Commonly Missed Injuries of the Extremities

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Top 10 Missed Fractures

- 1. Base of skull
- 2. Odontoid process
- 3. Zygomatic arch and orbit
- 4. C7 Fracture dislocation
- 5. Posterior dislocation of humerus
- 6. Scaphoid, lunate and perilunar dislocation
- 7. Sacroiliac fractures
- 8. Undisplaced neck of femur
- 9. Dislocated hip with ipsilateral femoral fracture
- 10. Tibial plateau fractures

Fulde GWO (1994) Emergency Medicine

Top 10 Missed Fractures

5. Posterior dislocation of humerus

Fulde GWO (1994) Emergency Medicine

Top 10 Missed Fractures

6. Scaphoid, lunate and perilunar dislocation

Fulde GWO (1994) Emergency Medicine

Top 10 Missed Fractures

7. Sacroiliac fractures

Fulde GWO (1994) Emergency Medicine

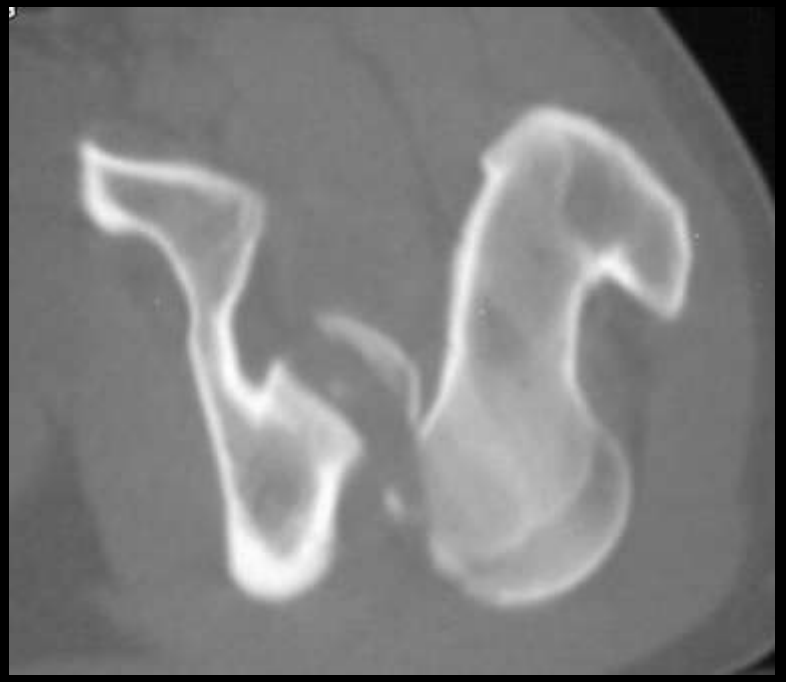
Top 10 Missed Fractures

8. Undisplaced neck of femur

Fulde GWO (1994) Emergency Medicine

Top 10 Missed Fractures

9. Dislocated hip with ipsilateral femoral fracture



Fulde GWO (1994) Emergency Medicine

Top 10 Missed Fractures

10. Tibial plateau fractures

Fulde GWO (1994) Emergency Medicine

Reasons for Misses

- Simple miss
- Satisfaction of Search
- Inadequate study
- Not what was expected
- Corner of film finding
- Inappropriate history
- Working conditions

Satisfaction of Search

- One of the commonest reasons to miss injuries
- See most obvious injury
- Miss other (more significant) injury

?

Reasons for Misses

Satisfaction of Search

?

SH2 fracture distal tibia with base of 5th MT fracture

Reasons for Misses

Satisfaction of Search

?

SOS wrist 68M

Reasons for Misses

Satisfaction of Search

Trans scaphoid and triquetral peri lunate 15M

Reasons for Misses

Satisfaction of Search

?

SOS radial head 48F

Reasons for Misses

Satisfaction of Search

Missed scaphoid fracture

Reasons for Misses

Satisfaction of Search

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- Working conditions

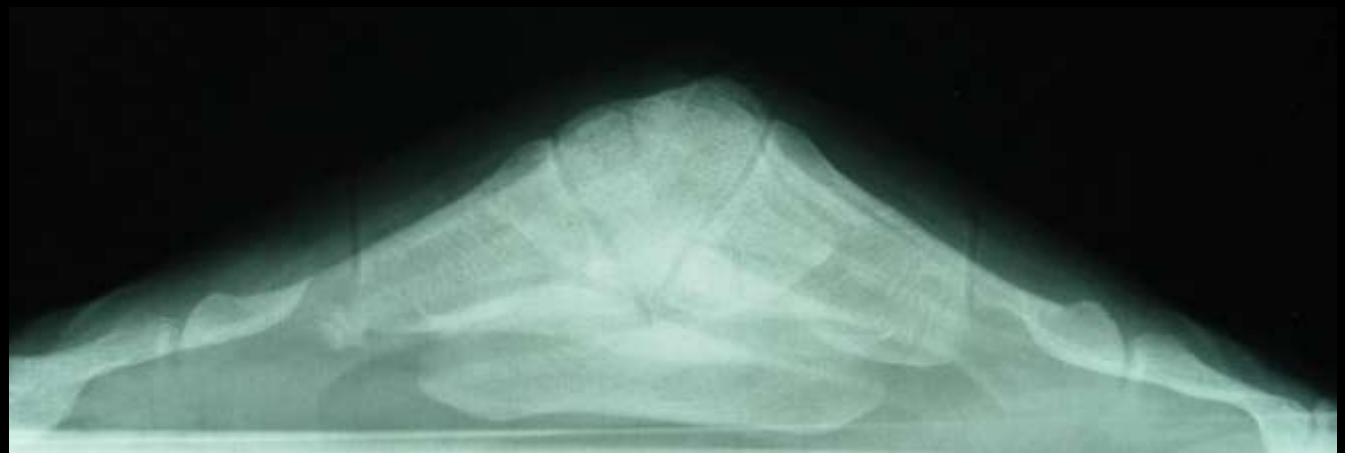
?

Talar neck fracture with subtalar dislocation

Reasons for Misses

Inadequate Study

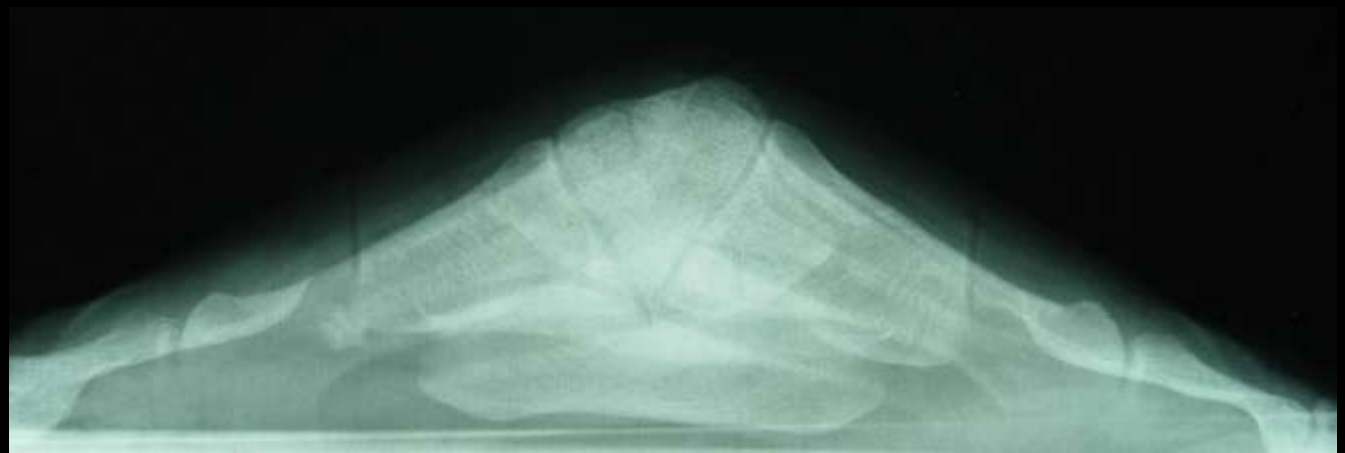
- Need two or more views to assess for fracture or dislocation
- Need appropriate study
- Insist on good quality studies
  - With empathy
- If equivocal, ask for more



Reasons for Misses

Inadequate Study

- All films need
  - Patients name
  - Patients number
  - Date and time of study
  - Side marker (lead, not added later)
  - Cone marks
  - Appropriate exposure



Reasons for Misses

Inadequate Study

LAO or LPO

RAO or RPO

36M Normal Cx Spine, Routine obliques

Reasons for Misses

Inadequate Study

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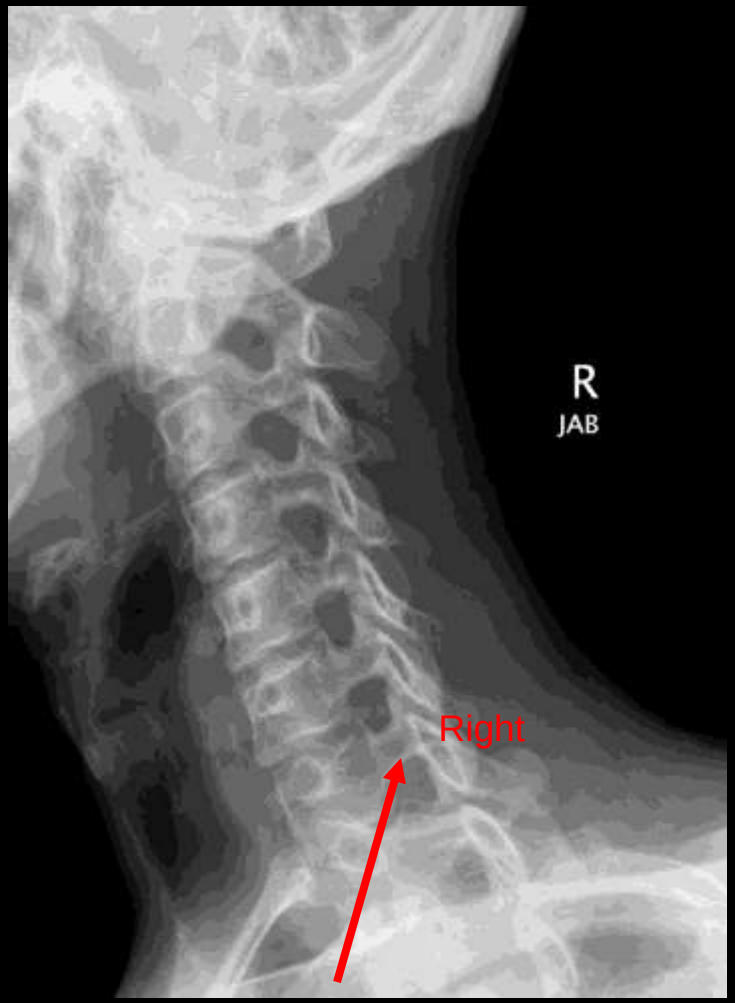

