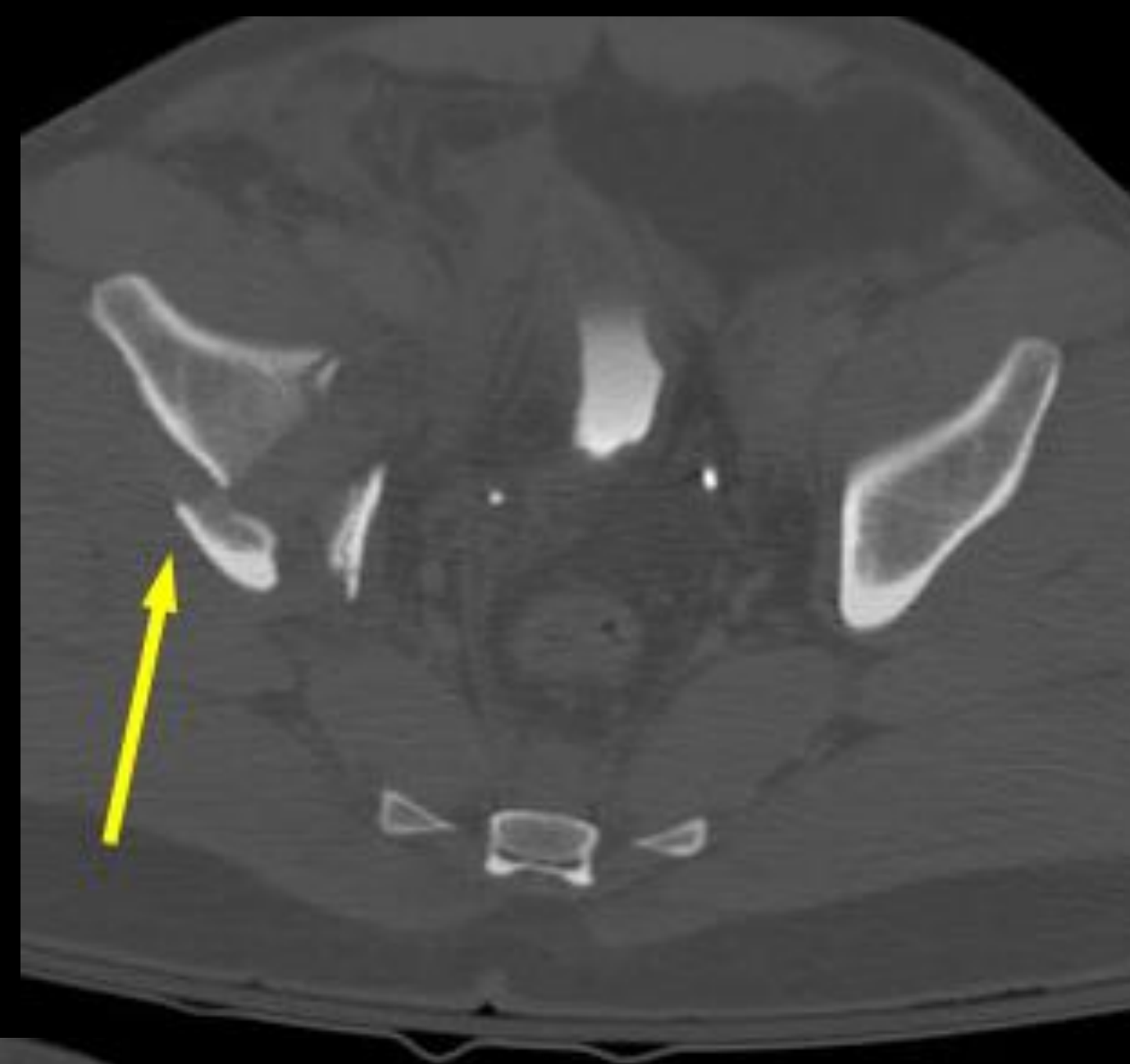
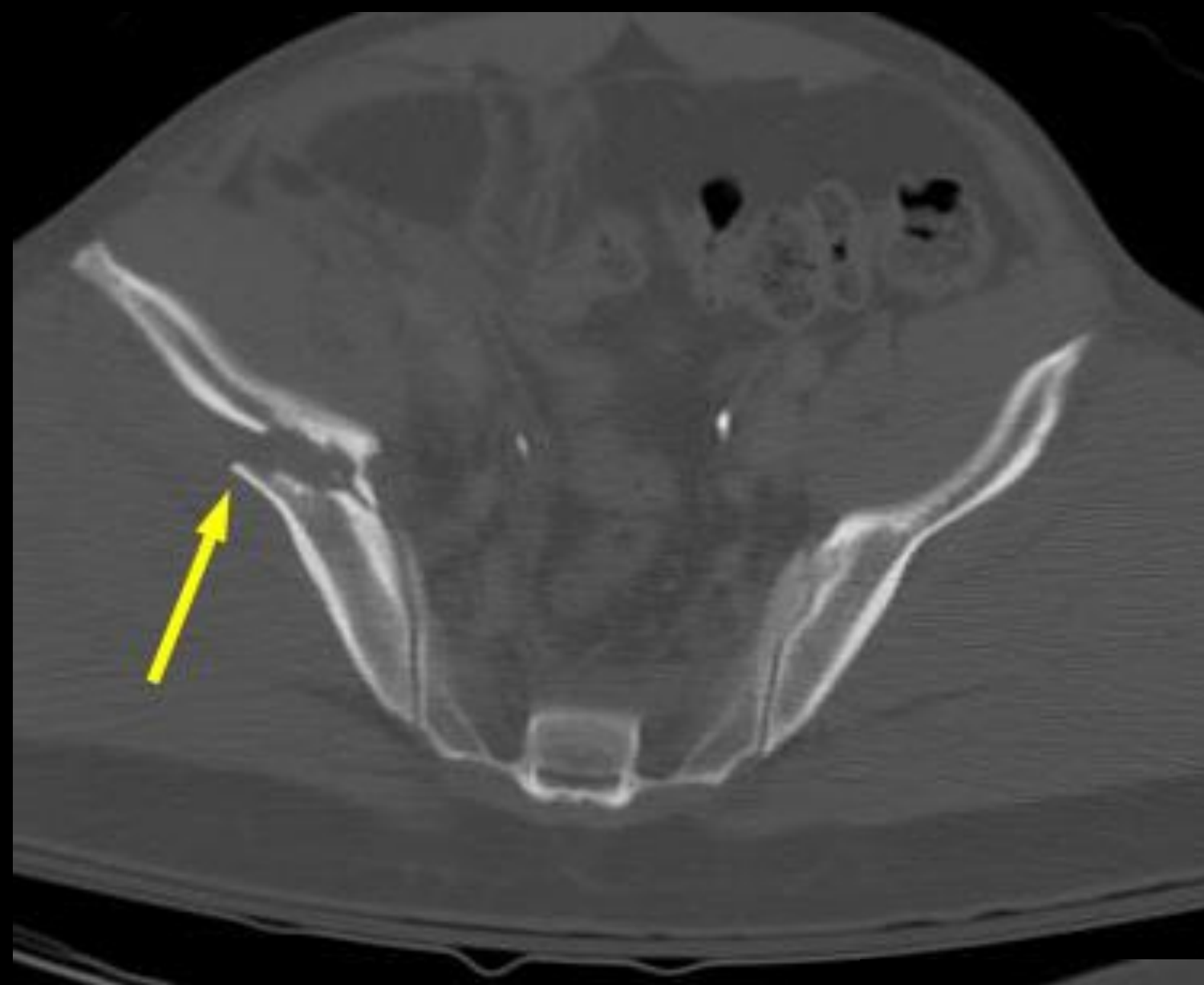