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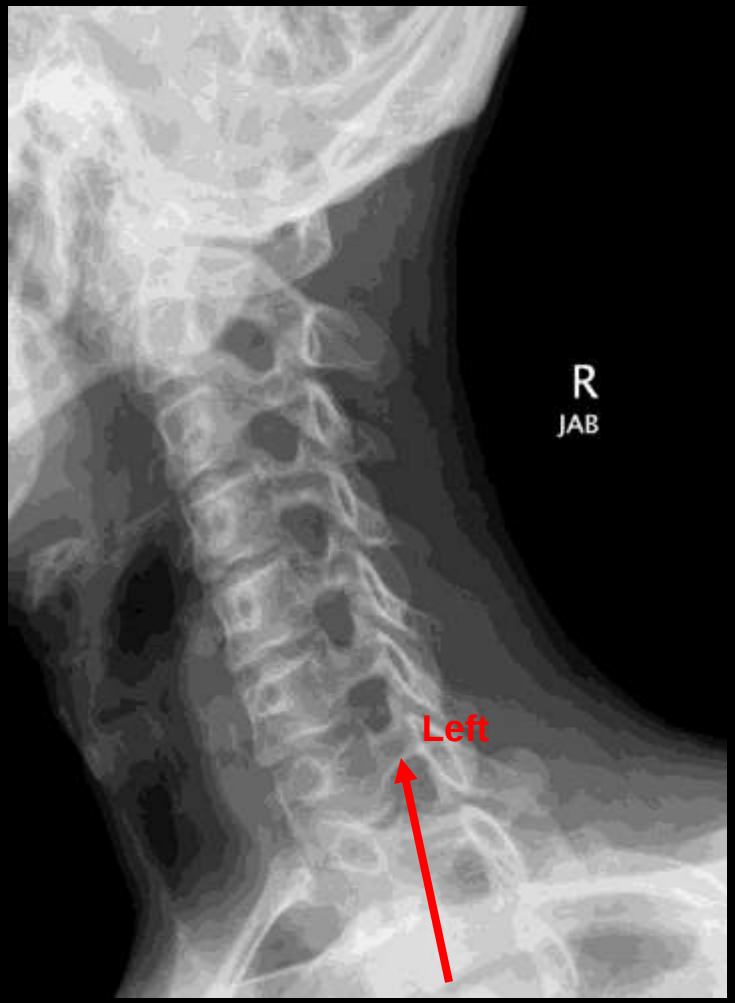
Reasons for Misses

Inadequate Study

LAO or LPO



RAO or RPO

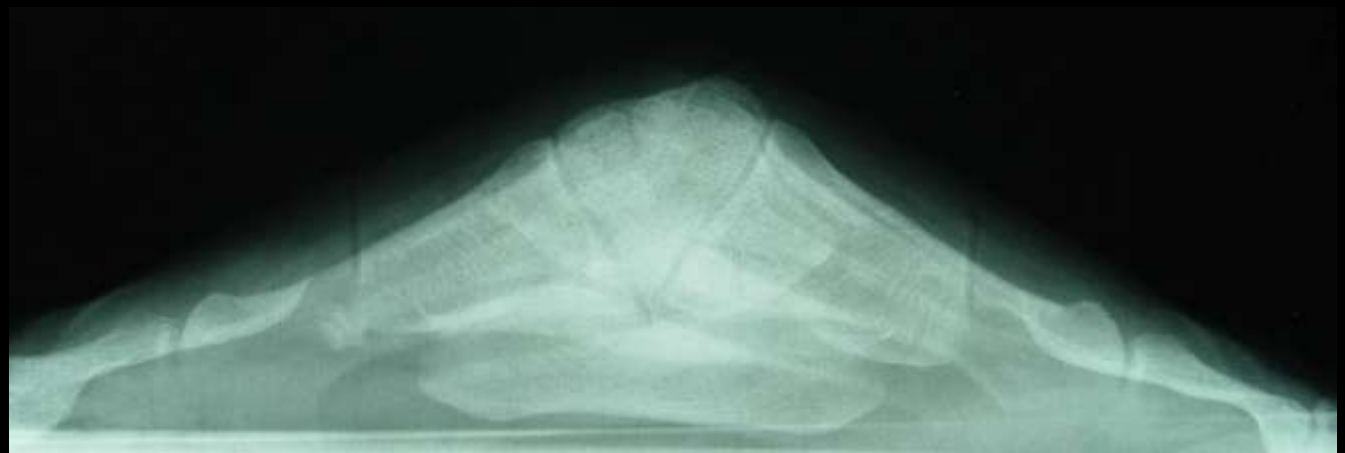
Lead or digital

36M Normal Cx Spine, Routine obliques

Reasons for Misses

Inadequate Study

- Department needs technologist CQI
  - Keywords
    - Reject markers
    - Reject technique
    - Reject patient details
    - Reject positioning



Reasons for Misses

Inadequate Study – Ways to improve

Two or more Views

- One view is never enough to assess for fractures

Posterior process fracture of calcaneus

Reasons for Misses - Inadequate Study

Two or more Views

Circular saw injury

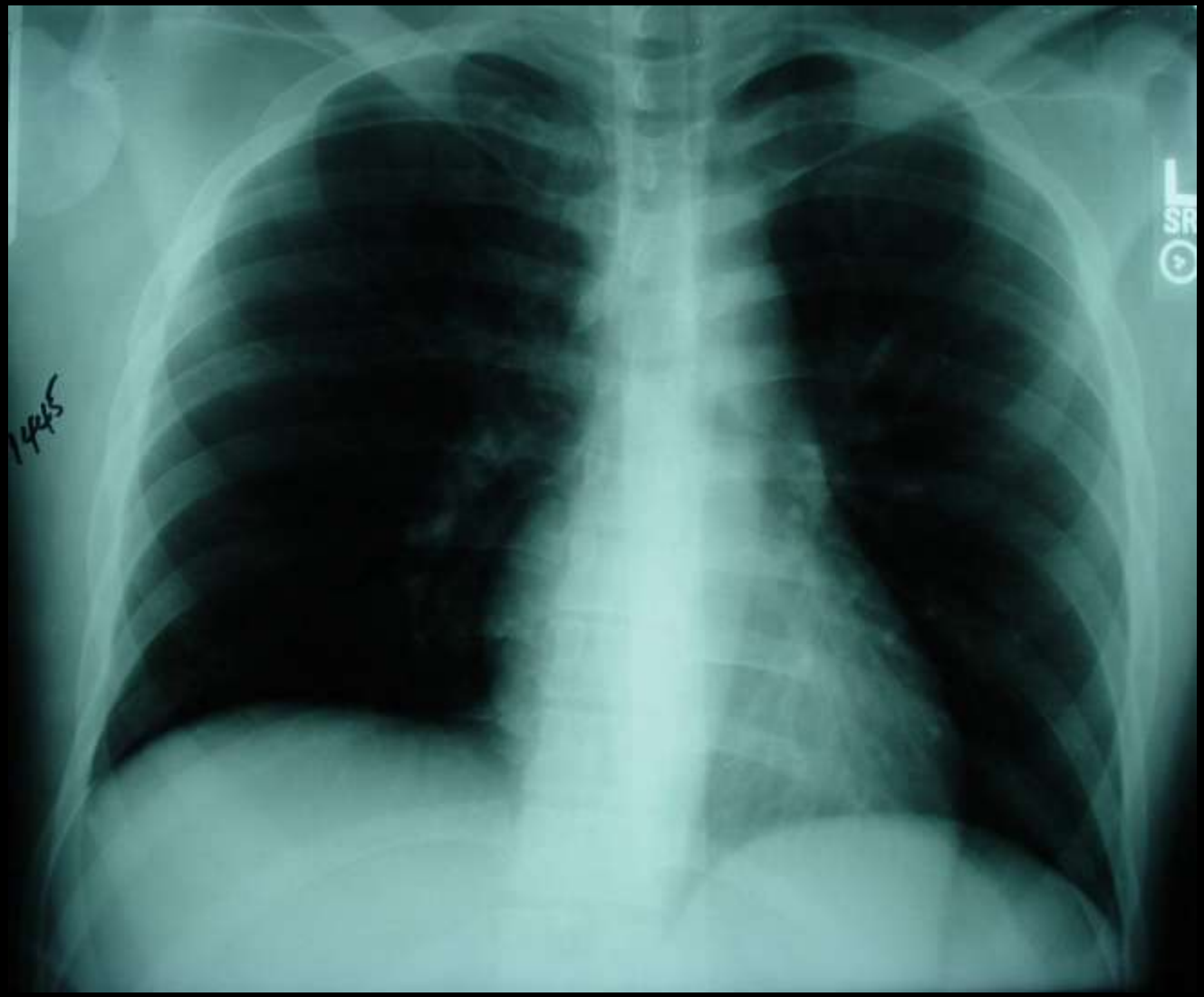
Reasons for Misses - Inadequate Study

Two or more Views

Car door

Reasons for Misses

Not what was expected



Dislocated right shoulder

Reasons for Misses

- Simple miss
- Satisfaction of Search
- Inadequate study
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- Inappropriate history
- Working conditions

Ways to Avoid Missing Fractures

- Look for fracture patterns
- Look at regions that should align
- Look for secondary signs of fracture
- Look for the common sites of fractures

Fracture Patterns

- Patterns help us know where to look
  - Transtriquetral / scaphoid perilunate fracture dislocation
  - Maisoneuve
  - Essex Lopresti
  - Galeazzi
  - Monteggia
  - Pelvic ring fractures
  - Waist of Scaphoid
  - Don Juan
  - Femoral shaft and neck

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Vertical Sacral fracture

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Pattern Approach

Occult basicervical fx NOF 32F

Pattern Approach

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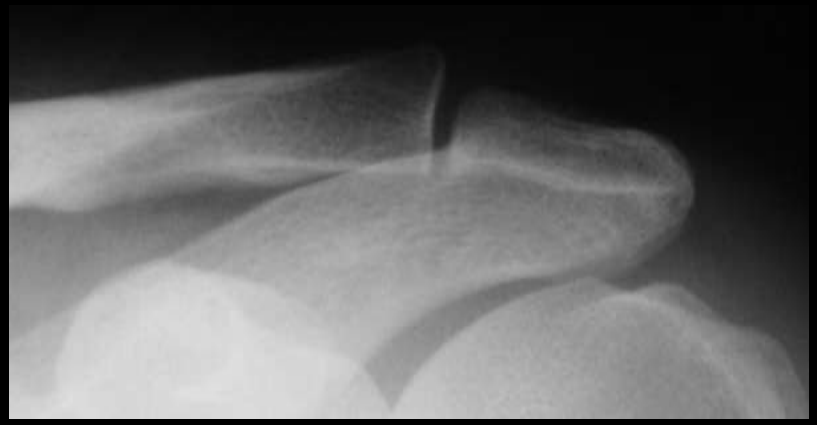
Pattern Approach

Occult basicervical fx NOF 32F

Alignment Rules

- These are helpful at various sites
  - ACJ
  - Lisfranc joint
  - Medial ends of clavicles
  - Elbow in children
  - Carpal bones



- Also check for rotation

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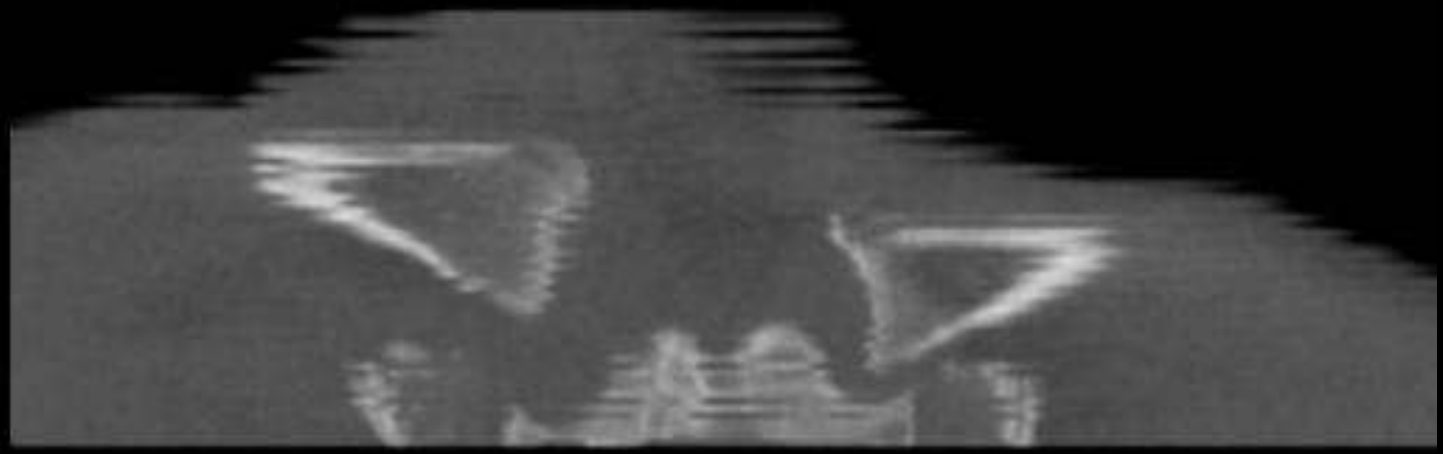
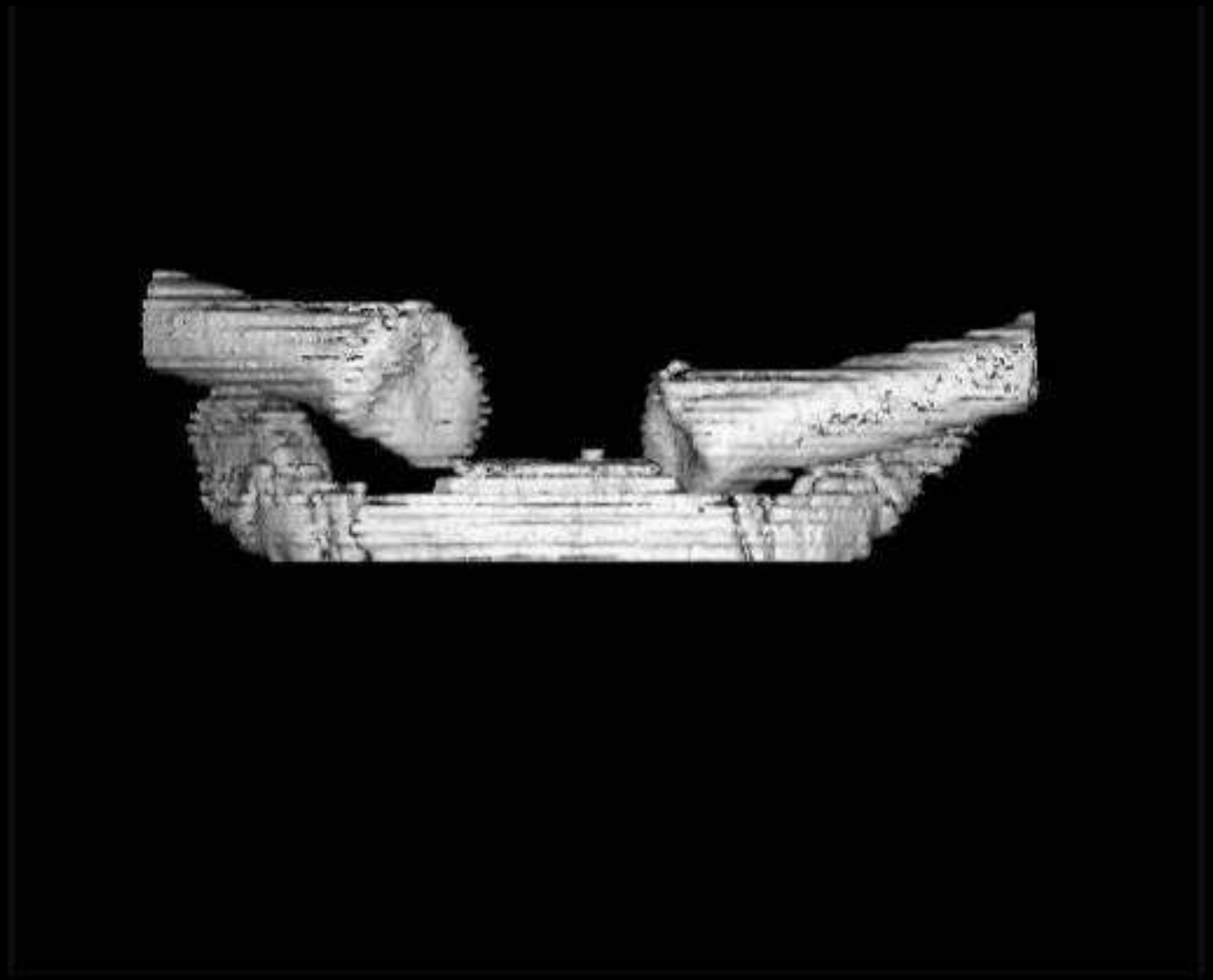
Sternoclavicular joint dislocation

1+2+10

Sternoclavicular joint dislocation



Sternoclavicular joint dislocation



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Alignment Rules - Rotation

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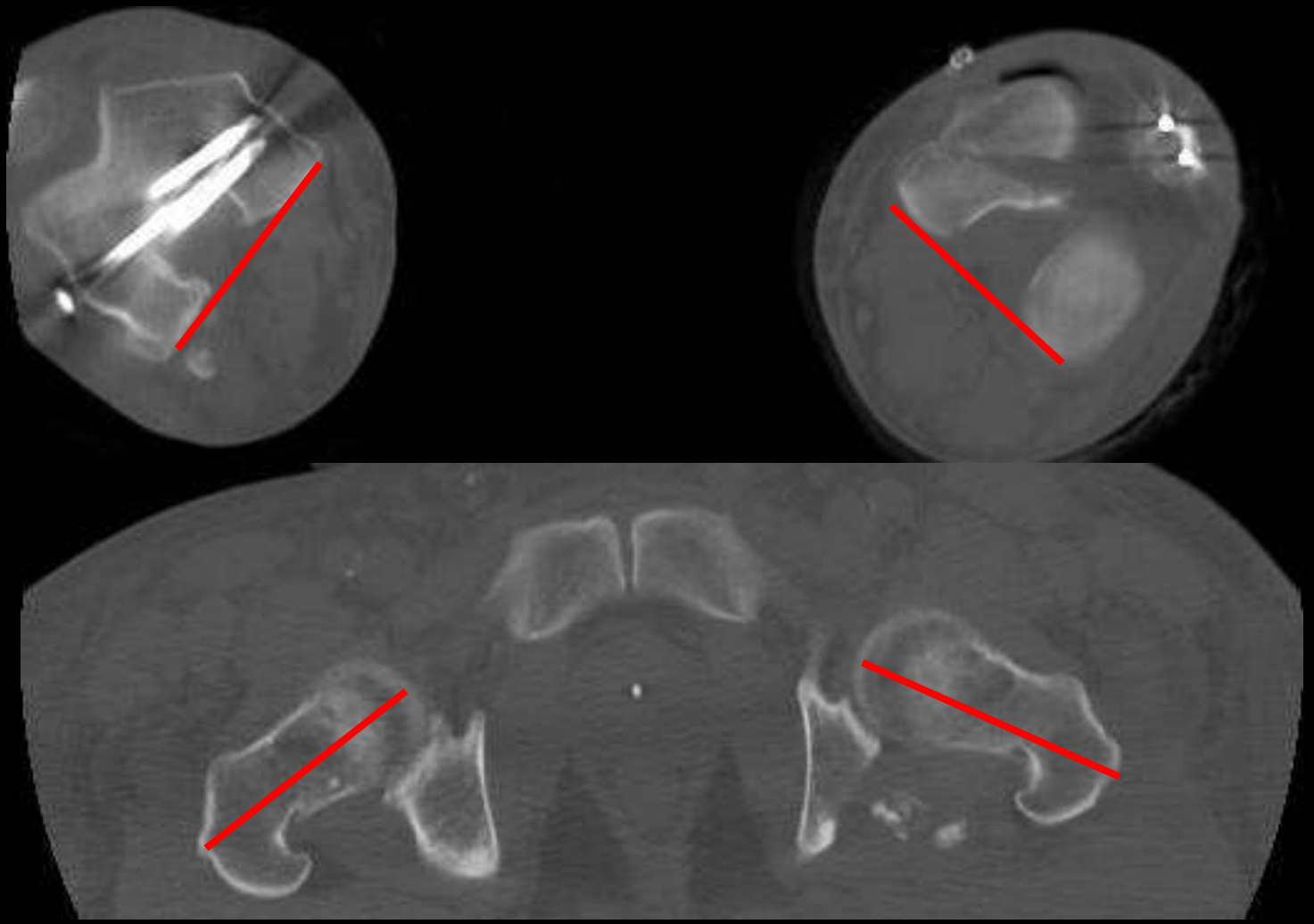