Transverse with Posterior Wall



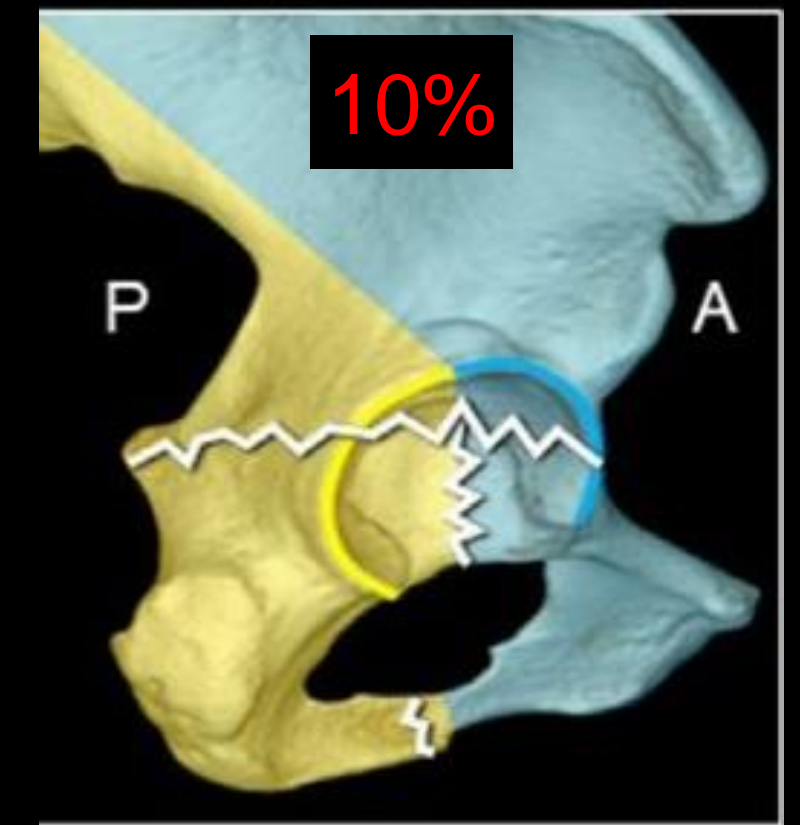