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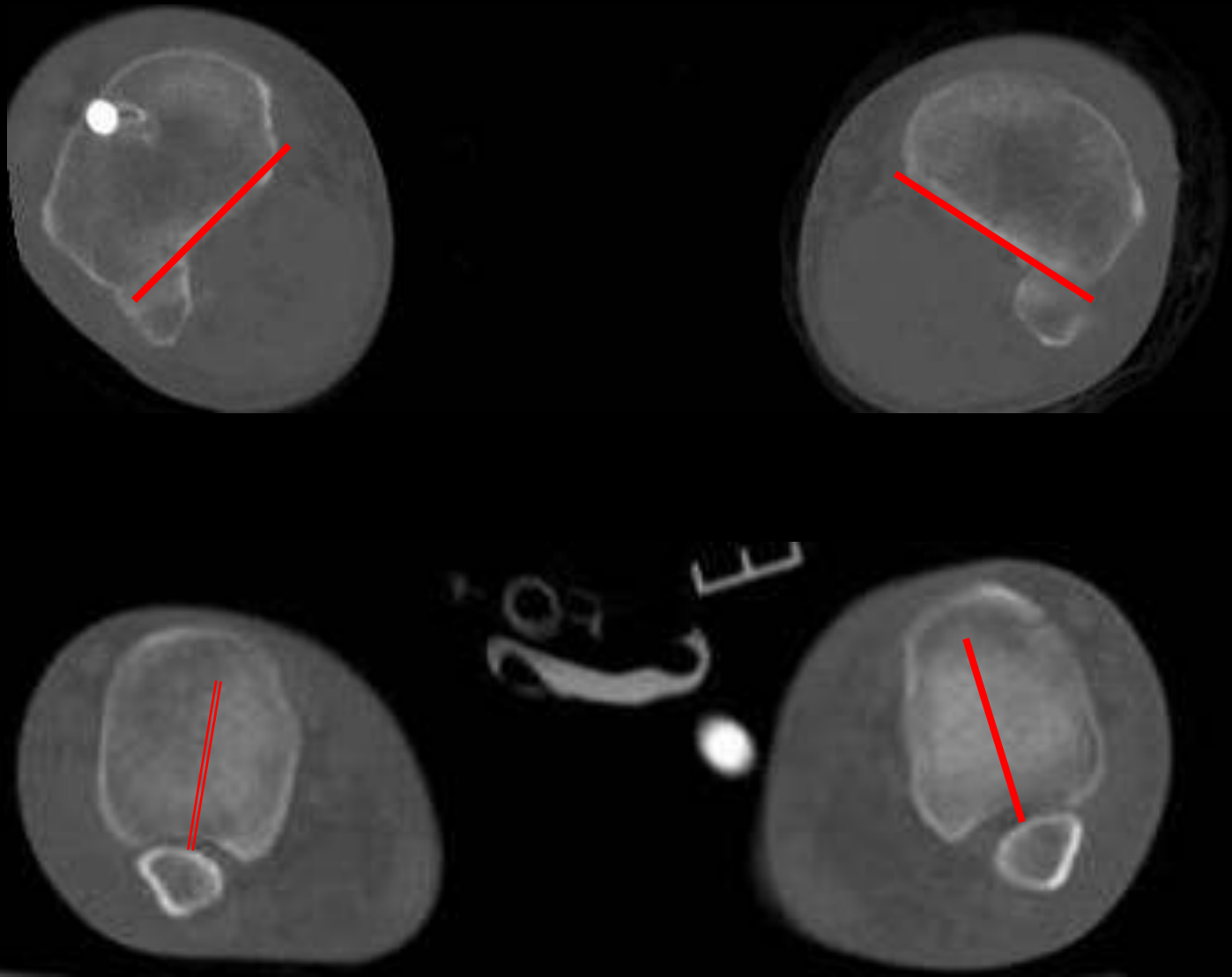

Secondary Signs
Joint Effusion

- Secondary signs
  - Joint effusion
  - Lipohemarthrosis
  - Gas in joint
  - ST swelling
  - Obliteration of fat planes
  - Fat in joint on CT
  - Bone edema on CT
  - Intraosseous Vacuum
  - Delayed resorption
  - Delayed sclerosis

Secondary Signs

Joint Effusion

Acute

6w later

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Tibial Plateau Fracture

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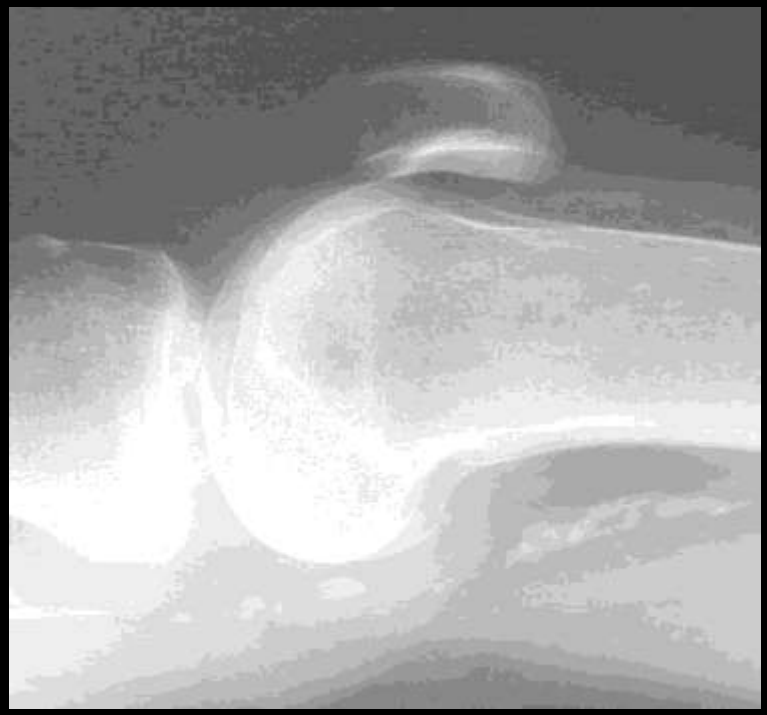

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50M

Lipohemarthrosis

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Open tibial plateau Fx

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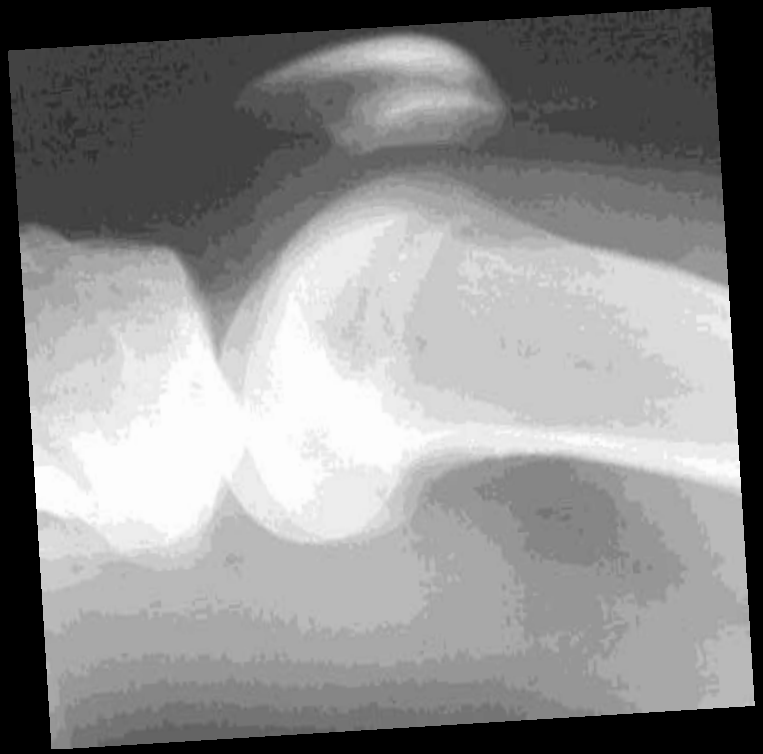

Open tibial plateau Fx

Soft Tissue Swelling

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Fat plane obliteration

- Secondary signs
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Between the radial collateral ligament and APL/EPB

Obliterated in Fx / Infection

Fat in joint on CT

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Secondary Signs

Lipohemarthrosis

Secondary Signs

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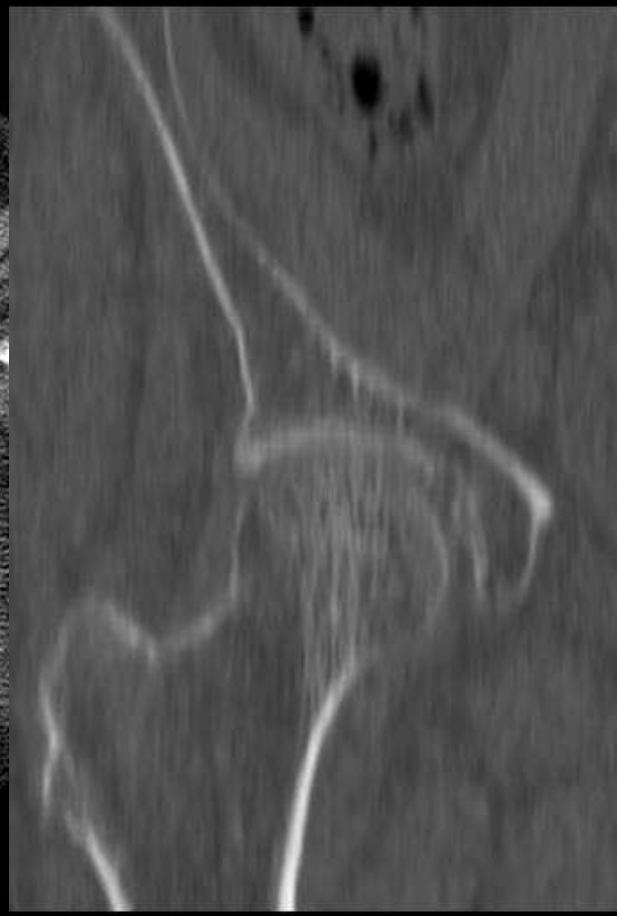
Secondary Signs

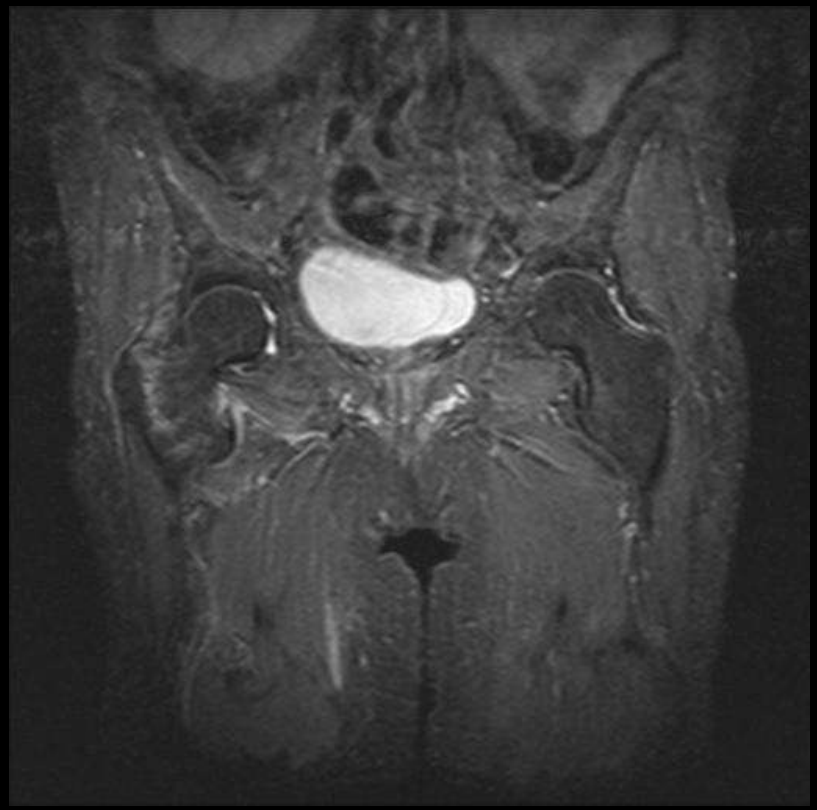
Lipohemarthrosis



10.12.2002

Secondary Signs

Lipohemarthrosis



2+1+4+1+3

10.14.2002

Secondary Signs

Lipohemarthrosis

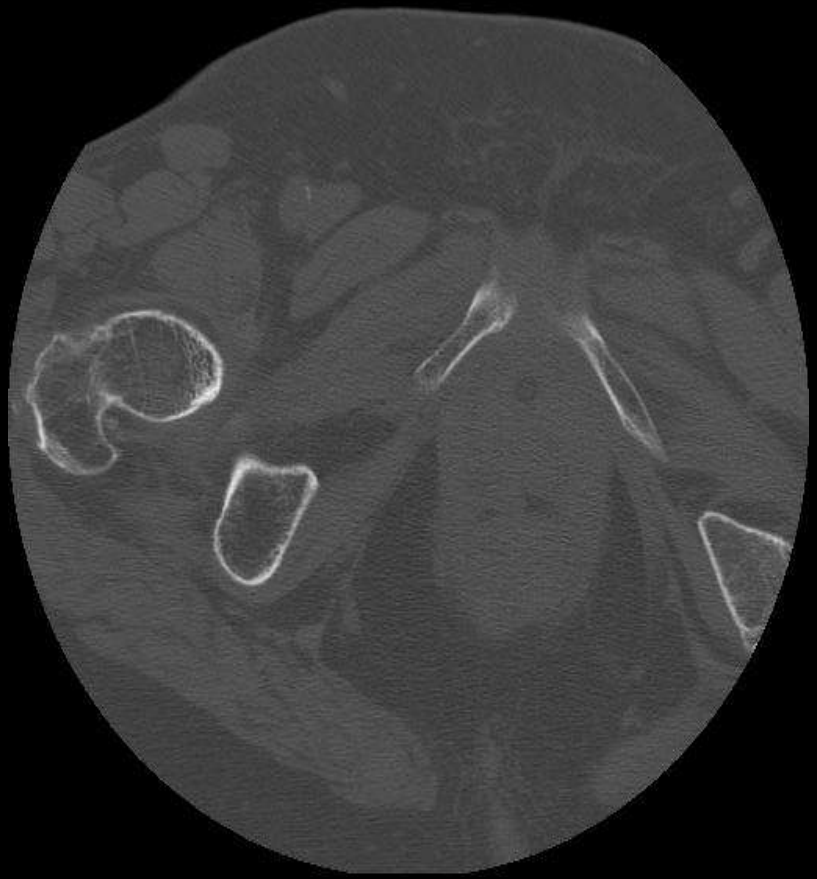
10m later

1+4+1+3

8.9.2003

Secondary Signs

Lipohemarthrosis



3+1+3

8.9.2003

Secondary Signs

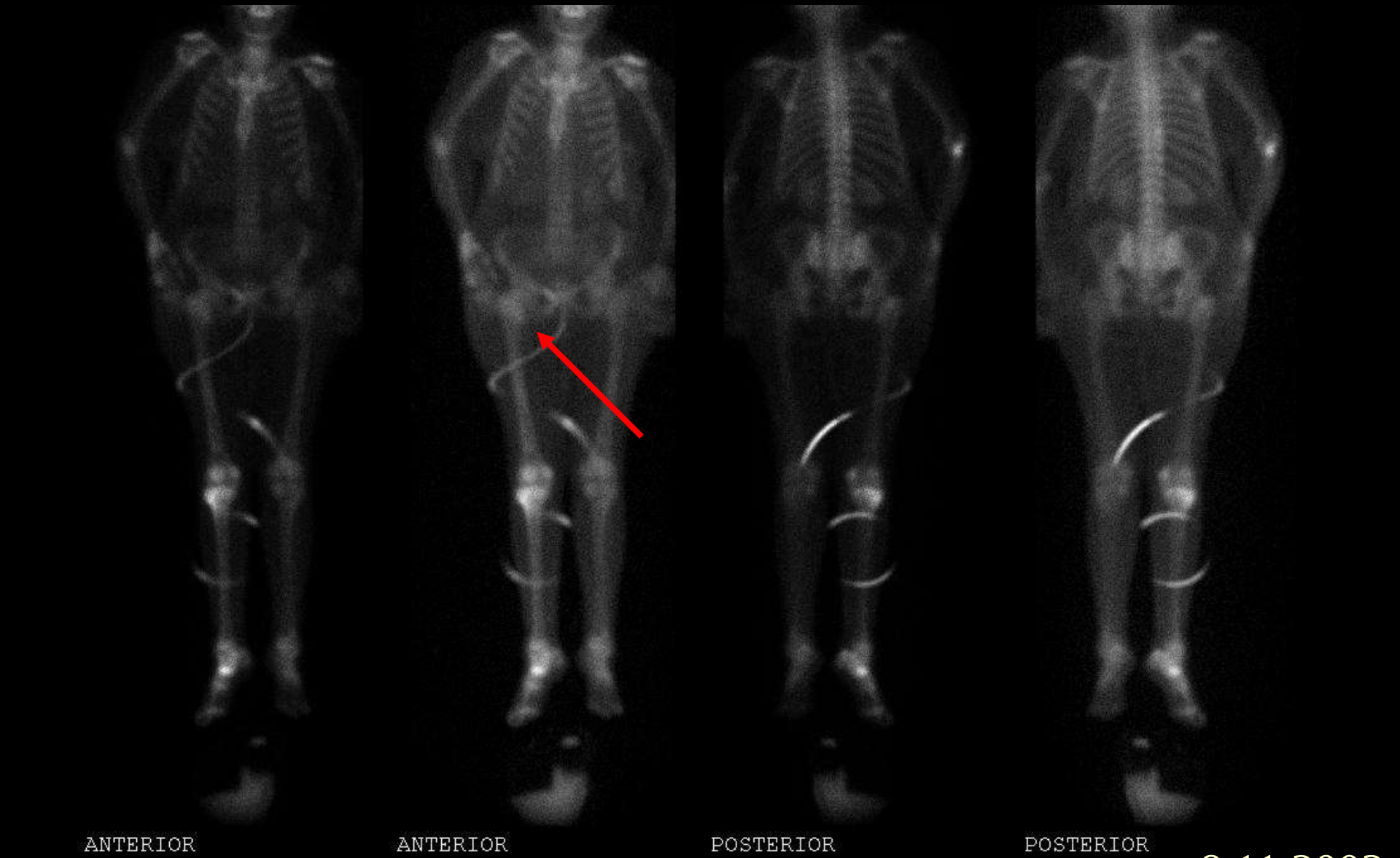
Lipohemarthrosis

1+1+3

8.9.2003

Secondary Signs

Lipohemarthrosis

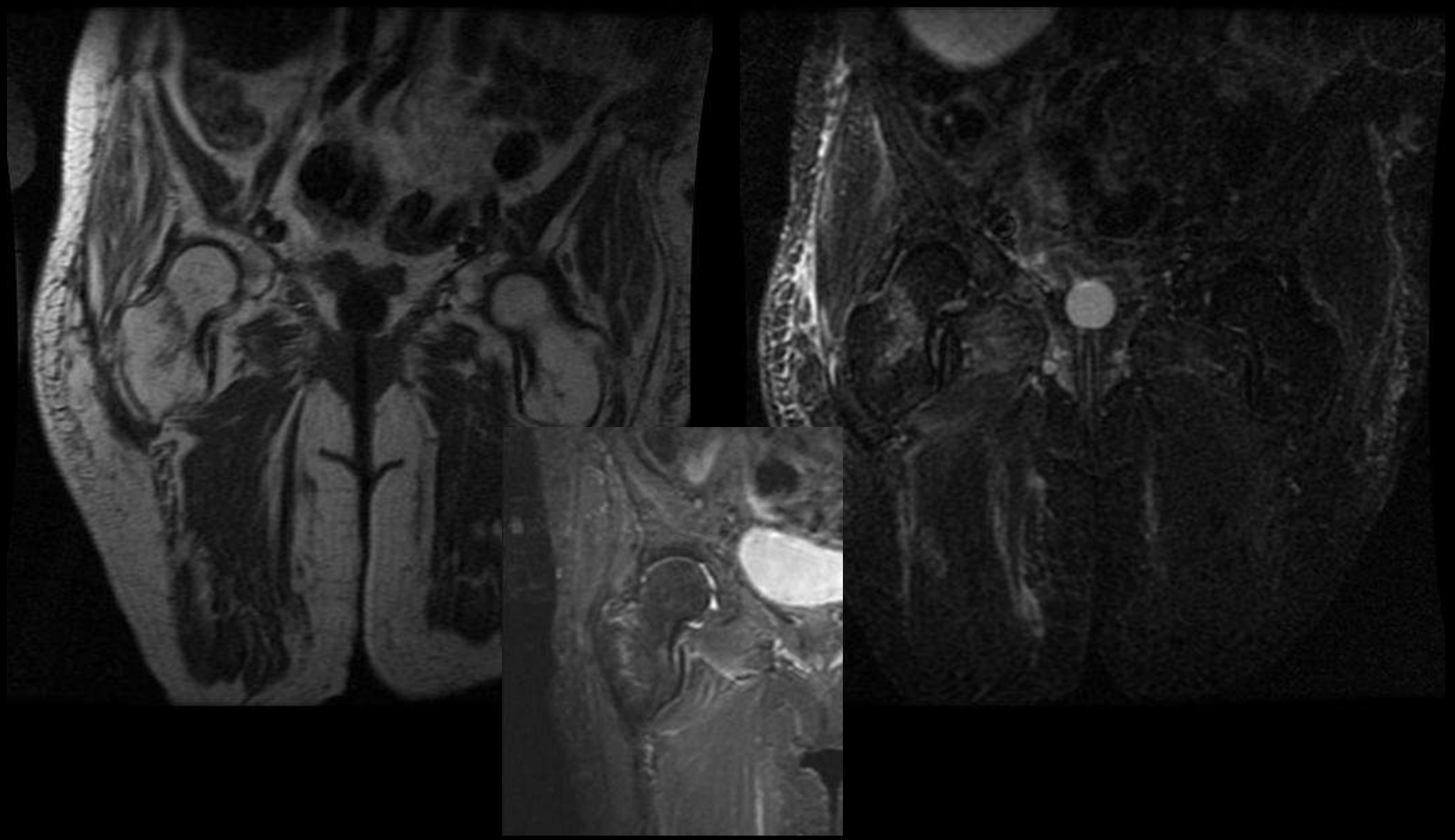


1+3

8.11.2003

Secondary Signs

Lipohemarthrosis



8.12.2003

Secondary Signs

Lipohemarthrosis