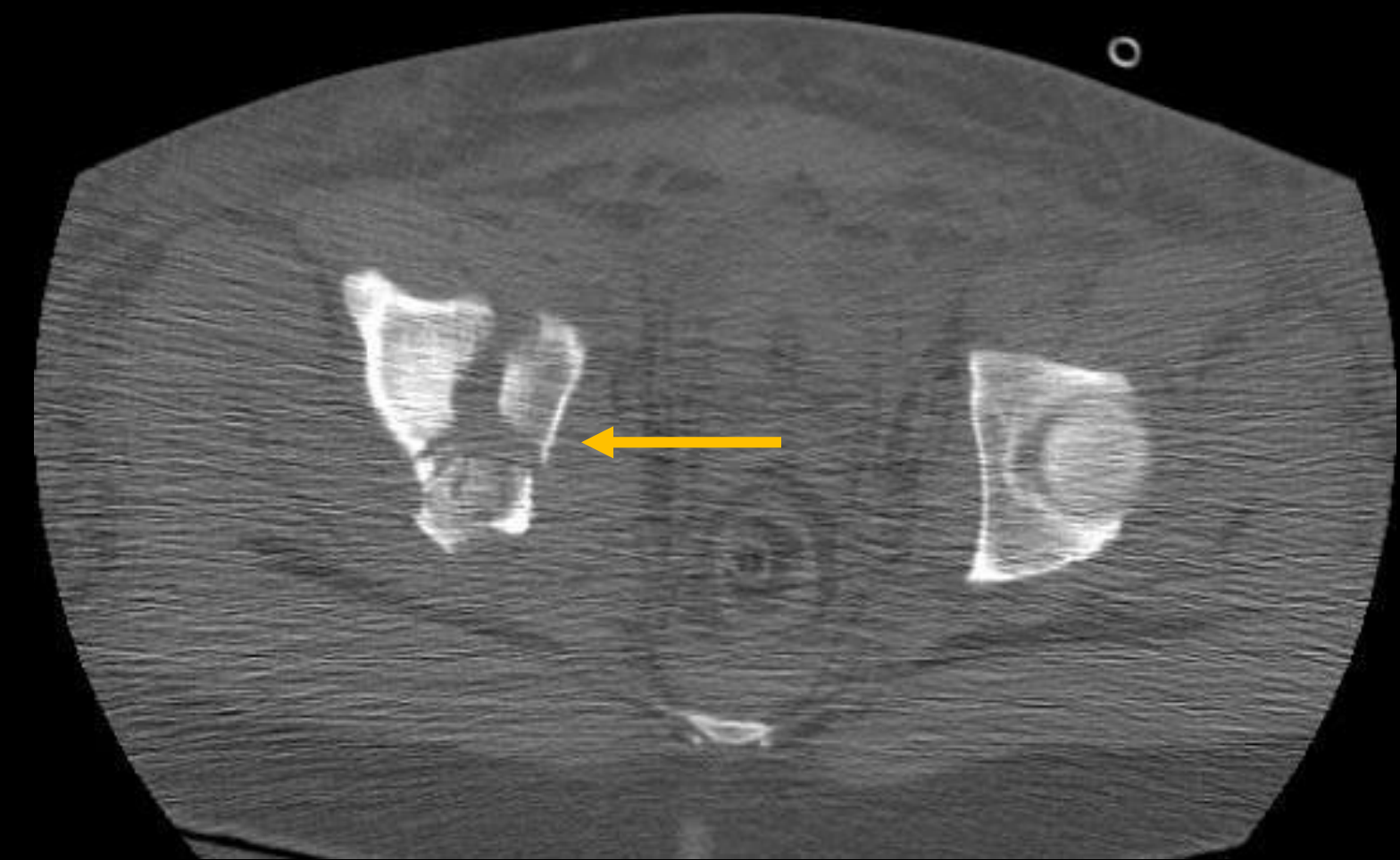
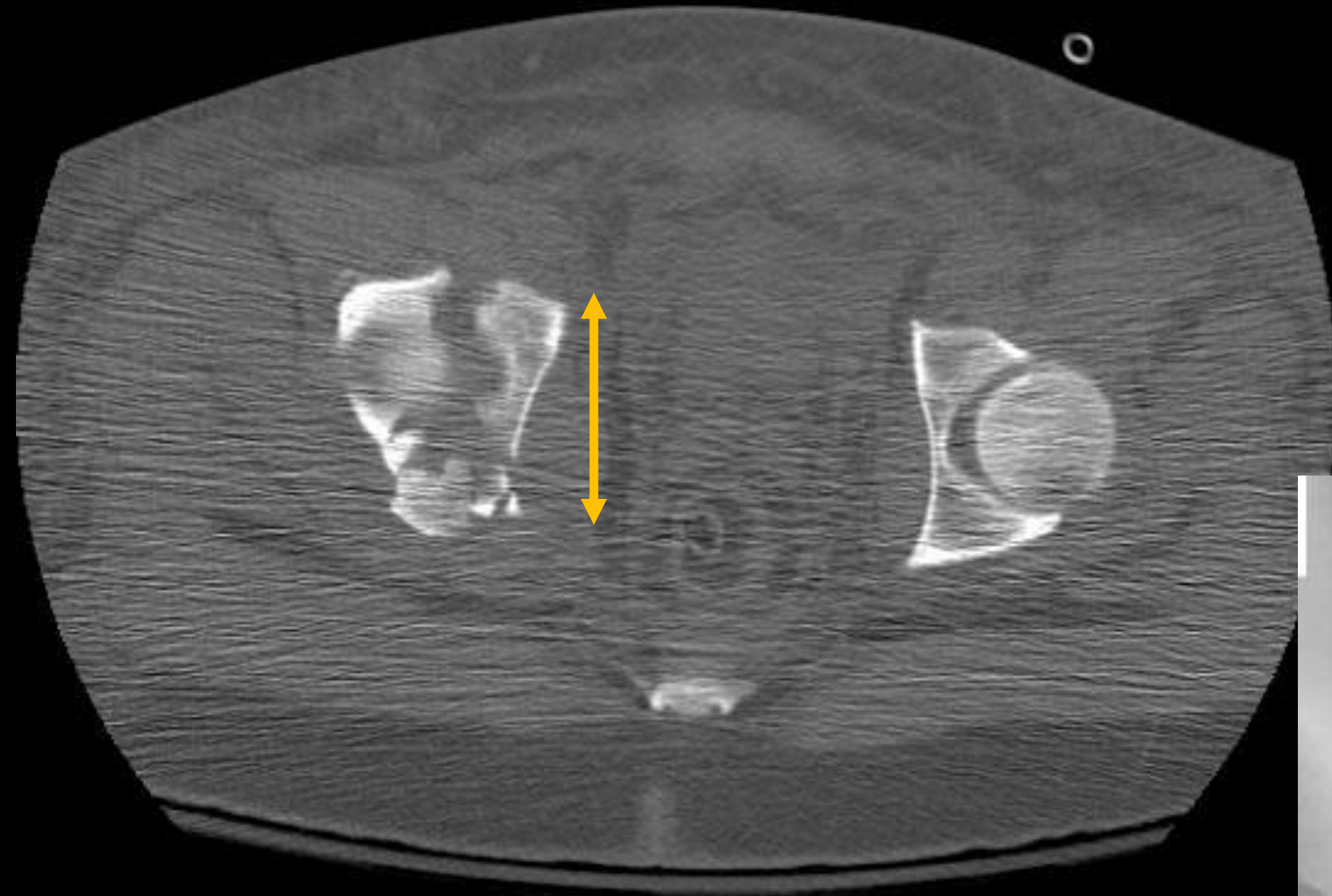
Case 2



Both Column Fx



T-Shaped Fx



T-shaped

Missed Transverse Fx