Bone window

ST window

78M

Secondary Signs

Lipohemarthrosis

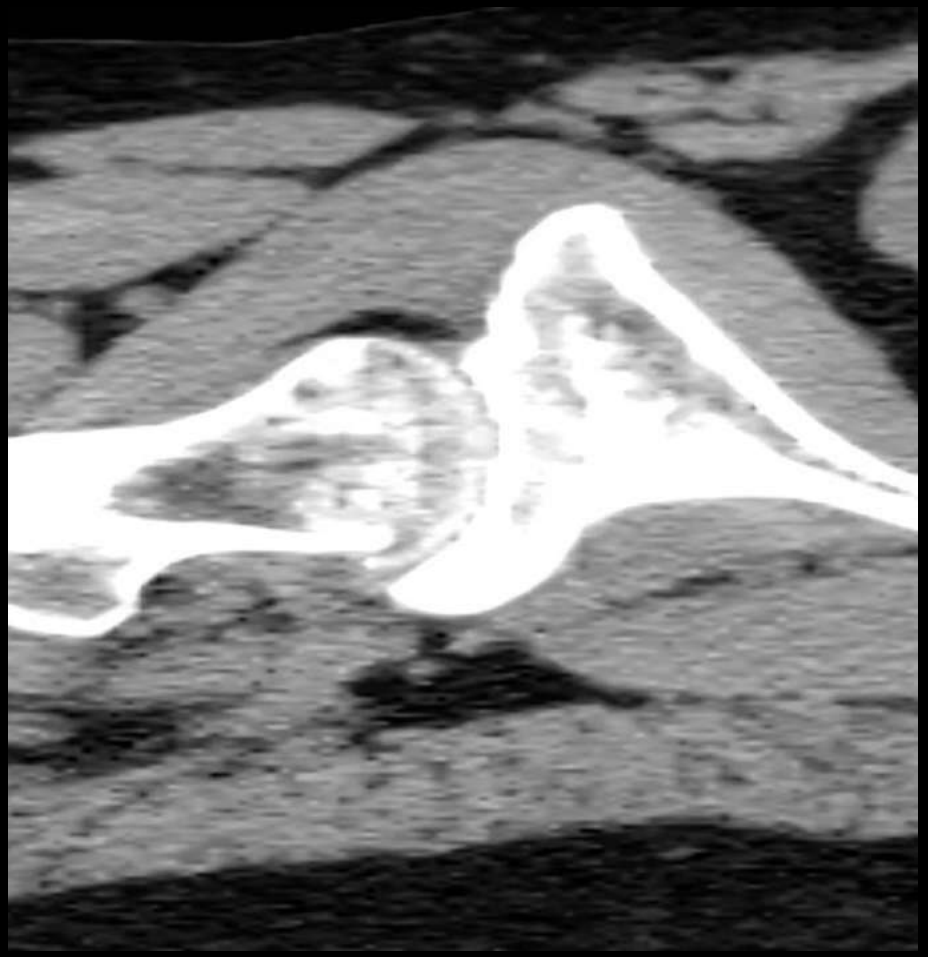
60 y/o female with pain s/p fall

Lipohemarthrosis

60 y/o female with pain s/p fall

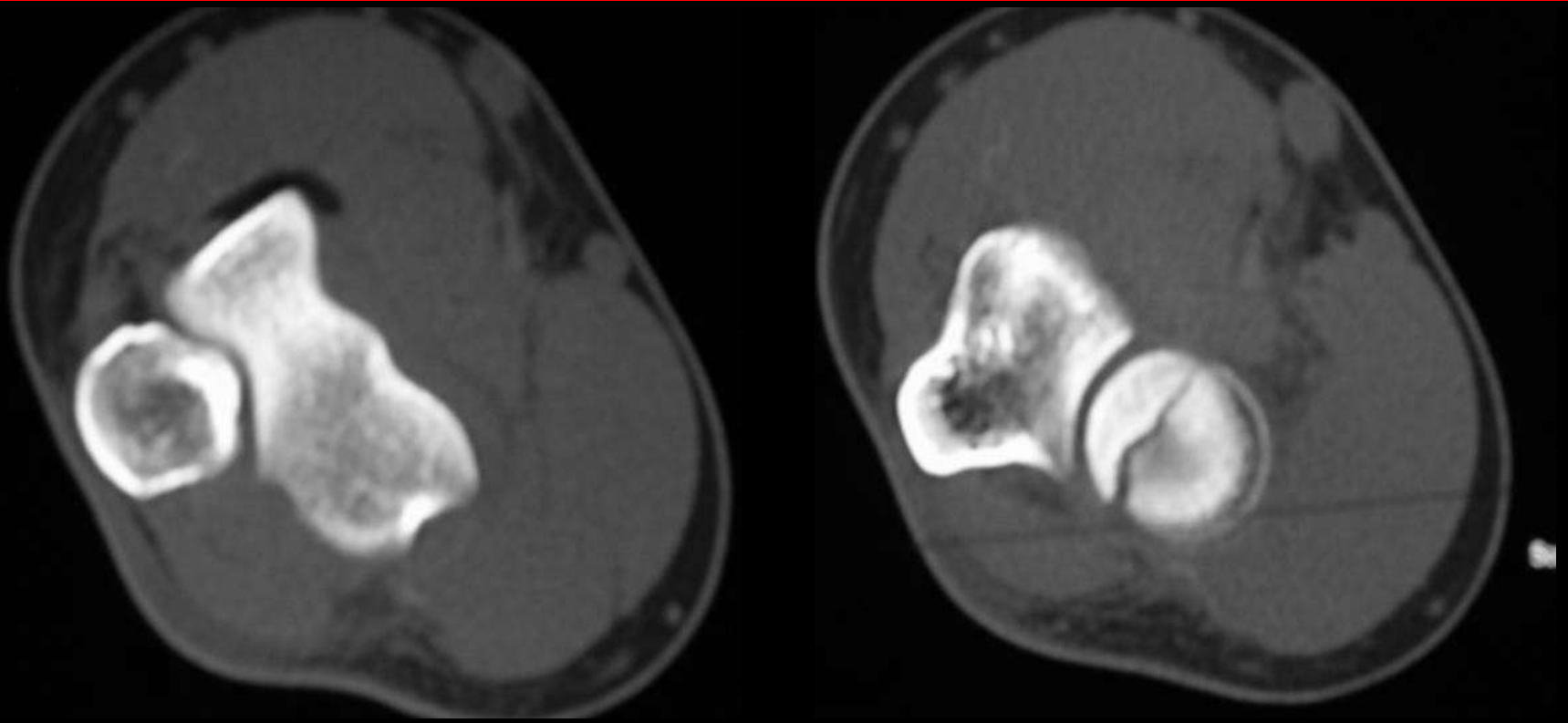
Secondary Signs

Lipohemarthrosis



60 y/o female with pain s/p fall

Lipohemarthrosis – Radial head Fx



History of recent trauma.

Secondary Signs

Lipohemarthrosis

Sag PD

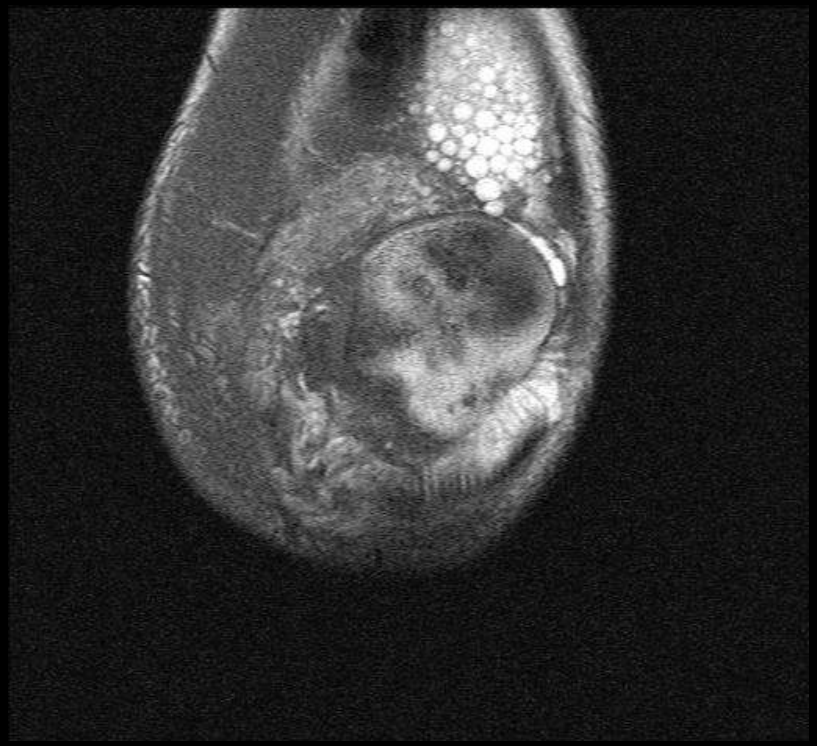
Sag T2FS

Bubbles may be more acute

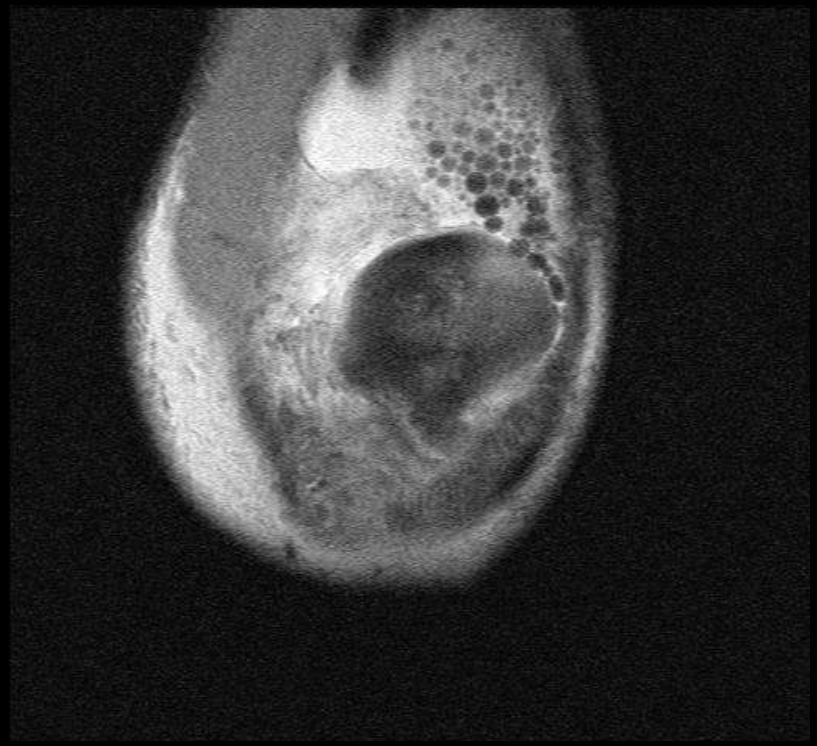
Lateral patella dislocation with patella Fx

Secondary Signs

Lipohemarthrosis



Cor T1



Cor PDFS

Bubbles may be more acute

1+1

Lateral patella dislocation with patella Fx

Secondary Signs

Lipohemarthrosis

Ax PDFS

Bubbles may be more acute

Bone edema on CT

- Secondary signs
  - Joint effusion
  - Lipohemarthrosis
  - Gas in joint
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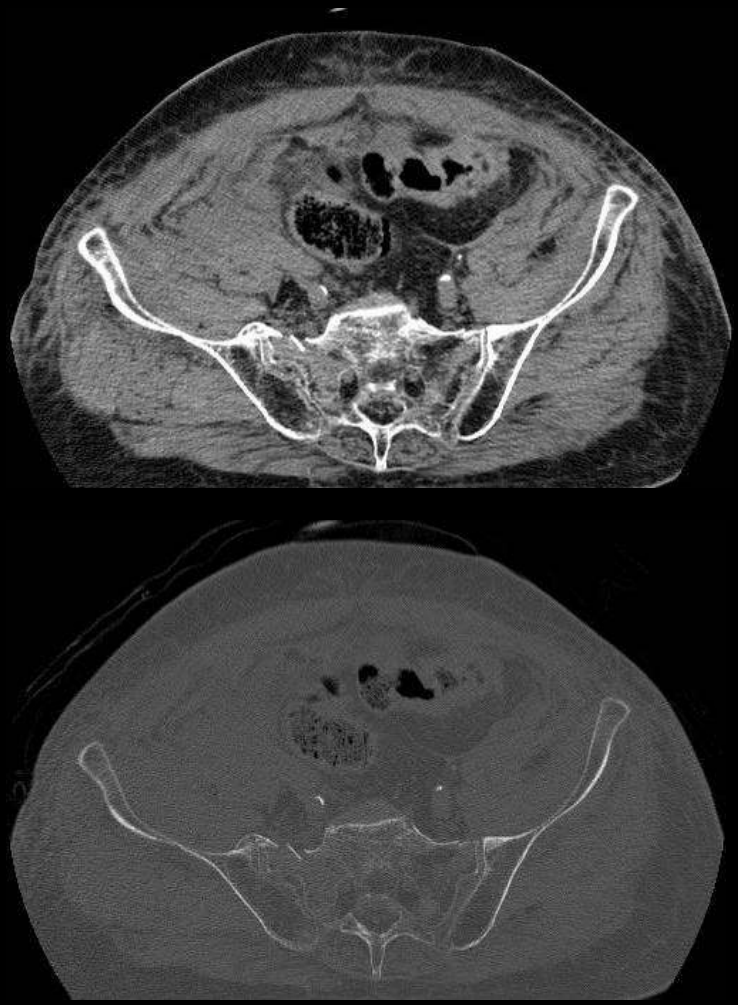

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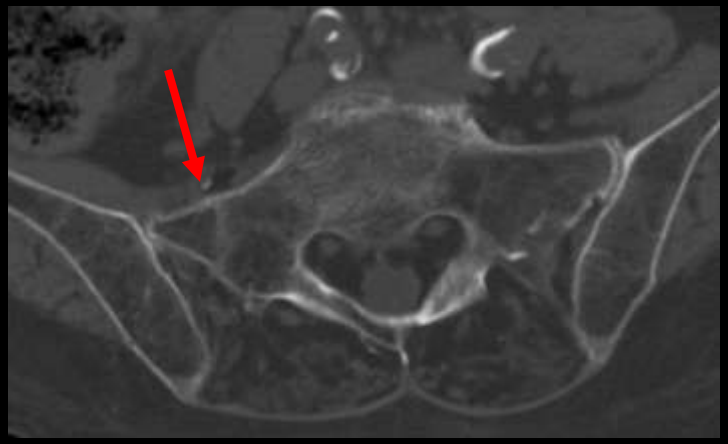

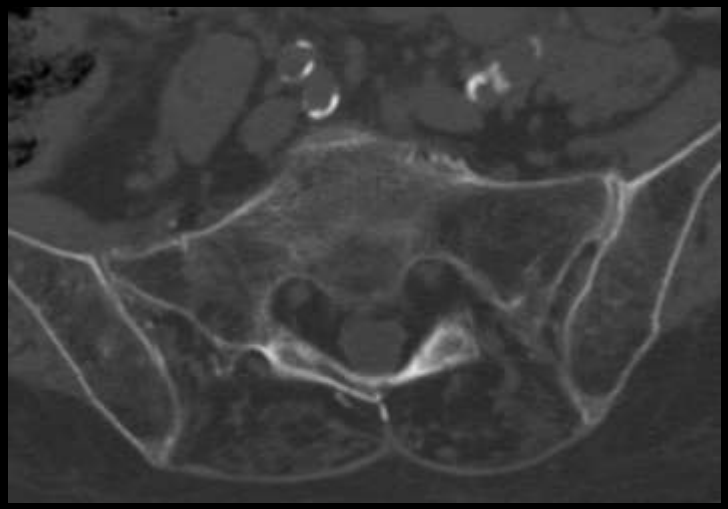

Sacral fx edema CT 98F

Lipohemarthrosis

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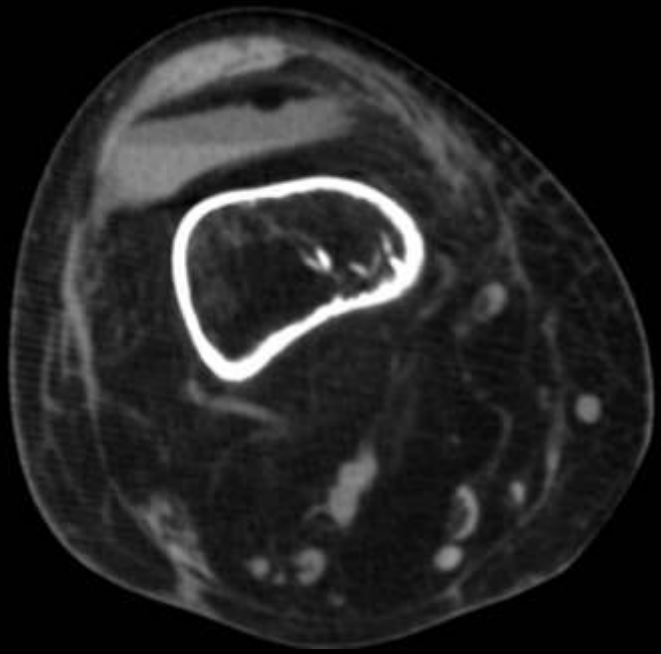

Lipohem knee bone edema 62F

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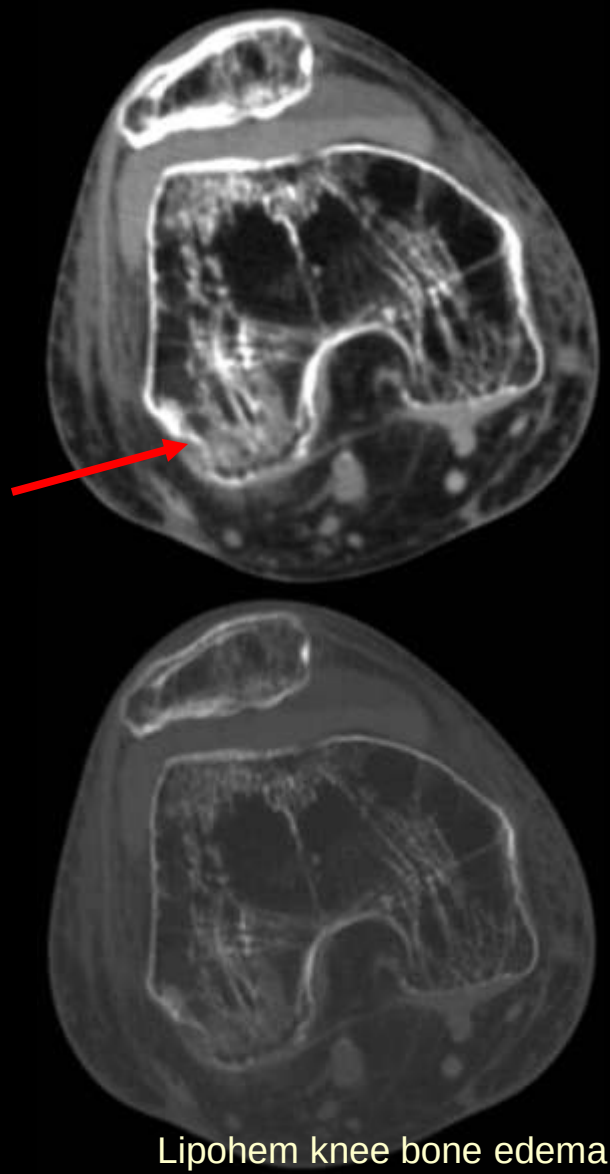
  - Obliteration of fat planes
  - Fat in joint on CT
  - Bone edema on CT
  - Intraosseous Vacuum
  - Delayed resorption
  - Delayed sclerosis



Lipohem knee bone edema 62F

Secondary Signs

Intraosseous Vacuum

- Secondary signs
  - Joint effusion
  - Lipohemarthrosis
  - Gas in joint
  - ST swelling
  - Obliteration of fat planes
  - Fat in joint on CT
  - Bone edema on CT
  - Intraosseous Vacuum
  - Delayed resorption
  - Delayed sclerosis

Lipohem knee bone edema 62F

Secondary Signs

Intraosseous Vacuum Phenomenon

2+8+7+1

93 y/o right hip pain s/p fall

Secondary Signs

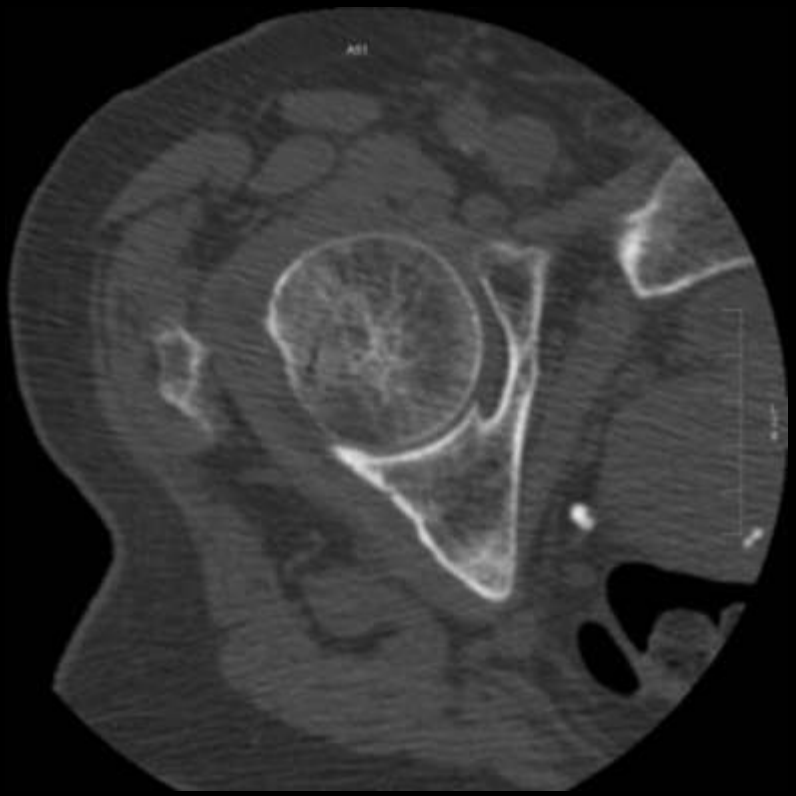
Intraosseous Vacuum Phenomenon

1+8+7+1

93 y/o right hip pain s/p fall

Secondary Signs

Intraosseous Vacuum Phenomenon



6+7+1

93 y/o right hip pain s/p fall

Secondary Signs

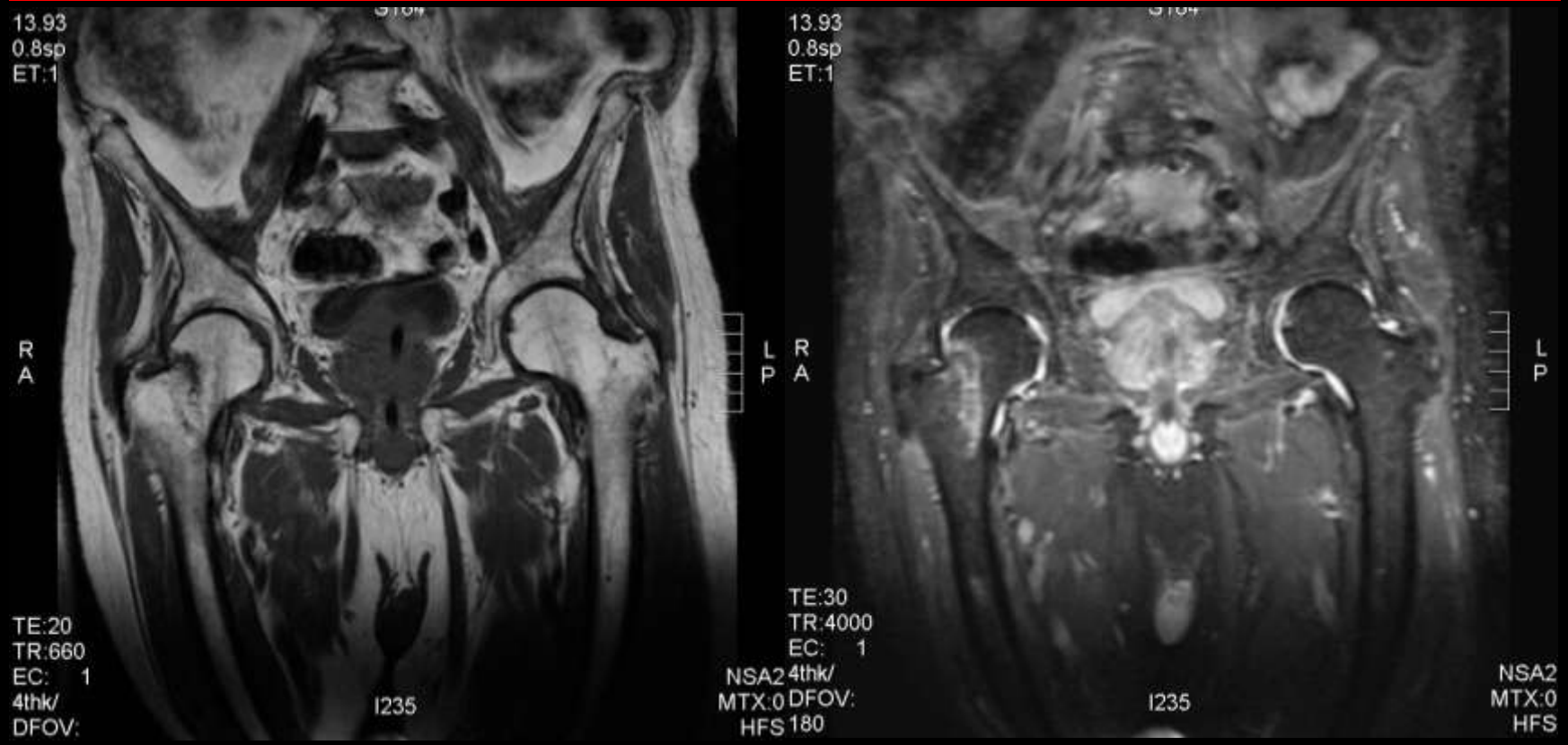
Intraosseous Vacuum Phenomenon

4+1

93 y/o right hip pain s/p fall

Secondary Signs

Intraosseous Vacuum Phenomenon



93 y/o right hip pain s/p fall

Secondary Signs

Delayed resorption

- Secondary signs
  - Joint effusion
  - Lipohemarthrosis
  - Gas in joint
  - ST swelling
  - Obliteration of fat planes
  - Fat in joint on CT
  - Bone edema on CT
  - Intraosseous Vacuum
  - Delayed resorption
  - Delayed sclerosis

Acute

2w later

Secondary Signs

Delayed sclerosis

- Secondary signs
  - Joint effusion
  - Lipohemarthrosis
  - Gas in joint
  - ST swelling
  - Obliteration of fat planes
  - Fat in joint on CT
  - Bone edema on CT
  - Intraosseous Vacuum
  - Delayed resorption
  - Delayed sclerosis

Presentation

1 month follow up

Elderly

- Fractures often hard to see
- Degenerative changes obscure fractures
- Fatty marrow makes bone edema useful sign
- Fractures more often fatal
- If alters management, low threshold for MRI

Childhood Fractures

- Tendons stronger than bone
  - Apophyseal avulsion
- Fracture patterns different
  - Salter Harris
- Incomplete fractures more common
  - Plastic bowing
  - Torus / Buckle
  - Greenstick
- Remember NAI

Children Avulse

11M ACL avulsion

Salter Harris 1

Problem solving

- Repeat
- Oblique views
  - Tibial plateau
  - Radial head
- Dedicated views
  - Scaphoid
  - Radial head
- Single emulsion
  - Periphery
- Tomography, CT, MRI, Scintigraphy

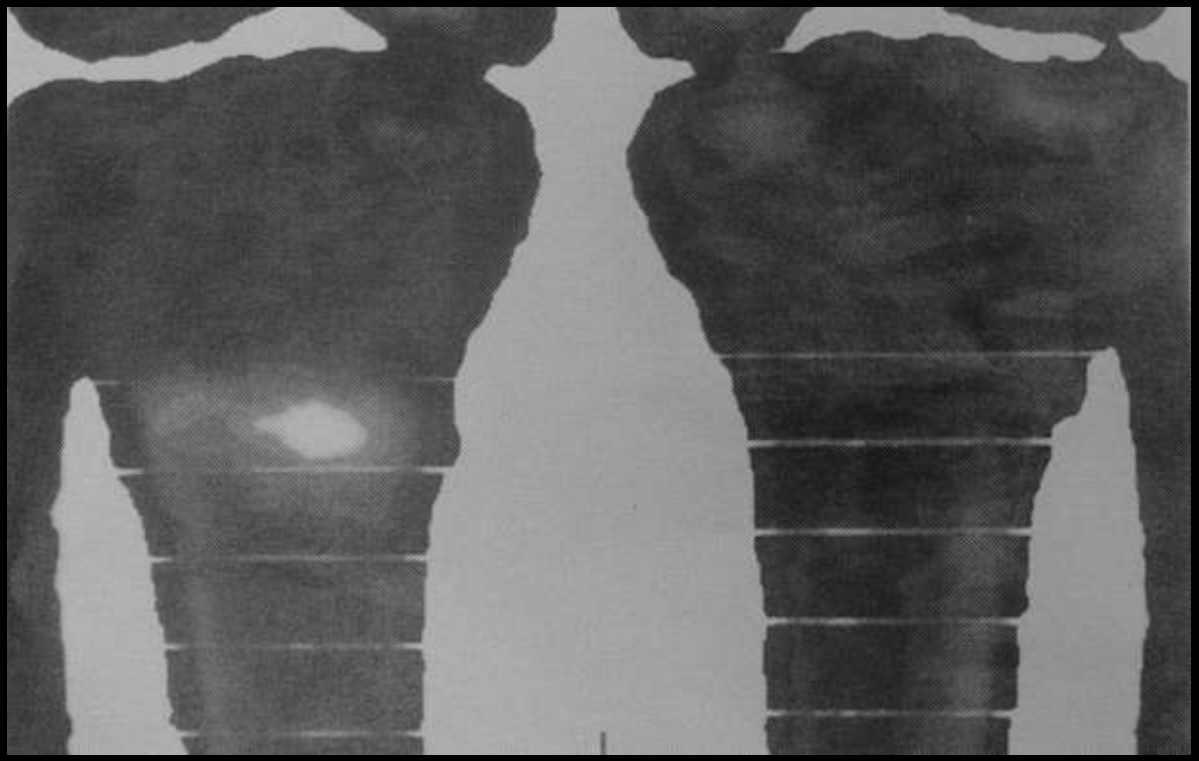
Dedicated views

Scaphoid fracture on ulna deviation view 19F

Imaging Techniques

DEXA

- Has been used to assess for stress fractures



Imaging Techniques

Plain Film V's CT V's MRI

- As CT and MRI continue to improve, only rarely now are fractures only seen on X-ray
- X-ray still mainstay
- CT and MRI complimentary
- CT good for defining complexity of fracture
- MRI good for presence of fracture and ST injury